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121st Session.] FRIDAY, NOVEMBER 20, 1874. [No. 1148. Vol. XXIII.

PROCEEDINGS OF THE SOCIETY.

POLLUTION OF RIVERS.

The Council have determined to hold a Conference on Thursday, December 10th, at 3 p.m., "On the steps to be taken to ensure prompt and efficient measures for preventing the pollution of rivers." The Right Hon. Lyon Playfair, C.B., M.P., F.R.S., LL.D., has consented to preside.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held on November 14, at the International Exhibition Buildings. Present:—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), F. J. Bramwell, F.R.S., Capt. R. A. E. Scott, R.N., Rev. Arthur Rigg, with P. Le Neve Foster (secretary).

FIRST ORDINARY MEETING.

Wednesday, November 18th, 1874; Wm. Hawes, F.G.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Ansell, W. T., Eastern Telegraph Company, 66, Old Broad-street, E.C.
Aria, Alexander, 28, Clifton-gardens, Maida-vale, W.
Badger, Rev. George Percy, LL.D., 21, Leamington-road-villas, W.
Baker, Sir Samuel, 19, Seymour-street, W.
Baker, William, 23, Lansmere-terrace, Victoria-park, E.
Barnard, Alfred, Upper King-street, Norwich.
Beach, Charles M., Hartford, Connecticut, United States, America.
Beaufoy, Mark Hanbury, South Lambeth-road, S.W.
Bell, Asahel Pilkington, The Vicarage, Sowerby-
Bell, Andrew, 44, Gloucester-road, N.W.
bridge, Yorkshire.
Brassey, Henry A., M.P., Preston-hall, Aylesford.
Carew, R. Russell, Carpenders-park, Watford.
Clark, Frank William, 52, Amhurst-road, Hackney, E.
Cobbett, Henry, Jun., 29, Sackville-street, W.
Coffin, Dr. Charles Read, 94, Cornwall-gardens, South Kensington, S.W.
Coles, F., Bethnal-green Museum, E.
Cripps, Edward, London Brighton and South Coast Railway, Electric Telegraph Department, London-bridge, S.E.
Cunliffe, E. T., Handforth, Cheshire.
Currey, Rev. R. A., Whittington-college, Highgate-hill, N.
Davidson, J., 59, Redcliffe-gardens, S.W.
Davis, Herbert Hall, 110, Cannon-street, E.C., and 56, Gresham-park, Brixton, S.W.
Defries, Henry, 50, Tavistock-square, W.C.
Duckham, H. A. F., 12, Oxney-villas, St. John's-road, Upper Holloway, N.
Edmonds, John Thomas, Cwmavon-house, near Pontypool, Monmouthshire.
Elkington, George, Jun., 95, Cannon-street, E.C.
Emmanuel, Morris, Portsmouth.
Farrell, Martin James, Wexford.
Foster, Alfred P., M.A., Ph.D., 3, Lower Sackville-street, Dublin.
Gawler, Colonel John Cox, Tower of London, E.C.
Gerson, Isidore, 5, Rathbone-place, W.
Gilder, Sherrington A. E., M.D., Montpellier-villa, Torquay, Devonshire, and Brisbane, Queensland.
Gooch, William Frederick, Wargrave, Newton-le-Willows, Lancashire.
Gordon, William, M.P., 11, Leinster-terrace, W.
Graves, James, Anglo-American Telegraph Company, Valentia Station, Ireland.
Harley, Colonel, Junior United Service Club, S.W.
Harris, Alfred Ellis, 130 and 136, Mile-end-road, E.
Hearson, C. E., care of J. T. Constantine, Ludgate-circus, E.C.
Howard, Joseph J. P., The Green, Tottenham.
Hunt, Edwin, Lea-brook, Wednesbury.
Hutchinson, Consul Thomas J., Chimoo-cottage, Mill-hill, N.W.
Huxley, Charles Rodney, M.R.C.S.L., 1, Gloucester-place, Portman-square, W.
Jekyll, Lieutenant H., R.E., 2, Morpeth-terrace, S.W., and Postal Telegraph Office, 101, Cannon-street, E.C.
Leitner, Dr. G. W., 22, Aberdeen-place, Maida-vale, N.W.
Lord, Edward, Canal-street Works, Todmorden.
McIsack, James, Alma-villa, Station-road, Barking, Essex.
Marshall, James, Britannia Iron Works, Gainsborough.
Morton, Robert, Stockton-on-Tees, and Alliance Chambers, Borough, S.E.
Muir, Richard, 12, Soho-square, W.
Oliver, Edwin, Natal Land and Colonisation Company, 41, Threadneedle-street, E.C.
Owens, Samuel, 22, Whitefriars-street, E.C.
Payne, Alexander, 4, Storey's-gate S.W.
Payne, William, The Keep, Forest-hill, S.E.
Phipps, Pickering, M.P., Northampton.
Powell, Harry, B.A., Glass Works, Whitefriars, E.C.
Rawlins, John, The Birches, Saltley, near Birmingham.
Reid, H. G., Newlands, Middlesborough.
Reynolds, Edward, Messrs. Vickers, Sons and Co., River Don Works, Sheffield.
Robertson, Donald, 5, Great Winchester-street-buildings, E.C.
Rowatt, Thomas, Radsworth-street, Baldwin-street, City-road, E.C.
Schröder, Frederick H., Old Swan-chambers, London-bridge, E.C.
Scovell, Edward, 86, Ladbroke-grove, W.
Sherriff, Miss Emily, 18, Cadogan-place, S.W.
Smith, Henry, 5, Ivy-lane, Paternoster-row, E.C.
Smart, Alfred, Crosby-house, 95, Bishopsgate-street, E.C.
Spagnoletti, C. E., Great Western Railway, Paddington, W., and Sussex-house, Slough.
Sparkes, J., The Lawn, 39, South Lambeth-road, S.E.
Thomas, Joseph Lee, 16, Holland-road, W.
Thorpe, George, 21, Eastcheap, E.C.
Williams, G. C., 92, New Bond-street, W.

In the absence of the Chairman of Council, who was unavoidably detained by official duties in connection with the artillery experiments at Eastbourne, the SECRETARY read the following

ADDRESS.

At the commencement of the 121st Session of this Society it devolves upon me once more to lay before you a few remarks in connection with its work, in reference to the Session lately ended, and to that on which we are now entering.

The pages of the *Journal* bear testimony to the manifold operations of the Society, while the very large attendances at all meetings, whether lectures, the reading and discussing of papers, or special Sections, testify to the interest excited by them. It is the endeavour of the Council to extend that interest by inviting attention to those legitimate subjects of discussion which are intimately connected with our national progress.

It has been customary on these occasions to record the losses which the Society has sustained during the past year by death amongst its members. We have this year to lament the loss of an unusually large number of those who have taken a lively interest in the Society's work, and done much to aid the advancement of industry and commerce. It would occupy too much of the time of the meeting to enter on any detailed statement of the varied services which they have rendered, and this is the less necessary, as obituary notices of them have already appeared in the Society's *Journal*. The names, however, of such men as the following cannot be passed over in silence:—Thos. Baring, M.P., nominated by the Society as one of the Commissioners for conducting the International Exhibition of 1862; Sir Charles Fox, the constructor of the building for the Exhibition of the Industry of All Nations in 1851; Sir Wm. Fairbairn, to whose exertions, in combination with the late Robt. Stephenson, we are indebted for the erection of the tubular structure known as the Britannia-bridge, spanning the Menai Straits; Sir John Rennie, who assisted his father in erecting the first iron bridge over the Thames at Southwark, and who, succeeding his father, brought to completion the present London-bridge; Wm. Felkin, who as Mayor of Nottingham in 1851 lent his valuable aid to H.M. Commissioners for the Exhibition, and who subsequently gave to the world a history of the rise and development of the lace industry, the staple trade of that town; Owen Jones, whose skill as a decorative artist lent so great a charm and gave such aerial effect to the interior of the Exhibition building of 1851; Sir Wm. Bodkin, late Assistant-Judge, ever active in the interest of the Society and the promotion of its welfare; Dr. Neil Arnott, F.R.S., whose name will always be associated with the promotion of science and its applications to the homes of the people; C. W. Eborall, the active manager of the South Eastern Railway; T. N. R. Morson, whose position as a chemist is well known. To the foregoing must now be added the name of Giovanni Franchi, the well-known artist in electrotype, and Archibald Campbell, M.D., whose connection with the Hon. East India Company, and whose intimate knowledge of the products and internal resources of India, rendered his services on our Indian Committee so valuable. As no obituary notices of these two gentlemen ha appeared in the *Journal*, it will be right should state some of their claims to recognit the part of this Society.

Franchi was a native of Lucca, in Tusca settled in this country nearly forty years ag 1846 he was rewarded by this Society for th duction of casts in fictile ivory. He was th person in this country that cast from g composition moulds, and he carried his pro a high state of perfection a year or two late perfected the means of casting from the ro moulds without seams, and thus laid the fo tion for the production of the elaborate e deposits richly undercut and in relie which he afterwards became so celebrated. of the chief works of art reproduced by l electrotype are the large bronze socke flagstaffs in the Piazza of St. Mark, V statuettes of our Saviour and St. John, fro originals in the Cathedral of Pisa; also tw of gates, one known as the Porta di San Ra the Cathedral of Pisa, and the other the G Gates, from the Baptistry of Florence. The of the royal plate from the Tower of Lond also reproduced, including the baptismal fo royal wine fountain, and sceptre of Ann B The royal plate from Windsor Castle w produced, and also works of art from Knowle belonging to the Earl De la Warr; besides a number of other productions to be seen South Kensington Museum. His casts in are unrivalled; two of the specimens are South Kensington Museum, and consist o production of the pulpits from the Cathed Pisa and Florence.

Dr. Campbell was one of the Cam of Islay, and entered the service of the India Company. He had, it is believed, employed in the Nepaul mission wit Bryan Hodgson, and was, soon after it mation, put in charge of Darjeeling, and i English invalid soldiers. Campbell was one many who, by administrative genius, have up our empire in India. The names of so those who had the good fortune to rule o presidencies and kingdoms are popular and l ical, but there are other benefactors, services, like those of Archibald Campbell, a known to their colleagues, though long tre in the memories of grateful natives. N offered less promise than Darjeeling—a few galows perched among the rocks, in sight mightiest snow-covered mountains of the with a poisonous jungle at foot, and a popu and neighbourhood of low savages—such we materials. Close at hand was the treac Rajah of Sikkim, and his hostile Dewan.

Under Campbell's care the natives b labourers, and learned new and useful art others flocked in to form a population, and them he raised a native army and police, eco cally paid from the scanty revenue he c This obscure place became the summer reside the govenors of Bengal, and might have b a pleasure town like Simla.

Its governor (Superintendent he was called), was, however, indefatigable in cr permanent resources, and of course many t many chances favoured him. Dr. Hooke

President of the Royal Society, having engaged in a botanical expedition, was by Dr. Campbell conducted into Sikkim, but both were imprisoned by the Dewan, glad to get hold of his great enemy. Hooker was speedily released, but Campbell was longer detained, and bore the marks of injury to his death. His followers in Darjeeling moved to his rescue, and on his release he invaded Sikkim, but unsuccessfully. The Government of India, however, sent a force to demand reparation, and such a cession of territory was obtained that Darjeeling became the capital of a district of 2,000 square miles.

At a latter date Dr. Hooker took an active interest in introducing the cinchona plant into Darjeeling, and it is now a great means of revenue. Campbell had, however, at the earliest moment when it was proposed to introduce tea culture into India, appreciated its full importance. He fostered the experiments at Darjeeling, and in the end he created an industry which has been successful, and the products of which have made a name even in this market. The labourers have been supplied from the neglected tribes, which under the Superintendent's training, have become useful and loyal subjects.

Many of the results have of course occurred since Campbell's departure, but he must ever be regarded in Darjeeling as its real founder. Thus, the Terai, in whose jungle miserable savages crouched, and to pass through which was even a danger to the English traveller on his way to the healthful hills, has now been largely reclaimed, and there can be no doubt that the Terai portions of the later-annexed Bhootra district will become granaries of food for thousands. Dr. Campbell, eager to promote every useful endeavour, took an active part in promoting cotton cultivation in the Terai, from which he always had great hopes.

He was a constant advocate of hill colonisation in India, and when the Minister in 1857 stated in the House of Commons the futility of such hopes—as there was not an acre of land available for cultivation in the hill regions—his strong testimony against the assertions has been confirmed by numerous proofs. In fact, if Darjeeling were tested as an Australian colony it would well bear the examination of its short history. In regions as healthy as those at home, and producing the same fruits and grain, not only do the invalids of Calcutta find new life, but many Englishmen are now successfully engaged in the plantations of tea and cinchona, and in various industrial occupations. During the mutiny the little community of Darjeeling held its own. It is now a rival to the group of English plantations which stud Assam and Cachar, and to those which are rising among the gorges of the western Himalayas.

One great object of the Superintendent was to obtain access to Darjeeling. He never desisted until he had got a fair road over the four hundred miles from Calcutta to its hill town. From 1858 until his death he never paused in demanding railway communication, so that within a day the sick soldier or merchant of Calcutta might reach the regions of health. The famine favoured him at length, and before his death he had the satisfaction of knowing that the construction of the railway is secured.

Another main purpose of Dr. Campbell was to pass the barrier interposed first by the Rajah fo Sikkim, and beyond him by the Chinese mandarins, to the free passage of merchants and goods into Tibet, the frontier of which was for years within his view. He created what was a considerable foreign trade for Darjeeling, and he agitated until he made a real impression upon the Government of India.

On his return home, after so many years' services, he felt the devotion of an Indian servant towards the country and people among whom the best years of his life had been spent, and to whom his labours were unremittingly devoted. His efforts were prompted by no hope of honour or reward, for be it said, to the shame of our administrators, that neither then, nor at any after time, was any honorary distinction or post of emolument at home bestowed upon him. This is the common fate of many a distinguished man, and it is not to be wondered that, in the exile from England, and in the chill of official thanklessness and neglect, some there are who shrink within themselves and retire from public life. Dr. Campbell's exertions were not only disinterested, but they often entailed on him expense and absence from family associations.

It was in the discharge of public duties that he became a member of the Council of the Royal Asiatic Society, of the Ethnological Society, and of the Anthropological Institute. On the formation of the Indian Section of the Society of Arts, he became one of its first and most active members, and his readiness to render service, as well as his wide knowledge, made his assistance most valuable. It will be remembered by our members that he took a zealous part in promoting the conference on Tea Culture and in obtaining the publication of a manual. He was also a leader in the deputation to the Duke of Argyll on Trade to Central Asia and China. It is a matter of great satisfaction to consider that in India practical results have been obtained from these exertions.

He was an authority whom we shall now miss greatly on all that relates to the countries of his devotion, the people, the geography, the productions of Tibet, Nepaul, Sikkim, and Bootan, on which he published useful memoirs, and communicated the information received from others.

Members cannot but have heard with regret of the close of the series of Annual International Exhibitions, instituted by Her Majesty's Commissioners at Kensington, and growing as they did out of the Great Exhibition of 1851 (a creation of this Society), it was hoped that a series of exhibitions had been entered upon which might have served largely the purpose of aiding the extension of technical knowledge in relation to trade.

The time has possibly not yet arrived when the full value of such exhibitions could be manifested, and it may remain for other Councils of this Society to suggest and promote a new series on a somewhat different basis. Should such prove to be the case, it may be well that the Government should give to them the aid which it affords to literature, art, and science, for assuredly if it is important to give to the art workman a knowledge of art, and to the dyer a knowledge of chemistry, the mechanic must stand in equal need of information as to new combinations of machinery, and men engaged in commerce should have equal opportunities of becoming familiar with the pro-

ducts of our colonies and of foreign nations, as well as the nature of the raw materials upon which commerce and industry are based.

If exhibitions are to be of real value and self-supporting they must enlist the sympathy of all classes of producers, and possess a wide and a general interest for the public. It is not sufficient to interest a few trades, and to exhibit their products. They must be exhibitions, not of exceptional examples of what money can cause to be produced, but of what industry produces for commerce, and if artists can find their interests promoted, and obtain the support of the public by the yearly exhibitions of their works, there appears to be no good reason for asserting that the industrial arts and commerce of the country cannot command a like share of support. The Council of this Society will take every opportunity in the future, as it has done in the past, of promoting the interest of Arts, Manufactures, and Commerce, and the advancement of technical knowledge by means of exhibitions. The Council have appointed a Committee to consider the subject of exhibitions generally; and have resolved at some future opportunity to prosecute an inquiry into the desirability of holding future International Exhibitions, and the results of past Great Exhibitions.

The Council consider that the question of Local Exhibitions stands on a different footing to International Exhibitions, and will be prepared to inquire what aid the Society can give to promote such Local Exhibitions.

It was long ago advanced in this room that exhibitions should form the basis upon which a commercial museum ought to be established, but to secure this result they must be carried out by the aid of a staff of officers possessed of the requisite technical knowledge, thereby securing for them the confidence of merchants, manufacturers, and producers, as well as public support.

We live in an age in which education is possibly making more rapid advances than it has ever hitherto done in England; but how slowly has it hitherto progressed in that class of knowledge which is calculated to advance the agriculture, manufacture, and trade of the country. It is not only in recent times that the desire has sprung up for more exact teaching in relation to science as an aid to industry, and a more exact knowledge of the products upon which industry is based. This desire led Dr. Alderson to attempt, at the beginning of the present century, to found a commercial college in Hull, the objects of which he thus set forth. 1st. To obtain for the man of business precise information on the nature and value of every article of commerce, whether crude or manufactured. 2nd. To point out the country where such articles are best to be procured. 3rd. To render him acquainted with the various processes by which they are rendered marketable. And, 4th. To instruct him in the languages of the different countries to which the objects of commercial intercourse may lead him.

Nicholson, in his journal, says in relation to the foregoing—"The Doctor, who stands in the honourable situation of proposer of an establishment so manifestly useful, disclaims the notion of this being a charitable institution; but considers it as the priv terest of every subscriber." "As the fat large family," the Doctor observes, "I c should not think myself at liberty to s fifty pounds merely for the personal pleas results from the contemplation of a cl action; but in subscribing fifty pounds above institution, I consider my interest welfare of my family. I am convinced it to the wealth and importance of the town both of these I am deeply interested; greatest interest I have, is in the facilit give to the education of my children. In mercial country and a seaport town, the sition of knowledge that evidently lead improvement of trade, becomes an objec first moment in the education of youth; mode now proposed offers advantages w private school can possess. To bring under the immediate observation of yout yet the memory is most retentive) perfe mens of the different articles of commer of the raw material and of the manufactu enable him to bear in mind the precise any article he may be called upon to ap To point out the country where every first procured or manufactured, will qualif go to the cheapest market, and by teaching language of such country, he will be at capable of transacting his own concerns the intervention of interpreters, often serious source of imposition."

The work proposed to be done by Dr. was, nevertheless, left undone, till a b was made by the exhibitions, museu examinations, instituted by this Societ thirty years ago; but a vast amount of w remains to be accomplished.

The Society's General Examinations, i known, have been doing good service an working classes of this country since their tion in 1853. The system then inaugur the Society ultimately gave rise to the U Local Examinations, and has resulte general desire for an improved educatio children of our working men. The latte being provided under the action of the Boards. The fact that other agencies doing so much on the one hand for art and and on the other for the general educatio people, has led the Council to extend it tions with the view of opening out fr of action, to be hereafter, it is possi veloped by more special agencies. The last year established a series of Exam in the Technology of Trades. There reason to hope that these will stimu acquisition of that knowledge, the w which in a commercial country like Alderson so clearly set forth three quar century ago, but which our universit colleges have till of late years entirely disr The Society is indebted to several of t companies for their co-operation and su this important work, and it is confident that the money which they have generousl at the disposal of the Society will se abundant harvest in the future.

Sir Thomas Gresham, who died i bequeathed funds to the City of London

ll, the provisions of which specify that lectures shall be read every day of the week for the instruction of the youth and others of this City in useful knowledge. After the destruction of the Royal Exchange by fire in 1841, the Gresham Committee, consisting of four Aldermen and eight Commoners of the City of London, and twelve Commoners of the Company of Mercers, purchased a plot of ground at the corner of Basinghall-street, and erected a building upon it at a cost of 7,000. The building was opened on the 2nd November, 1843, and lectures have since been delivered there; but it is questionable how far they meet the requirements of the present age. The Council have under consideration a suggestion made to them, that they should enter into communication with the managers of the Gresham Lectures—trustees by the Corporation of London and the Mercers Company—with the view of increasing the usefulness of these lectures, especially in their bearing on technical instruction.

If we failed to improve the education of the people, so we equally failed to render our museums as efficient for educational purposes as they were long since capable of being made. A writer upon this subject in December, 1802, speaking of the British Museum, says :—

"The collection of objects relative to natural history, &c., should be under the superintendence of a separate committee; and this establishment, if properly conducted, could hardly fail to become one of the finest and most instructive repositories in Europe.

* * * * *

"The arrangement of this establishment requires considerable knowledge and ability; it would therefore be the highest presumption in me to attempt to dictate on the subject. I should conceive, however, that the whole collection might be advantageously separated into five classes. The first might comprehend the animal, the second the vegetable, and the third the mineral kingdom; the fourth might comprehend objects of pure curiosity, and such as were illustrative of the state of society, of arts, and of manufactures of various nations; the fifth might comprise such objects as tended to the improvement of, or were simply illustrative of the arts, sciences, and manufactures of our own country.

"In the arrangement of the objects of natural history, I would suggest that the most extensive scale should be assumed, and that spaces should be left for the insertion of such objects as were wanting, and were likely to be procured. The places of these objects should be supplied by accurate drawings or models, if possible. To each object might be attached its proper name, both in Latin and English; and a descriptive catalogue of the museum should be printed, which might, at the same time, serve as an introduction to the study of each class.

* * * * *

"A laboratory for the preparation of objects of natural history should be annexed to the establishment, and the committee might be directed to offer premiums for improvements in the art of preparing and preserving these objects. The committee might also be enjoined to publish concise directions for travellers, for collecting, preserving, and transporting the different objects they might meet with. Copies of this work should be given to all who might request them.

"I am inclined to think that if this establishment was conducted on an extensive and a liberal scale, it would shortly comprise most of the private collections in the kingdom; for it is presumed that there are few lovers of natural history who would not prefer the honourable applause of completing the national museum, to the selfish pleasure of possessing an imperfect and comparatively useless collection of their own, especially as they would enjoy the credit of the collection equally as if it remained in their own private possession.

"By degrees as the collection enlarged, and as its utility was more sensibly felt, it is presumed that the nation might be induced to purchase ground, and to erect appropriate and extensive buildings to contain it; in short, it would seem, were this plan to be adopted, that we might indulge ourselves with the prospect of speedily possessing one of the finest, the most interesting, and most instructive establishments in the universe."

The Council congratulate the members upon the time having at length arrived, when the Government has purchased the ground and is at present erecting the necessary buildings for the proper display and utilisation of the Natural History Collection belonging to the nation; and let us hope that before long the collection will be properly housed in its new home at Kensington, and made available for the education of the people, not only in relation to scientific natural history, but in connection with its practical application to commercial knowledge.

In connection with this subject, it is gratifying to know that although the International Exhibitions have been for the present, at least, set aside, the buildings in which they have been held are still to be appropriated to kindred objects. The Indian Museum is to occupy one portion, a Colonial Museum is to be established and arranged in another, whilst a third portion is to be appropriated to the use of the Patent Museum, where the objects may be displayed in a manner more worthy of their importance, and greatly to the convenience of the public.

This reference to the Patent Museum leads me to draw attention to the present state of the law relating to patents for inventions. These laws will doubtless form an important topic of inquiry and possibly of legislation in the next Session of Parliament. It is well known how large and active an interest this Society took in the amendment of the law as it existed previous to 1852. Previous to the new law being enacted, patents were costly, and the publication of specifications by the Government was unknown. Many were the predictions of failure, if immediate publication were attempted, to say nothing of the heavy charges which would be thrown upon the country if fees were reduced and publication entered upon. How utterly erroneous all such predictions have proved is now well known. The greatly increased number of patented inventions is equally well known, as is also the fact that the country derives yearly a considerable revenue from the fees received through the Stamp-office. It has already been announced that this subject will be discussed in this room, being introduced by a paper which Mr. F. J. Bramwell, the well-known President of the Mechanical Engineers, has undertaken to prepare, and I have no doubt that many members who are largely interested in this important question, will attend and take an active part in its discussion.

In speaking of an improved patent law I have referred to the value which would attach to a proper arrangement of models and specimens in a patent museum. In the Museum as it at present exists, there are doubtless many models of machines which have not formed the subject matter of patents, and many more would probably be obtained if proper space and accommodation for their exhibition were provided. How interesting would it be, for example, if models could be obtained of the first railway proposed for construction, and for which the Gold Medal of this

Society was awarded to Richard Lovell Edgworth, Esq., in 1768, thirty years before its adoption, and a description of which was published by its author in January, 1802. In a letter addressed to Mr. Nicholson,* "On the practicability and advantages of a general system of railroads, and the means of carrying the same into effect," he says:—

"Many years ago I formed the project of laying railways for baggage-waggons on the great roads of England, but, having consulted several of my friends, who were eminent mechanics, so many objections were started that I for some time despaired of success. One great objection arose from the vast expense of massive railways, and the continued cost of repairs. To obviate this difficulty, it occurred to me to divide the weight that is usually carried upon a single waggon into four or five portions, and to place them upon four or five small carriages; these carriages linked together would be as easily drawn as the same load upon one waggon. In pursuance of this idea, about the year 1768, I presented models of three such carriages to the Society for the Encouragement of Arts and Manufactures, who for this and other inventions in mechanics honoured me with their gold medal; the date of which, and the *Journal* of the Society, may ascertain the early claim which I have to this invention. In 1788 I constructed four carriages with cast-iron wheels, truly turned and supported upon friction rollers. These were shown to several eminent persons, and were employed upon a temporary moveable wooden railway for a considerable time, in carrying limestone for the improvement of land. A variety of accurate experiments, and some useful improvements in this mode of carriage, were made with these machines, which it would take up too much of your valuable time to detail. I shall mention only one idea, which appears to me so practicable that I beg a place for it in your *Journal*, which will secure to it the most extensive circulation here and on the Continent. I propose that, by way of experiment, iron railways should be laid on one of the great roads, to the distance of ten or twelve miles from the metropolis, upon something like the following plan:—Four railways should be laid on the road, raised on sleepers of stone, so that their upper surface should stand about four inches above the road. They should be made hollow from the bottom upwards; for strength and to save expense, broad at bottom, and rounded at top, to prevent the lodgment of dirt and dust. On these should run light waggons, each containing not more than one ton and a-half weight. . . . . Where hills intervene, new roads must be made following the course of streams that wind between the hills; a moderate acclivity would not obstruct the progress of these carriages, that is to say, a rise of one foot in ten. Every person conversant in these subjects must know how much within bounds I speak, with respect to the ease of draught upon railways. The saving of horses and their food, the saving of wear and tear of carriages, the increased distance to which horses could travel in a day, the freedom from dirt and dust, the security by night, the ease with which the sick and infirm might be transported from place to place, are all obvious considerations. . . . . If such a plan should have a fair trial, it might lead the way to farther speculations. It is not impossible by slight circulating chains, like those of a jack running upon rollers, to communicate motion between small steam-engines, placed at a considerable distance from each other. To these chains carriages might be connected at will, and when necessary they might instantaneously be detached. What a prodigious saving of expense might be thus effected? If the freedom and facility of intercourse, which has been obtained by good roads and canals, be, as Adam Smith asserts, one of the great causes of our national wealth, how far might this freedom and facility of intercourse be extended by the perfection of the scheme whose outlines I thus lay before the public. Every great project requires time for consideration; time accustoms the public mind to new views, and what at first appears too distant and unattainable, by time becomes familiar and practicable."

How fully have the concluding words of Edgworth been realised in our own time in relation to railways and tramways, and it is to be borne in mind that when the Society rewarded Edgworth for his railway, the steam-engine was in a most primitive condition, and up to 1780 was co[...] to raising water. Watt's first "rotary" s[...] engine was not erected till 1782; and th[...] practical application of high pressure stea[...] Trevithick, was in the working of small "s[...] whims," which he carried from place to pl[...] a cart, as was required. It is stated by Trevithick that his first steam carriage was prior to 1800, but it was first publicly u[...] carry a number of persons on Christmas-eve, Even this was only a common road carriage, locomotive was not used on a tram for seven later. I may add that the use of the crank [...] by Watt, and high-pressure steam by Trevi[...] form the starting point of our present locomo[...] The steam governor applied by Watt w[...] adaptation of the same principle previously ap[...] by Samuel Bunce, of the Admiralty, to a cr[...] the year 1785, the construction of which was municated to the Society of Arts, and publish[...] its Transactions, vol. iv., p. 187. He there state[...] his design is to substitute for the bellows, hit[...] used for that purpose, "a ball, so connected small and horizontal wheel that when the ma[...] moves too fast, it may, by its centrifugal [...] throw a stop upon the wheel."

Since 1800 how vast have been the strides [...] we have made by the agency of steam, varied have become the forms in which the st[...] engine has been applied. Industry, comm[...] and civilisation have been advanced throug[...] agency, and the Council have thought th[...] might be of especial interest that the attenti[...] members should be directed to some of the [...] of the modern steam-engine during the se[...] upon which we are now entering. They therefore arranged for the delivery of a cou[...] Cantor Lectures upon that subject, and members will, I am sure, agree with m[...] thinking that the Council have been singu[...] fortunate in having been able to induce Mr. Bramwell to undertake that duty.

Before I quit the subject of museums and connection with the advancement of art and sci[...] it is my duty to inform you that the comm[...] which was formed last year on the subject o[...] National Museums and Public Galleries, wi[...] view to the promotion of their increased useful[...] more especially in the direction of giving a[...] original research, and the advancement of tech[...] instruction, has already recommenced its sitt[...] and the Council through its means will contin[...] prosecute this action.

Much has been written of late in relatio[...] the sanitary improvement of towns and vill[...] the water supply, railways, tramways, and r[...] all subjects in which the Society from its institution has taken an active interest—an int[...] which has been continued down to our days. The improved sanitary condition of citie[...] towns is of slow growth. Dr. Lyon Playfai[...] his recent address to the Health Section of Social Science Association at Glasgow, pain[...] fearful picture of the condition of things at pr[...] existing in Scotland. If we look back a few [...]turies we shall find that the sanitary conditio[...] the City of London was equally disgraceful. [...] the streets of London were not paved at the e[...] the eleventh century, is asserted by all histor[...] Several of the principal streets, such as [...]

* Nicholson's Journal, vol. I., 8vo, p. 221.

born, which at present are in the middle of the city, were paved for the first time by royal command in the year 1417. In the king's order it was said, "that the highway named Holbourn, in London (*alta via regia in Holbourne Londoniæ*) was so deep and miry, that many perils and hazards were thereby occasioned, as well to the king's carriages passing that way as to those of his subjects; he therefore ordained two vessels, each of twenty tons burthen, to be employed at his expense, for bringing stones for paving and mending the same."

The construction of canals at the close of the last century, the improvement of our turnpike-roads by Macadam, the introduction of railways and tramways, have all promoted a larger amount of intercourse between cities, towns, and villages, and led to a more intimate knowledge of the conditions and wants of the people. Sanitary, Railway, and River Pollutions Commissions have sat and reported, Commissioners of Sewers have acted and been superseded by other Boards, but doubtless in London we have made considerable progress in improving our roads, rivers, and water-courses. Not only the condition of that noble river which bears so much of the produce of other nations to us, but our roads have also been equally improved owing to the inquiries and investigations which have been bestowed upon them. But it is yet by no means a settled question as to which is the best of the many systems which have of late been introduced for the improvement of our road surfaces. Bearing this fact in mind, the Council last session appointed a committee to investigate the degree of tractive force required to be exerted upon the various descriptions of roadway as at present laid in and around London. These experiments in road traction under the directions of the committee, have during the summer been carried out with the assistance of Mr. C. E. Amos, and the results recorded by means of an ingenious dynamometer constructed by that gentleman. The trials have been made with an omnibus specially loaded for the purpose, and in order not to be interfered with by the street traffic they have had to be carried out at a very early hour in the morning. The road surfaces tested have been macadam, in a dry good condition, as well as newly laid asphalte, wood, and stone pavements. It is, however, thought desirable that some further trials should be made before the results are published.

I may here remark that this is no new subject of inquiry with the Society, for in "Letters to a Merchant," published by Mr. C. Dodd in 1799, on the improvement of the port of London by constructing a new bridge, instead of, or upon, the old London-bridge, which was proposed to consist of one principal centre arch, formed of iron, one hundred feet from low water to the crown of the arch, describing a span of 300 feet, with two large shore arches of 80 feet span, as near to the butment on each shore as advisable, for keeping deep water alongside the present below-bridge quays. The slope on each side, which must necessarily be added to this structure, was proposed to have an inclination answering to three inches in the yard. In view of this matter, experiments were made by the Society with an appropriate instrument, under the superintendence of Mr. Samuel Moore, its secretary, who determined "That a horse, moving at the rate of three miles an hour, can only exert a force equal to 70 or 80 lbs."

In my address last year I alluded to the desirability of obtaining an engine of small tractive force suitable for the traction of tramway-cars on our common roads; the late Mr. John Grantham was then doing his utmost to realise so desirable an object; unhappily he has been taken from us before his work was completed. I understand that others are now directing their attention to this subject, and I wish them every success, though I do not feel that the steam-engine is precisely what we desire. If some new source of power, such as the carbonic acid gas engine, which has of late been so much written upon, can be perfected and applied, it might deserve and doubtless would receive the serious consideration of men of science and engineers in order to bring it into use in so important a direction.

The Society continues the offer of the award of the Howard Prize for a satisfactory solution of this question, and will be glad to receive information in reference to any proposals which may tend towards a satisfactory solution of so important a proposition. The terms of this prize are as follows:—"A Gold Medal, or £25, for the production of a traction engine of moderate power, capable of being employed as a substitute for horse-power on tramways, and in the streets of cities and towns. The engine to form one structure in combination with the tramway carriage. The power may be generated by any means, provided that noise, noxious fumes, or the discharge of refuse into the air or on to the road-surfaces are avoided."

The ever increasing population of our towns has led to the destruction of the purity of our rivers and streams. Commission after Commission has sat and reported on their condition, but the problem of how best to secure their freedom from pollution without injury to manufacturing and mining industries, and with greater economy in the application of our sewage to agriculture, with due regard to economy on behalf of the ratepayers, is still unsolved. With reference to the question of the pollution of rivers, the utilisation of sewage, and other kindred subjects, the Council have decided upon holding a morning conference, over which Dr. Lyon Playfair, M.P., C.B., F.R.S., has undertaken to preside. The conference is fixed to be held on Thursday, the [illegible] o'clock, and all those who [illegible] before the public are invited [illegible] them for discussion [illegible]

Serious fires and [illegible] unchecked in the [illegible] two-thirds greater [illegible] the constant [illegible] and other cities [illegible] ing death [illegible] occasioned by [illegible] we have not [illegible] sion of the [illegible] arisen [illegible] by Colonel [illegible] Russell [illegible] by an [illegible] [illegible] [illegible] [illegible]

under a restriction of rates to a threefold extent beyond what on a public footing would be remunerative; rising colonial possessions are checked in their progress; the means of the quick concentration of aid and of naval and military force for protection are withheld by the want of numerous branch lines, which cannot be obtained on any other than a public footing; and continued obstruction is caused to the progress of arts, manufactures, and commerce by the delay of legislation on sound economic principles. A confident expectation is entertained that if an impartial committee of inquiry is given to our colleague on the Council, Mr. E. J. Reed, C.B., M.P., a financial as well as an administrative case will be presented that will be found to be unanswerable.

It has been said that the age in which we live is an age of specialists; that whereas formerly those who followed a profession or trade undertook the duties appertaining thereto, whatever were there requirements, in the present day the practice of medicine or the law is divided into many branches, each having its own special practitioner. What is true of professions is equally true of trades and handicrafts. The application of machinery in aid of industry has doubtless relieved men from much that was mere physical labour, and while it has greatly lessened the cost of production, has so increased the demand for the thing produced, that he is now more fully and better employed as a thinking being. The merchant, manufacturer, and chemist of former times was in no respect differently situated from the professional man, for in each case knowledge was then much more circumscribed than it is in our own day. The researches of men of science, the discoveries made by travellers in foreign lands during the last fifty years, and the facilities for extending commerce which have grown up owing to the discovery of the capability of steam to propel vessels across the ocean, the development of iron shipbuilding, the construction of locomotives, railways, and telegraphs, have collectively led to such a piling up of knowledge as was previously undreamt of, and have necessitated subdivision of labour in every department of both mental and physical industries. As a result Societies like our own have thrown out new branches in a variety of directions, and we now have not merely an Institute of Engineers, but a Society of Mechanical Engineers, and also Telegraph Engineers. We have the College of Pharmacy devoting its attention to the chemistry of medicine; the Chemical Society to chemistry proper or scientific, as tending to the discovery of new bases for industries in the future; while geography, geology, botany, and all the kindred sciences come in and help to pile up facts which commerce and industry seek to apply for the good of mankind in general. To make known the application of some of these modern discoveries as applied, and to point out markets ready to absorb the things produced has ever been the duty of this Society. With this object the Council, as members are aware, some four or five years since entered on a sectional action, and so great was the interest expressed in the work of the Indian Section, which was the first established, that last year two additional sections of action were entered upon, viz., Africa, as a field for commerce, and Chemistry in its relation to industry. It has been highly gratifying to the Council to observe the crowded and interested audiences which the action of the Sections has induced; and I am glad to be in a position to state that arrangements have been made for continuing the work of both the Indian, African, and Chemical Sections during the present session. The Indian Section will, as heretofore, be conducted by Colonel Hardy. Mr. Wills has again expressed his willingness to superintend the Chemical Section; and Dr. Mann, an African colonist, well known to the members for the part he has taken in many of the Society's meetings, has kindly undertaken the duties connected with Africa.

The Food Committee will still continue to pursue its inquiries, and though it has not yet been able to award the Trevelyan Prize of £100, it still looks forward to a solution of so important a problem as that of bringing in from abroad increased supplies of fresh meat for our teeming population. It is glad to learn that the plan proposed some time since for bringing live cattle from the River Plate, Texas, and other parts of South America is again under consideration, and it is hoped that the endeavour when made may be attended with that success which the application of increased experience may entitle it to.

The Cantor Lectures, which have now for several years past drawn crowded audiences into this room, will be continued during the present session, and the Council doubt not that the names of Dr. B. W. Richardson, F.R.S., the Rev. Arthur Rigg, and Mr. F. J. Bramwell, F.R.S., who have undertaken each to deliver a course, are sufficient guarantee that the lectures will be in no respect less interesting or important than those which have preceded them. The Council feel that the large amount of labour which gentlemen undertake in the preparation of original courses of lectures for delivery here would alone entitle them to our warmest thanks, but when it is remembered that the lectures are not only delivered but are allowed to be published in the Society's *Journal*, they feel that members are doubly indebted to them for the work they perform. The courses, as already announced in the *Journal*, will be—1. "Alcohol: Its Action and its Use;" 2. "The Material, Construction, Form, and Principles of Tools used in Handicraft;" and 3. "Some of the Forms of the Modern Steam Engine." It is the anxious desire of the Council that the mechanics of industry and manufactures should hold a more prominent place in our proceedings than it has hitherto done. The difficulty which has hitherto and still stands in the way of the appointment of a Mechanical Section is finding a competent person to take charge of the same. Engineering machines and tools, the steam-engine, hydraulic engineering appliances, and many other departments of mechanical engineering have been largely written upon and have able exponents, but the mechanics of industry, such as the lace loom, the embroidery frame, cotton machinery—the loom itself, notwithstanding the vast improvements which have of late years been introduced into its structure and working—silk machinery, paper machinery, and many other mechanical appliances, seem to have no representatives competent to bring such questions before a

public meeting. So soon as the Council can supply this deficiency in their operations it will do so; meanwhile I am sure that the members will feel that what the Society is proposing to do is worthy of their hearty support, and as the work done can only be carried on at great cost, I would urge them once more to bring in as many of their friends as members as possible.

The enlarged action of the Society causes the question of endowment to be increasingly important. To meet the various tastes and interests of such a large number of members, the Council is encouraged to form committees of inquiry, and to hold discussions on subjects in reference to the products of all countries connected by commerce with our own land. In order to secure continuous attention to such inquiries, and to prosecute them in a becoming manner, it is of the utmost importance that the hope expressed by the Council relative to the formation of an endowment fund should not be lost sight of, and they therefore hope that the members, especially the more wealthy, will respond to the invitation to form such a fund, and so place the Society on a more sure foundation than can be secured by annual subscriptions only, and thus place it in such a position as to enable it to carry on its operations with full energy should a time of commercial adversity as in the past overtake it in the future.

During the session it will be our business to further consider and complete the work already commenced in connection with the establishment of a National Training School for Music. The building, you may remember, was commenced last year, His Royal Highness the Duke of Edinburgh laying the first stone. The work is making progress, and the structure is now roofed in, so that it may be expected that before the winter is over the joiners' and glaziers' work will be completed. The main endeavour of the Council will, however, be to increase the number and amount of free scholarships for which the building will find accommodation. The members are already aware that Her Majesty the Queen, the Prince of Wales, the Duke of Edinburgh, Sir Titus Salt, the Mercers' Company, the Fishmongers' Company, and others, have already announced their intention of providing scholarships. The Council of the Society, as named in the last report, have voted £[illegible] to enable this matter to be brought prominently before the public; and Mr. Lionel Benson, a distinguished musical amateur, has been dispatched on the part of the Society to visit some of the principal towns in the country, and bring the scheme before them, with a view to obtaining their aid in the establishment of scholarships for their several localities. He has already made a successful beginning at the town of Birmingham, which has subscribed to establish several scholarships. Manchester has formed a local committee to promote the object, and Mr. Benson is now on a tour to visit Liverpool, Leeds, Halifax, Bradford, and Huddersfield; and it is confidently expected that before the sessional year of the Society is brought to a close, these, as well as many other towns in the United Kingdom, will have given in their adhesion to the undertaking. The Council hope that in furtherance of this great national work, the members generally will do their utmost to assist.

You may remember that when I addressed you from the chair last year, I alluded to the munificent gift of £500, placed at the disposal of the Society to advance, by premiums and otherwise, improvements in our stoves and ranges with a view to a greater economy in our high-priced fuel, and that a competition for this purpose had been invited. You have been informed, both in the Council's report and by notices in our *Journal*, that a large number of competitors entered for the prizes offered, and brought their plans before the Committee, and that testing-houses had to be erected for their practical trial, conducted by a special Committee, with a special officer to carry out the tests. Much time, anxious thought, and labour have been bestowed by the Committee, and it was not till late in the summer that the actual tests were completed. When it is recollected that each competitor was allowed two days to show his stove in action before the Committee, and that delays on the part of the competitor, either in fixing his apparatus or in arranging to suit the convenience of his attendance, would necessarily occur, it was not to be wondered at that a long time elapsed before the trials could be brought to an end. All the details resulting from the tests, involving a large amount of figures, have had to be carefully tabulated, and the Committee is now employed in going over them, with a view to report. The problem is by no means so easy to solve as it may seem at first sight, and the Committee regret that delay must occur before they can report their final decision. While the Committee recognise the expenditure both of time and money to which the competitors have necessarily been put, it must not be forgotten, on the other hand, that the cost to the Society has been equally large. It is due, however, to the competitors, as well as to the public, that the report should not hastily be made, and on this ground the Committee claim their indulgence for a time.

Although the members have been officially informed by the Council's Report in June last that the Albert Gold Medal of this Society has been conferred on Mr. C. W. Siemens, a distinguished member of our body, I cannot refrain from referring to his early connection with us on his arrival in this country in 1844. A German by birth, he has cast in his lot with us, and we claim him now as a fellow-citizen, who has conferred large benefits on the industries of this country. He first became known in connection with the anastatic process of printing, which he brought before this Society. He subsequently directed his attention to the improvement of processes for the evaporation of brine, and jointly with his brother paid much attention to the early development of the telegraphic system, which he has since carried out on a gigantic scale, to the social and industrial advantage of the world at large. As a man of science he stands in the foremost rank, and at the same time combines with it the rare capacity for applying his knowledge to the improvement of industries. The medal has been awarded to him "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; for his improvements in the manufacture of [illegible] and generally for the services rendered by [illegible]

connection with economisation of fuel in its various applications to Manufactures and the Arts."

It is deplored by many, and by none more than by the Council of this Society, that there are so few sources of occupation open to the better educated of our female population. Art has ever been looked to as a source from which might spring profitable employment to many among those who have had the benefit of an art education. "The end of art (said Lord Bacon) is to perfect and exalt nature," but to that end it is important that good art should be placed before the people, and to encourage art in connection with industry is one of the primary objects of our Society. Bearing the foregoing facts in mind, the Society long since pointed attention to Shell Cameo cutting as an industry suited to female artists, and published the necessary information relative to the shells more generally used, in the hope that our country-women might in some cases be induced to apply their skill and ability in the production of cameos of a higher class than those generally met with in commerce, the majority of which were, and it is believed still are, the products of foreign workmen. The Society has from time to time offered its medal with the view of inducing attention to the subject, but it is not till the present year that it has been able to award the medal so offered, and it has afforded the Council peculiar satisfaction to do so on the present occasion. The report of the Committee on the works of Miss Emily Addis Fawcett was highly commendatory, and they hope that a beginning thus made may lead to large and beneficial results, by inducing other ladies to become producers and competitors for a similar medal in future years. The Council propose to continue the offer of the medal on the same terms and conditions in the present as on the former occasions, viz., the Society's silver medal is offered to "female artists, for the best cameo designed and executed on any of the shells ordinarily used for that purpose."

It has ever been the desire of this Society to lend its aid and to make its House available, whenever possible, in the development of new art industries. Thus, in 1846, when the Society started on its present career of usefulness, one of the earliest examples of the application of mechanically-produced tesseræ, under Prosser's patent, was laid in the Society's Hall by Messrs. Minton and Blashfield. Since that date an extensive art industry has grown up, and now scarcely a building of any importance is raised in which it is not employed. Soon after the production of tesseræ from a mixture of flint and compressed dry clay powder had become an established fact, owing to the enterprise of the late Mr. Herbert Minton, attempts were made to compress glass into cubes of a similar character while in a semi-molten state, but the air enclosed in the die used in compressing it was driven down by the plunger upon the face of the cube, and indented the surface of it in so irregular a manner as to render the use of glass tesseræ, for a time at least, impracticable. Recently, the endeavour to apply glass tesseræ to the decoration of surfaces has been more successful. The well-known firm of Messrs. James Powell and Sons, of Whitefriars, have taken the matter in hand, and applied glass mosaics in facing one of the staircases of the South Kensington Museum. Availing themselves of a knowledge of this fact, Council being under the necessity of repairing staircase of these premises, they applied to Me Powell to carry out the necessary work for Society, but I regret that, owing to unavoid circumstances, we are not in a position to p before the members this evening the result opening for their use the staircase, which is unfinished. It is hoped that the work shortly be complete; and that what is being done may, in its turn, give rise to a l and durable art industry in the future.

I must add one word more before clo and that is in relation to Juvenile Lect It will be remembered by some now pre that last session the Council, anxious to in an interest in the objects of this So among the younger branches of the famili members, did so by the establishment of a co of juvenile lectures, two of which were deliv in this room by Mr. Frank Buckland, a third delivered in the Fish Museum at South Kens ton, and a fourth at the Aquarium at Brighto

The success of the effort thus made exce the most sanguine anticipations of the Cou and placed them in the position of being obl to stop the issue of tickets as soon as su number as could be accommodated had applied for. Notwithstanding the limited ex of accommodation at its command, the Co propose, during the ensuing Christmas vacatio again afford to the juvenile branches of the fan of members an opportunity of learning that tures on applied science are not the dry uninte ing things which many would have them bel In order to accommodate the largest pos number of children, it is requested that mem desirous of obtaining tickets for themselves and children under sixteen years of age should se their names at once to the Secretary. The n as received will be registered, the tickets be issued strictly in the order of application, no more tickets will be issued than the accomm tion admits. Members unaccompanied by children are not expected to attend these tures, but in order to accommodate the la possible number, it is proposed, if possible, the lectures should be given at three o'cloc the afternoon, and repeated at eight o'clock in evening of the same day. The Council by this arrangement to increase and extend benefit of the juvenile course to as large a nu as possible.

I have thus once more endeavoured to lay b you a few among the many subjects of int which have and still continue to occupy the at tion of this Society. I might have dilated many others, some of which I hope will also the subject of discussion or report during the se upon which we have now entered. I am sure n are waiting and watching with interest the prog of the vessels at present being constructed to o come the inconveniences of the channel pass as also the progress of the proposed cha tunnel so ably brought before the Society last sion by our colleague, Mr. William Hawes, time forbids my enlarging upon them, and I conclude by expressing a hope that members afford to the Council and officers their hearty operation in the conduct of the Society's busi

and will seek to bring to the notice of the Council on every occasion such matters as may come under their observation, and which they may consider calculated to benefit in the future the arts, manufactures, and commerce of this country, and the welfare of our fellow countrymen in her many far distant foreign and colonial possessions.

The Chairman then presented the following medals and prizes :—

His Royal Highness the Prince Consort's prize of Twenty-five Guineas to Alexander Gibson, aged 20, of the Manchester Mechanics' Institution, draughtsman, who has obtained the following First-class Certificates in the present and three preceding years :—

1871—Domestic Economy — First-class Certificate, with a Prize of Books to the value of £1.
Mensuration—First-class Certificate.

1872—Metric System—First-class Certificate, with the First Prize of £5.
Geography—First-class Certificate, with the Second Prize of £3.

1873—Logic—First-class Certificate, with the First Prize of £5.
Political Economy—First-class Certificate, with a Prize of Books to the value of £1.
English Language—First-class Certificate.

1874—Arithmetic—First-class Certificate.
Bookkeeping—First-class Certificate.
English History—First-class Certificate, with the Second Prize of £3.

The Council Prize (for Female Candidates) of Ten Guineas to Mary Elizabeth Martin, aged 25, of the Birkbeck Literary and Scientific Institution (no occupation stated), who has obtained the following First-class Certificates in the present and the preceding years :—

1872—German—First-class Certificate, with the First Prize of £5, and the Special Prize of £2 for Females.

1874—French—First-class Certificate, with the Special Prize of £2 for Females.

The Society's Silver Medal to Emily Addis Fawcett for specimens of cameo cutting.

The first census of the United States was taken in 1790, and a decennial census has been taken ever since. An estimate has been made for the ten years previous to 1790, from the data of years 1790, 1800, 1810, and 1820. From the data thus obtained calculations as to future increase have been made. The present and prospective population of the United States is as follows :—1870, 38,558,371 ; 1871, 39,555,000 ; 1872, 40,604,000 ; 1873, 41,704,000 ; 1874, 42,856,000 ; 1875, 44,060,000 ; 1876, 45,316,000 ; 1877, 46,634,000 ; 1878, 47,983,000 ; 1879, 49,395,000 ; 1880, 50,858,000.

The eleven principal nations of the world—Great Britain, United States, France, Germany, Belgium, Austria, Russia, Italy, Spain, Holland, and Sweden—have more than doubled their aggregate commerce in less than twenty years. The foreign trade of these countries amounted in 1855, to £850,340,000, and in 1872, to £1,854,400,000 ; showing in seventeen years an increase of £1,004,060,000, or 113·5 per cent. The increase of population during the same period is 40,177,000 souls, or 14·8 per cent.

In a recently issued report on the trade and commerce of Java, it is stated that the total amount of Cinchona trees of all sizes and ages growing in Government plantations at the end of 1873 was 1,705,542, and the bark crop for the same year amounted to 18,000 kilogrammes.

Tin mining is said to have settled down into a permanent industry in Queensland. The production is steadily maintained at present at a little over 100 tons weekly.

MISCELLANEOUS.

THE PROGRESS OF THE BRITISH COLONIES.

The publication of a further number of the "Statistical Abstract for the Several Colonial and other Possessions of the United Kingdom" affords an opportunity for inquiring into the present condition of our colonial possessions, and also for ascertaining the amount of progress they have made during the past fifteen years.

The welfare of our colonies is of treble interest to the mother country, inasmuch as they not only provide a home for her surplus population, but also contribute to the spread of the Anglo-Saxon race, with its free institutions, and create new markets for the disposal of British manufactures, in exchange for the raw materials of industry and articles of food, which are so abundantly produced in many of the colonies.

In order to keep the present remarks within the limits of the *Journal*, it is proposed briefly to notice the progress that has been made in the various possessions under the heads of—1. Population; 2. Finance; 3. Trade; 4. Agriculture; and 5. Climate.

1. *Population.*—Owing to the unfortunate absence of a census for British India in 1861, it is not possible to ascertain the increase of the total population of all our colonies since that date. As regards the other possessions, however, with the exception of St. Helena, Antigua, and Honduras, the population in every case shows a large increase in 1871 over 1861. In some of the more important colonies it was as follows :—In the Australian group, 56 per cent.; in the Cape Colony, 112 per cent.; in the Dominion of Canada, 12 per cent.; in the West Indies, 14 per cent.; and in the Mauritius, 27 per cent. If we compare these rates of increase with that of the increase of the population in the mother country (which was a little over 12 per cent. in the same period), the peopling of our colonies appears to be advancing at a highly satisfactory rate. The total population of all the colonies in 1871 may be stated in round numbers at about 202 millions; of which 191 millions belonged to British India, and 11 millions to the remaining possessions. Of this latter amount the Canadian Dominion possessed 3,748,000 inhabitants; the Mauritius 2,405,000; Australia 1,978,000; the West Indies 1,062,000; and the Cape of Good Hope and Natal combined, from 800,000 to 900,000.

2. *Finance.*—As some of the colonies include the amounts raised by loans in their revenue statements, whilst others exclude such amounts from their income returns, it is not practicable to ascertain in a very accurate manner the total revenue of the colonies, but taking the returns as published, which are rather under than over the mark, it appears that, with the exception of the revenue of Labuan, the gross receipts from revenue from all sources (including loans as far as given) show a considerable increase in 1872 over those of the first year in the series published in the abstract.

In 1858 the total gross revenue of all the colonies together was about 43 millions sterling against 72 millions in 1872; this gives an increase of 68 per cent. The total amount of the public debt of the colonies at the same dates was 86 millions sterling in 1858, and 180 millions in 1872, showing that it had more than doubled in that period. The amount of debt was equal to two years' revenue of 1858, and to two and a half years' revenue of 1872. This is the general average for all the colonies, but in some instances, as in Australia and Canada for example, the proportion is much greater, the debt amounting to from four to five years' revenue. It is very important in colonies with limited resources that great circumspection should be used in creating debt, however worthy the objects may be for which the

debt is created, as the tax for interest may become so heavy as to act as a clog on the advancement of the State. The public debt of the United Kingdom amounts to 779 millions, which is equal to about ten years' present revenue.

Next to the Gold Coast, which only gives about one shilling per head of population, British India produces, in proportion to its population, the smallest revenue of any of the colonies. During the five years, 1868-1872, the average revenue of India stood at fifty millions sterling, which would represent a contribution of only five shillings per head.

The expenditure returns of the colonies, including repayment of loans, pretty nearly correspond with the amounts of revenue raised, and therefore do not call for special remarks.

Attention may here be drawn to the two last tables in the abstract, which give the rates of import and export duty levied in the various colonies upon the principal articles of import and export. With the exception of the import duties in the North American Colonies and in some of the West Indies, where the rates exceed ten per cent. *ad valorem*, the customs' tariffs, as a rule, are moderate in their rates, but they do not appear to be based upon any principle. Raw materials and manufactured goods, necessaries of life, articles of food and luxuries, yarns and tissues, in many of the colonies, are all equally taxed. Space will not permit of a complete examination of these tables, but it is clear that there remains a great deal to be done in colonial legislation before the true interests of consumers in the colonies are duly provided for. It is moreover certain, notwithstanding the amount of progress that has been made in the trade of the colonies of recent years, that it would have been still larger under the guidance of a commercial policy based upon sound economic principles.

4. *Trade*.—The returns of trade exhibit very satisfactory results. The total value of imports into all the colonies (exclusive of Hong Kong and Gibraltar, which do not publish returns,) in the year 1858 amounted, in round numbers, to 92 millions sterling, and increased to 144 millions in 1872, showing an increase of fifty-six per cent. The total exports, on the other hand, amounted to 81 millions in 1858, and to 156 millions in 1872, showing an increase of ninety-two per cent. The above amounts include bullion and specie as well as merchandise.

The extent of the interchange between the colonies and the mother country in 1873 amounted to no less than 161 million pounds sterling; namely, 81 million worth of goods sent home from the colonies in addition to 9½ millions of gold, and 71 millions worth of goods exported from this country to the colonies.

In 1858 forty-nine per cent. of the total imports of the colonies was received from the mother country, and in 1872 fifty-three per cent.; and of the total exports of the colonies forty-seven per cent. was exported to the United Kingdom in 1851, and fifty-one per cent. in 1872.

These facts clearly demonstrate the stability of the trade between the mother country and her colonies, as well as indicate its importance.

As regards the present extent of the trade between this country and the colonies, that with India occupies the first place, next Australia, then the Canadian Dominions, the Straits Settlements, Malta, the Cape of Good Hope, the West Indies, Ceylon, &c.

The increased amount of trade in the colonies has naturally given rise to an increased employment of shipping. Leaving the returns of Malta and Gibraltar out of the calculation, as relating chiefly to ports of call, it will be found that the total amount of British shipping entered and cleared in the trade of the colonies, increased from 14,700 tons in 1858 to 21,700,000 tons in 1872, or to nearly double. This tonnage, of course, includes that of vessels belonging to the colonies, but the far greater part belonged to this country, and the freights carried by them went into the pockets of British shipowners.

The value of the resources of the colonies is not duly appreciated in time of peace, but within recent years, during foreign and civil wars abroad, their importance to many of our national industries have been fully felt. During the Russian war Australia made up, in a great measure, for the supply of tallow and some other staples withheld by Russia, and during the American war India furnished our spindles with large supplies of cotton. The woollen industry now receives more than two-thirds of its raw material from the colonies, and one-third of the raw sugar imported into this country is also furnished by them.

The following are the chief products exported by the leading colonies:—

India—Raw cotton, opium, jute, rice, dye-stuffs, coffee, silk, tea, hides, and skins.
Ceylon—Coffee, cocoanut oil.
Mauritius—Sugar.
New South Wales—Wool, tallow, copper, coal, gold.
Victoria—Gold, preserved meat, wool, tallow.
South Australia—Wool, copper, wheat, and flour.
Tasmania—Wool.
New Zealand—Gold, wool, preserved meat.
Queensland—Gold, wool.
Natal—Wool.
Cape of Good Hope—Wool, coffee, skins, diamonds.
Canada—Grain, timber, animal products.
Jamaica—Sugar, rum, coffee.
Trinidad—Sugar, cocoa.
British Guiana—Sugar.

If it is borne in mind that an almost unlimited market exists in this country for the disposal of colonial produce, it will appear strange that so little is done by the colonies in making their resources fully known in this country. With the exception of some few returns from the Australian group, no information is published respecting the nature and amount of the various crops raised, nor of the results of mining and other operations. Happily, more attention is now being paid to statistics, and it is to be hoped that the colonial governments will perceive the necessity which exists for supplying information which is so much needed.

4. *Agriculture*.—There are, unfortunately, none but the Australian colonies which publish annual returns of agriculture. The area under wheat in the whole of the Australian group increased from 437,000 acres in 1858 to 1,439,000 acres in 1872. The total number of horned cattle in Australia in the same period increased from 3,429,000 to 5,038,000. In 1872, 2,287,000 belonged to New South Wales; 1,200,000 to Queensland; 812,000 to Victoria; and 436,000 to New Zealand. The total number of sheep increased from 19,513,000 in 1858 to 51,508,000 in 1872. Of this latter number 17,560,000 belonged to New South Wales; 10,575,000 to Victoria; 9,700,000 to New Zealand; 6,687,000 to Queensland; 4,900,000 to South Australia; and 1,395,000 to Tasmania.

5. *Climate*.—Intending emigrants may with much advantage consult tables 23 and 24, containing abstracts of the meteorological statistics of several of the colonies. From these tables they may ascertain the peculiarities of the climate of some of the principal possessions and thus avoid the trouble and expense of migrating to a climate unsuited to their constitution. There are few, for example, who would care to select for a residence a country where the thermometer ranges perpetually between 72° and 89° Fahr. in the shade and where the average rainfall is about 120 inches, or about 12 feet in the year; yet such is the climate of Singapore. It is to be hoped that endeavours will be made to render these tables more complete.

The production of coal effected last year in the French department of the Nord amounted to 3,503,461 tons. This total presents an augmentation of 257,458 tons as compared with the corresponding extraction for 1872.

PRINTERS' WASTE.

Of all our waste products, there are few more abundant and perhaps none more universally produced than waste paper. Like most other refuse material, old paper has of course a certain value of its own. After being used for writing or printing on, perhaps more than once, as for instance, in the case of "bills" for newspapers, which are generally printed on surplus sheets of the newspaper itself, it can be again worked up into fresh paper, and this process can be repeated again and again, so long as any fibrous character remains in the material, though each time the resulting paper is of a more brittle and generally inferior character. In practice of course the old paper is mixed with a certain proportion of new material, which lends tenacity to the manufactured article.

For a long time the market value of the various qualities of old paper remained almost stationary, but now it appears that there is a great falling off in the demand. So considerable is this falling off that printers' and bookbinders' cuttings, which formerly averaged 15s. per cwt., now are only worth from 5s. to 7s.; ordinary quire waste, consisting of clean printed sheets, surplus stock, &c., which formerly could be sold for 13s. per cwt., now only fetches from 5s. to 6s.; while the lowest class of all, what is known as "machine waste," consisting of torn pieces and crumpled sheets considerably discoloured with ink, which was sold in June, 1873, at 5s. per cwt., can now with difficulty be disposed of at 6d. per cwt., and often cannot be got rid of even for nothing. The effect of this is that the waste is now accumulating in London in large quantities, and has in many cases to be destroyed on account of the room it occupies. When heaped up in large quantities there is even considerable danger of fire, as it is, from its oily nature, not at all unlikely to generate sufficient heat to produce combustion. To show that the amount of this material is sufficient to make it worth while to consider whether it cannot be usefully employed, it may be well to state that, according to some statistics obligingly furnished by Messrs. Cassell, Petter and Galpin, this one firm alone makes about 30 tons of machine waste per annum, besides from 18 to 20 tons of brown paper waste, which is equally unsaleable. It is probable that there are not many firms which make so large a quantity as this, but there must be several which do so, while in all printing establishments a quantity proportionate to the work done is produced.

Most of this "machine black waste" consists of paper which has been passed several times through the machine to clean the face of the "forme," before commencing the regular impressions, and has consequently become nearly black with ink. The former market for this was principally America, whither very large quantities used to be shipped, to be employed in the manufacture of paper. The demand in this quarter seems to have ceased almost entirely, as does also that for the English market. It would appear that the reasons for this change of circumstances are two. First, the chemicals used to remove the ink from the paper have risen in cost, so that it no longer pays to work up the old stuff; and secondly, paper is now made of such various materials, and contains so large a proportion of china-clay and other non-fibrous substances, that it will not stand the repeated workings applicable to paper made from rag or similar materials in the first instance. It is consequently only paper of a very inferior description that can be made from such materials by using them a second time. It appears that the effect of these facts has been to induce many paper makers, both in this country and America, to make such changes in their plant as would fit it for treating fresh fibrous materials rather than paper already used, and hence it seems probable that should a fall in the price of chemicals or other circumstances render the old paper again available, it is not likely ever to be as largely used as heretofore.

It is believed that the circumstances of the case are correctly stated above, and unless the data supplied are inaccurate, which can hardly be, it would appear that there is here a condition of things on which the ingenuity of manufacturers might well be expended. There is a large quantity of waste material, formerly readily used, but now no longer available for the same purposes as before. The supply is regular and not subject to variations in amount, and the matter itself is cheap. Attempts have indeed been made to utilise it, but hitherto not with much success. For instance, it has been tried as manure, but, as might be expected, it was quite useless for such a purpose. In small amounts it can still be disposed of for making brown paper, but when the amount is large, it is, as stated above, practicably unsaleable. Whether it could be used in making paper board, or the coarser qualities of papier mâché, and if not, to what other uses it can be applied, are questions which can best be answered by those who have had practical experience in these manufactures. As the matter stands, we have here a waste material which it would appear might easily be turned to some use, and the question is to find a use for it. The problem is but a variation of one that has been answered in different shapes over and over again by the science of our days. It will be strange if no fresh use can be discovered for waste paper even of the sort above described, when so many substances, once the merest refuse and waste, have become the foundations of flourishing industries.

CATTLE TRADE OF MARSEILLES.

A report has been published by the Commission appointed by the municipality of Marseilles to inquire into the causes which have produced the high price of butchers' meat in that city. Marseilles, from its position, is one of the most important cattle markets in France. Previous to 1872 the cattle trade at this place was insignificant, the greater number of towns on the coast of the Mediterranean being supplied from the Alpine districts. The town of Aix was then the most important market, and at Marseilles the sales of cattle were unimportant.

In 1862 the importation of foreign cattle into France having been facilitated by the diminution of the duty, Marseilles, from her favourable situation, has become a market for cattle of first importance.

This great increase will be seen at once, for whilst in 1862 only 63,000 head of cattle were imported, in 1873 their number amounted to 1,054,862 head, of which 221,786 head arrived by land and 833,076 by sea, the greater part being supplied by Sardinia, Italy, Spain, the Danubian provinces, Algeria, Morocco, and other countries bordering on the Mediterranean. Although but little known, Morocco is eminently a cattle-producing country, feeding no less than 40 millions of sheep, 19 millions of goats, 6 million of horned cattle, and 50,000 horses, all of which ultimately are shipped to Marseilles. The market of Marseilles supplies the south and interior of France, as well as Belgium, Switzerland, and Germany.

It has been discovered that the bamboo contains a poison which the natives of Java extract. The cane is cut at each joint, and in the cavity is found a small quantity of black fibrous matter, which is covered with an almost imperceptible coating of tissue which contains the poison. If swallowed the filaments do not pass into the stomach, but remain in the throat, and produce violent inflammation, and ultimately death. Experiments are to be made with various kinds of bamboo, to test the existence and nature of this alleged poison.

THE OVERLAND MAIL TO INDIA *VIA* BRINDISI.

Although much was said and written for many years in favour of the Brindisi route over that *via* Marseilles for the Indian mails, nothing absolutely was done until the breaking out of the Franco-Prussian war, and in consequence of railway communication in France being stopped, our post-office authorities were forced into adopting the Italian route, and sending the mails *via* Germany and over the Bremen pass. Railway communication being re-established in France, and towards the close of 1871 the Mont Cenis tunnel completed, the postal service (for the Indian mail only) was again resumed *via* France, but instead of Marseilles the mails were sent from Calais to Modena, and from thence through the great tunnel of the Alps to Tunis, Bologna, and Brindisi, 55½ hours only being occupied in the journey from London to that port, and the service from London to Alexandria in 137½ hours.

The regular service by this route was commenced in 1872, and has been continued ever since with the greatest punctuality. The importance of the Indian mail service by this route to Italy, may readily be seen by the following table:—

	Weight of Letters.	Weight of Newspapers.	Total weight of mail.	Amount paid to Italian Government for carrying mails.
	grammes.	grammes.	grammes.	Francs.
England	39,700,084	198,100,827	237,800,911	496,051·26
France ..	1,617,320	4,217,208	5,834,528	70,103·78
Holland	1,434,421	11,208,454	12,642,875	15,164·52
Spain ..	300,079	2,185,267	2,485,346	5,503·62
Total	43,051,904	215,711,756	258,763,660	586,823·18
	lbs.	lbs.	lbs.	£ s. d.
	94,514	474,566	569,280	23,472 14 6½

About 50,000 francs are paid Germany, but as the mails come *via* Alba and Verona, and with the other letters, and not in separate bags, no exact returns can be made, but in round numbers it may be estimated that £25,500 is paid by the various European countries to Italy for the carriage of the overland mails.

In 1871 the weight of the mails passing through Italy *via* the Bremen, were only 231,969,908 grammes, or 26,788,752 grammes less than in 1872.

It may be remarked that a large proportion of the dues paid to the Government for carriage of mails are absorbed by the various railway companies, who are obliged to provide special trains, with carriages for the *employés* of the Post-office who accompany the mails, the expenses of loading and unloading.

The mails which arrive at Brindisi by the Peninsular and Oriental Company's steamers have to be sent on at once to Bologna, where the correspondence directed to Great Britain, France, or Spain is sent on *via* the Mont Cenis tunnel, while that for Central Europe are forwarded *via* the Bremen, and it is therefore necessary to divide the mails at this point and forward them by special trains on the line from Bologna to Modena, as well as on that from Bologna to Alba.

In 1872, for this service, the Meridianal Railway Company supplied 53 special trains from Bologna to Brindisi, 47 from Brindisi to Bologna, 4 from Brindisi to Ancona, whilst the Alba-Italia Railway Company provided 88 special trains between Bologna and Turin, 91 between Turin and Modena, 20 between Bologna and Padua, and 8 between Padua and Alba. 430,680·36 francs were paid by Government to the Meridian Railway Company for this service, of which amount half was returned, according to the conv respecting the guarantee. Some difficulty was by the Alba-Italia Company respecting this ded and it was ultimately settled by the Government taking to pay 80,600 francs yearly for the carri the mails. Deducting these amounts from th amount (586,823·18) received, it will be seen clear profit was made by the Government of 3 francs (£15,239 6s. 8d.) The benefits to the c by the transit of the Indian mails *via* Brindisi limited to this amount, immense advantages are d from it indirectly.

THE ITALIAN POST OFFICE.

The statistics of the Italian postal service fo have recently been published by the Minister of Works, and are comprised in a large volume of the following is a *resumé* giving some of the most tant facts.

The total number of letters, newspapers, &c through the post-office during 1872 amount 232,242,677, showing an increase over that of th vious year of 1,966,527. In 1862, the total num letters and packets sent by post was only 111,73 Out of the 232,242,677 packets of corresponden through the post in 1872, 100,357,669 were letters, ing an increase of upwards of a million on those previous year.

The provinces in which the greatest amount of work was done, were—Milan, 9,076,984 ; N 7,391,703 ; Florence, 7,192,564 ; Rome, 7,12 Turin, 6,169,911 ; Genova, 4,934,764, and Alexa 3,067,835.

In the provinces of Leghorn, Novara, Palerm Venice more than two millions of letters, &c., pass through the post-office, whilst Ancona, Bari, Bo Brescia, Caserta, Como, Cuneo, Messina, Padua, Perugia, Udine, and Verona their number ex one million.

Taking into consideration this movement of corr dence with regard to the population, it appears t the province of Leghorn there were 10·41 lette each inhabitant; Rome 9·01 ; Milan 8·97 ; Fl 8·83 ; Venice 7·76 ; Naples 7·25 ; Genoa 6·82 ; 6·36. It should be mentioned that in the provi Leghorn there is no rural population, which ac for the proportion of correspondence per inha being larger than for the other provinces. The vinces in which the smallest amount of correspon took place and where the number of letters, &c not exceed two per inhabitant, were :—Avellino, Belluno, Benevento, Caserta, Catania, Cata Cosenza, Girgenti, Lecce, Modena, Potenza, Regg Calabria, Reggio in Emilia, Salerno, Syracuse Trapani. Only six per cent. of the 100,357,669 l sent were unpaid, whilst two years previously the u represented 66 per cent. of the letters sent. number of registered letters amounted to 3,08 showing an increase of 669,756 over the previous The insured letters (that is to say those of whic value contained is declared), were 219,480, representi amount of money sent through the post of 144,31 francs, being an increase over that sent during the pre year of 29,186,187 francs. The largest declared am that passed through the post-office were, in numbers, Naples 22 millions of francs ; Flo 11 millions ; Milan 13 millions ; Rome 11 mill Genoa 9 millions ; Turin 8 ; and Leghorn 7.

The quantity of newspapers and other printed m sent by post amounted in 1872 to 96,826,506, of v 68,832,684 were newspapers and reviews, and 27,99 not periodicals, showing an increase of more than millions on the previous year. The greatest nu appears to have been at Florence 15,449,784 ; N 14,520,714 ; Rome 14,117,736 ; Turin 11,324,802 ; N

5,601,800. In proportion to the population it appears that Florence has 20.15 per inhabitant; Rome 16.87; Milan 14.38; Turin 11.64; Naples 10.58.

The value of postage stamps sold throughout the kingdom amounted to 16,562,585·62 francs, being an increase on that of 1871 of 1,349,292·71 francs. The stamps put upon letters insufficiently paid by post-office authorities gave a revenue of 1,393,602·20 francs, an income of 300,000 francs over that of the previous year.

The number of post-office orders was 3,127,130, representing a money value of 327,236,301·56 francs, and showing an increase of those of the previous year of 700,000 in number, and of about 40 million of francs in value.

CORRESPONDENCE.

SANITARY EXHIBITS AT THE INTERNATIONAL EXHIBITION.

SIR,—In Mr. Homersham's interesting review of the sanitary exhibits at the International Exhibition, he sums up his remarks on the chemical treatment of sewage, by stating the two important points which are necessary to success.

First—Can delicate fish live in the effluent?

Secondly—Is the process of treatment throughout free from nuisance and injury to health?

As the Native Guano Company's A B C process had not the benefit of Mr. Homersham's criticisms, I take the liberty of asking you to allow your readers to read the following testimonials from independent authorities as to the success of the A B C process on both the points considered of paramount importance by Mr. Homersham.

First, as to fish living in the effluent, I send copies of official declaration of the chairman of the Leeds Streets and Sewerage Committee; and I may state in addition that in the Company's tanks at Paris, fish of many kinds, including hundreds of the delicate gudgeon, lived and thrived.

"I, George Tatham, an alderman of the borough of Leeds, in England, and chairman of the committee of the Council, having charge of the works hereinafter referred to, do hereby certify that the Native Guano Company of London, in England, have superintended the construction of works at Leeds for the Corporation of this borough, such works being for the purpose of carrying out the purification of the Leeds sewage matter by the process patented by the said company, and known as the 'A B C process.'

"The said works are now in operation, and are daily purifying from one and a half to two millions of gallons per day of the sewage of Leeds, the effluent water from which runs from the tanks into the River Aire.

"On the 17th of February, in this present year, a quantity of the effluent water was placed in a vase, and on the same day a fish (a carp) was placed in the water, where it remained alive and well and increased in size, until the 29th of July in this year, on which day it died, thus living and thriving in the effluent water between four and five months, no other water having been used.

"That between these dates the weather was very hot, and the water was changed every six or seven days, the fish being taken from and put into the water by hand.

"On the 17th of February, three fish were also placed in the water supplied by the Corporation for domestic purposes, where they remained until the 25th of July, when one of them died.

"Dated this 17th day of October, 1872.

"(Signed)

"GEORGE TATHAM,

"Chairman of the Streets and Sewerage Committee
" of the Borough of Leeds."

Secondly, as to absence from nuisance, Mr. Keates, chemist of the Metropolitan Board of Works, in his official report states:—

"That during the preparation of the manure, including the storing of the moist cakes of mud from the process, and the final drying in the drying cylinder, no offensive effluvia were emitted; and that, taking the experience of Grossness as a guide, the A B C process may be carried on up to the completion of the manure for the market without producing any nuisance."

And the Chairman of the Leeds Streets and Sewerage Committee, on the 22nd September, 1873, certifies as follows:—

"I, George Tatham, of Leeds, in the County of York, an alderman and chairman of the Streets and Sewerage Committee of the Council of the Borough of Leeds, at the request of the Native Guano Co., hereby certify:—

"1. That the town of Leeds has disinfected a part of the sewage of the town, and are about completing the works to disinfect the whole of the sewage by means of the 'A B C process.'

"2. That the effluent water produced by the process is sufficiently pure to be allowed to flow into the river with the assent of the authorities.

"3. That the whole process, including the preparation of the native guano, is performed without offensive odour or nuisance.

"(Signed) GEORGE TATHAM."

I would also state that this company have already sold over 4,260 tons of their native guano, and have received for it £14,398, and that they have numerous and important testimonials to its value as a manure. The Leeds Corporation made their own trial of it against Peruvian guano and other manures, and the results were satisfactory, as you will see by the accompanying official reports.

I would also claim for the process that it is equally efficient with sewage mixed with the many dye waters of a manufacturing town, as proved at Leeds by months of a clear bright and innocuous effluent.

In conclusion, I am in a position to prove that the sale of the native guano produced will certainly cover the expense of treating.—I am, &c.,

C. RAWSON.
Managing Director of the Native
Guano Company (Limited).

9, Victoria-chambers, Westminster, S.W.

GENERAL NOTES.

Coal in Italy.—A discovery of coal has recently been made at Rocca Sinibaldi (Saline), in the Roman territory, and is said to be of excellent quality. There are numerous deposits of Tertiary coal throughout Italy, and more especially in the Tuscan Maremma, some of which are at present worked on a comparatively extensive scale. There is no doubt that in the hands of English capitalists coal mining might become a most profitable undertaking in Italy, as the consumption of coal in that country is daily increasing.

Technical Instruction.—In a recent letter to *The Times*, a jeweller's assistant refers to the Lord Mayor's speech at the distribution of prizes given by the Turners' Company, and expresses a hope that some great and serious movement may soon be inaugurated for placing before learners of his craft the higher artistic and technical knowledge once recognised as necessary to masters in the art. He further expresses the feeling of himself and his fellow craftsmen that the revenue at the disposal of the Goldsmiths' Company, confessedly available for the purpose, would give them all they want in the shape of schools of design, collections of jewellery, lectures, and other appliances that would ultimately result in freeing them from the harsh criticisms now general in reference to jewellers' work.

Manufacture of Soda.—F. Beilstein states, in the *Chemisches Central-Blatt*, that in Denmark cryolite is worked to a great extent for this purpose; bauxite is preferred in Germany, since America has a monopoly of cryolite. Cryolite contains only 84 to 88 per cent. of pure substance; this yields on heating with chalk 12 to 13 per cent. of alumina and 60 per cent. of soda. At Oeresund, fluor spar is added to the cryolite, whereby the yield of alumina is increased to 18 per cent., and that of soda to 68 or 70 per cent.; very pure alumina is thus obtained containing only 0·01 per cent. of iron.

Channel Passage.—A Dover paper states that a meeting of the council for carrying out the project of Channel communication between England and France was recently held, when it was determined to resume active operations at St. Margaret's in shaft sinking, with a view of excavating the experimental drift preparatory to carrying out the scheme as a whole. The same paper hears of an important movement being made at Calais in the consideration of plans for immediately improving the harbour for continental passenger and goods traffic. It is reported that there is to be a large basin constructed to the eastward of the present Quay de Marie. The passenger station will be moved to the improved Quay de Marie, and the present station of the Northern of France Railway will be used only for goods. A Calais new town station will be constructed some half-way between the present place and St. Pierre. This project, if carried out, will be of great importance and advantage to the port of Dover, as the same, if not greater facilities will be possessed at Dover and Calais than at Folkestone and Boulogne.

Indian Railways.—There are now open in India 5,872 miles of railway, which have cost about £97,000,000, giving an average expenditure of £16,536 a mile. Of this length, 727 miles are laid with a double line, and 5,725 miles on the 5 ft. 6 in. gauge. A further extent of 1,850 miles is now in course of execution, of which 817 miles will be on the 5ft. 6in. and 1,033 on the metre gauge. It has lately been decided that the Indus Valley line shall be constructed on the 5ft. 6in. instead of on the narrow gauge. During last year 312 miles of additional line were opened. The quantity of materials sent out from this country last year amounted to 118,245 tons, exclusive of 10 locomotives and 85,499 tons of fuel. The Government were the chief consignors, having shipped nearly 60,000 tons for the State railways. Since the commencement of railway operations in India about 4,700,000 tons of materials have been despatched to that country, of the value of £31,150,000.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

NOVEMBER 25.—"School Buildings and School Fittings," by T. ROGER SMITH. On this evening Sir CHARLES REED, Chairman of the School Board for London, will preside.

DECEMBER 2.—"The Expediency of Protection for Inventions," by F. J. BRAMWELL, F.R.S.

DECEMBER 9.—"The Protection of Buildings from Lightning," by Dr. R. J. MANN.

DECEMBER 16.—"The Sandblast and its Application to Industrial Purposes," by W. E. NEWTON.

CANTOR LECTURES.

Courses of Cantor Lectures will be gi[ven on] Monday evenings at eight o'clock, as follow[s:]

1ST COURSE.—"Alcohol: Its Action and its U[ses,"] Dr. B. W. RICHARDSON, F.R.S.

2ND COURSE.—"On the Material, Constructio[n] and Principles of Tools used in Handicraft," Rev. ARTHUR RIGG, M.A.

3RD COURSE.—"On some of the Forms of the Steam Engine," by F. J. BRAMWELL, F.R.S., P[ast] of the Institution of Mechanical Engineers.

The following is the syllabus of th[e] course:—

LECTURE I.—MONDAY, DECEMBER 7TH.

The history of Alcohol in relation to its varied to mankind—in the Arts and in Science.

LECTURE II.—MONDAY, DECEMBER 14TH

The Alcohol group of organic bodies.—Re action of different Alcohols.

LECTURE III.—MONDAY, DECEMBER 21ST

The influence of Common or Ethylic Alc animal life.—The primary physiological ac Alcohol.

LECTURE IV.—MONDAY, JANUARY 18TH

The position of Alcohol as a food.—Its effect animal temperature.—Hygienic considerations.

LECTURE V.—MONDAY, JANUARY 25TH.

The secondary action of Alcohol on vital func Physical deteriorations of structure—general and —incident to its excessive use.

LECTURE VI.—MONDAY, FEBRUARY 1ST.

Influence of Alcohol on the nervous organ with special reference to the mental phenomena by its use.—Summary.

JUVENILE LECTURES.

During the Christmas vacation, Lectures delivered, specially suited to a juvenile au Particulars will be duly announced.

Members are privileged to introduce *two* to each of the Ordinary and Sectional Meet the Society, and *one* friend to each Cantor L

SCIENTIFIC MEETINGS FOR THE ENSUING

MON. ...Birkbeck Scientific Society, Southampton-buildin 8 p.m. Mr. Joseph H. Shirley, "Water."
Royal Geographical, 1, Savile-row, W., 8½ p.m. P. Egerton Warburton, "Journey across the Interior of Australia."
Social Science Association, 1, Adam-street, Adelp 8 p.m. Adjourned discussion on Mr. Thoma paper "On the Construction of a Municipalit Metropolis."

TUES....Civil Engineers, 25, Great George-street, West S.W., 8 p.m. Mr. Charles Douglas Fox Francis Fox, "The Pennsylvania Railroa remarks on American Railway Construction a agement."
Anthropological Institute, 4, St. Martin's-plac 1. Professor Busk, "Skulls from Palmyra, wi on the Antiquities." 2. Mr. Wm. Bollaert, Peruvian Antiquities." 3. Mr. H. Howarth, on Anthropology at Stockholm."

WED. ... SOCIETY OF ARTS, John-street, Adelphi, p.m. Mr. T. Roger Smith, "School Buildi School Fittings."
Royal Society of Literature, 4, St. Martin's-plac 8 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,149. VOL. XXIII.

FRIDAY, NOVEMBER 27, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

POLLUTION OF RIVERS.

The Council have determined to hold a Conference on Thursday, December 10th, at 3 p.m., "On the steps to be taken to ensure prompt and efficient measures for preventing the pollution of rivers." The Right Hon. Lyon Playfair, C.B., M.P., F.R.S., LL.D., has consented to preside.

JUVENILE LECTURES.

The Council have arranged with Prof. McLeod, of the India Engineering College, Cooper's-hill, to deliver two lectures (on dates to be hereafter determined) during the Christmas holidays. The subject will be "The Work and Food of the Iron Horse."

COMMITTEE ON CARRIAGE LAMPS.

A meeting of this Committee was held on the 20th inst. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S., Alexander Beattie, Myles Fenton, Seymour Teulon, and J. Tomlinson, with P. Le Neve Foster, Secretary.

INDIAN COMMITTEE.

The Indian Committee held its first meeting for the Session on Monday, the 23rd Nov. Present—Hyde Clarke, Chairman of the Committee (in the chair), Dr. Boycott, Thomas Briggs, Sir George Campbell, K.C.S.I., A. Cassels, Major-General F. Eardley-Wilmot, R.A., F.R.S., W. S. Fitzwilliam, W. Maitland, with Col. Hardy, Secretary to the Committee, and P. Le Neve Foster, M.A., Secretary of the Society. The Committee had under consideration the arrangements for the meetings of the Section, and Sir George Campbell undertook, at the request of the Committee, to deliver an address at the opening meeting on the 22nd of January.

SECOND ORDINARY MEETING.

Wednesday, November 25th, 1874; Sir CHARLES REED, Chairman of the School Board for London, in the chair.

The following candidates were proposed for election as members of the Society:—

Campbell, Charles Halliburton, 10, Eaton-place, S.W.
Gill, Lieut., W. J., R.E., Aldershot.
Grosvenor, Henry, 1, Bridgewater-square, Barbican, E.C.
Huxley, Charles Rodney, M.R.C.S.L., 1, Gloucester-place, Portman-square, W.
Moberly, Charles Henry, 1, Park-crescent, Erith, Kent.
Moser, Richard, C.E., the Lawn, Lower Tulse-hill, S.W.
Pease, H. Fell (Mayor of Darlington), Brinkburn, Darlington.
Wagstaffe, Thomas Rogers, 10, Lancaster-place, Strand, W.C.
Waite, William, Park-road, Halifax.
Wright, Dr. C. R. Alder, Chemical Laboratory, St. Mary's Hospital, Paddington, W.

AND AS HONORARY CORRESPONDING MEMBER.

Lassala y Palomares, His Excellency Don Vicente, G.C.Ch.III., Valencia, Spain.

The Chairman, before calling upon Mr. Smith to read the following paper, desired to express the pleasure with which he had accepted the invitation of the Council to be present on this occasion. The passing of the Elementary Education Act of 1870 had brought the subject of school architecture prominently forward, and great attention had been paid to it, not only by the profession, but also by the public. Excellent examples of such buildings might now be seen in this country, and many no doubt had had the opportunity of seeing what had been done on the Continent in this direction, while some perhaps like himself had enjoyed the privilege of viewing in the United States and Canada, some excellent specimens of first-rate school buildings. As the object of the country was to make education as good as possible, so the great object of school committees and architects had been to make the schools themselves, and their fittings, as perfect as possible, and during the last three or four years, therefore, school architecture and planning had received a great deal of attention. It was one thing to have a pleasant looking handsome elevation and exterior, and quite another to have a building in all respects fitted for the purpose of the work to be carried on within it. School-building was now being developed into a science, and he had no doubt they should hear some useful suggestions from Mr. Roger Smith, who had long paid great attention to the subject. The London School Board, with whom he had the honour of being connected, had already built and opened 71 schools within the metropolitan area, and before it had concluded the first term of its existence it would provide

school accommodation for 134,000 children. Similar Boards in other parts of the country had been building and opening schools at the same rate, in proportion to the population under their charge, and all these bodies, therefore, had great interest and some experience in the matter. The Society of Arts had for more than a century rendered great public services by its spirited action on important occasions, and he could not but feel that the public were still further indebted to it for the opportunity now afforded of considering and discussing a question which, as he had said, was at the present time of paramount importance. He had long had the pleasure of Mr. Smith's acquaintance, and he felt sure that his experience would enable him to offer many valuable suggestions.

The paper read was—

SCHOOL BUILDINGS AND FITTINGS.

By T. Roger Smith.

This very wide subject is one which it is impossible to embrace fully within the narrow limits of a single paper, and it becomes therefore necessary to select a portion of it for consideration. I have judged that the most useful course will be to consider the buildings and fittings of public elementary schools, such as are now required in every part of England, and public middle-class schools, the call for which is beginning and only beginning to make itself felt; and I shall not attempt to pursue the many ramifications into which the subject might extend. Did time permit we might consider on the one hand, private and boarding schools, science schools, colleges, and the buildings required for the higher education; or on the other hand reformatories, refuges, parochial schools, and schools for the blind or the deaf and dumb; but it is the less to be regretted that these must be left out, since much of what is useful in arranging elementary and middle public schools will be equally useful in other cases.

If we commence where elementary education itself begins, namely, with the infant school, we shall find the circumstances for which the architect has to make provision to be very much as follows.

A considerable number of little children, many of them quite unused to any discipline and all restless and childish, are to be trained, reduced to order, instructed, and prepared for entering a higher school; and for this arduous work the services of one or two teachers, and one or two young assistants are obtainable.

Little personal attention can be given during school hours to an individual child, for if the teacher's eye is taken away from the group, discipline relaxes; but as a compensation for this, the influence which the teacher can exert over the children in a mass is extraordinary, and produces the most salutary effect upon each component of that mass. It is accordingly necessary, as much as possible, to keep the children grouped under the teacher's eye. In addition to a provision for this purpose, space in which exercises more resembling drill than anything else can be carried on is essential; for the restlessness natural to a very youn cannot be long controlled, and frequent ch occupation and position is necessary, and sh so provided and regulated as to form part training.

We must, in order to meet these r ments, provide a large room, with pl unoccupied space in which our infants can about, and we must provide a sloping group on which they can sit clustered togeth directly under the eye of their teacher. particularly essential that the room sho sweet, sunshiny and cheerful, and to obtai ends we should give it a considerable introduce ample windows, obtain a sunny for it, and give it a little simple decoration. it is desirable that when the children look teacher and she at them, her face and the should be well and naturally lighted, with to dazzle either. To accomplish this w provide if possible a skylight over the seats, or as they are usually, but so unsuitably called, the "gallery." The prog upon which a good infants' school-room built, and one which is not now often depart widely, is therefore ample clear space—rais lighted gallery—and plenty of light, vent and sunshine.

Among the infants there will be considerabl tions, some of the youngest who will be h are too childish for it to be possible fo to be interested in the lessons which the ge can follow, and these, if not weeded ou destroy discipline; others, among the eld have acquired, before passing into the schools, some power of application and som ledge of writing and even ciphering. T little ones are best drafted off into a room b selves, where they can be kept amused; th is called the babies' room. For the m vanced, desks and benches must be provi the school-room at which they can writ sometimes a smaller separate gallery in whi can have a collective lesson; but where the is at all large there will be enough children a ing to this description to render desirable t vision of a second class-room for them, in they can be partly removed from the noi movement of the general room.

Here we find added to the school-ro class-room, a significant feature not formi of the earliest infant schools any more t earliest schools for older children, but a on account of its great utility, if not ne And the further we go the more importan we learn to attach to the provision of s rooms for separate classes.

It is always desirable for infant schools t the ground floor, as the steps up to a schoo on an upper floor, which are no very evil in the case of more advanced childre dangerous and difficult for infants. A w 24 to 25 feet is desirable for the general room, and the education department requi area of school and class-rooms together to 8 feet of floor for each infant. It is not con that more than 250 infants can be as managed with success under one head teac ordinary capacity, and if the requirements district call for a larger amount of accomm

it will be better to build two infant schools. It is also considered that 70 is as a large a number as one teacher can usefully instruct at one time, and therefore the largest gallery in an infant school had better not seat more children. In very large infant schools two such galleries may be placed side by side, with a sliding partition to separate them.

The fittings of an infant school are simple, and must be adapted to the size of the children. The gallery, the one fitting peculiar to infant schools, is a platform broken into broad steps of no great height. In some schools the infants sit on these steps, but it is far better to provide little seats, furnished with backs, the seat-boards fixed a trifle above the step. The children sitting behind are not so liable to kick or disturb those in front where there are seats, as where there are not. Gangways of shallow steps are formed at each side, and the sides are enclosed. It is not well for infants to sit more than six deep on a gallery, and generally five deep is enough. It is advantageous to be able to place the gallery partly in a recess, so as to leave the school-room floor less interfered with, and also so as to obtain a sky-light. Such benches and desks as are used in the room may correspond (except in height) with those required for higher grades, but I think desks with flaps ought not to be used. Most infant-teachers prefer desks with a flat top, as kinder-garten toys can be placed on them without their rolling off, and I have seen them used with a slate top. Simple stands or easels for diagrams, and some other matters of this sort, are required also, but these are perhaps more furniture than fittings.

The playground, never unimportant, is, in the case of the infants' department, almost more a part of the school than a place where the children are to be left to do just what they like, and it requires constant superintendence and careful preparation for its purposes. A good covered playground is almost essential for infant children; and it is very customary, and I believe very advantageous, for the playground to have a few simple pieces of gymnastic apparatus, such as parallel bars, &c. It is, I believe, not found advisable in practice to make the girls and the infants share the same playground; even a small space entirely their own, and under the eye of their own mistress, will be more advantageous to infants than a share in a large playground, where the elder children will find them in the way, and treat them accordingly.

When public attention was first turned to the education of the multitude in this country, the sort of training in the mass which I have sketched out as suitable for infant children was applied to those of more advanced years. This was the famous system of Bell and Lancaster. It was in 1798, two years before the present century began, that Lancaster opened his first school, and the type of building which his method required was as widely different from that which we have arrived at after three-quarters of a century of modifications, as can well be conceived, so that those who, like myself, consider that a perfect model has not yet been attained, may very well hope to see further modification take place.

I well recollect, when exceedingly young, being occasionally taken to see the Lancasterian schools of the large north-country town where I was born, carried on in buildings erected for the purpose, which may be taken as a fair sample of the Lancasterian school-house. The school-room was nearly square, lofty, and I think airy and fairly lighted, but most forbidding and grim in aspect. The scholars, who were partly looked after by selected scholars called monitors, sat so as to form a compact square phalanx under the head teacher's eye, and very large numbers were taught in one school under such a system; indeed Lancaster is reported to have said that he should not shrink from conducting a school of 1,000 scholars in one room. The instruction given by the chief teacher under such a system as this must necessarily have been simultaneous, and no large amount of attention can possibly have been given to individual pupils, indeed I doubt whether the head master had any easier mode of access to the boys in the middle of the block than by walking over the desks till he came to them. At any rate I recollect to have seen this done.

From this original starting-point a series of modifications has been introduced into the methods of teaching, all tending to secure more separation of classes, and more possibility of aiding individual scholars in their work. In 1834 grants of public money began to be made towards school-houses, and in 1839 the Committee of Council began to administer these grants. In 1840 instructions and plans of schools were first published by the Committee as a guide to those proposing to build; and the type of building which they embody, and which has been repeated hundreds and thousands of times since, is adapted to a system far removed from that of Lancaster.

The pupil-teacher had now taken the place of Lancaster's monitors. A pupil-teacher is a promising scholar apprenticed to learn the business of teaching, available as an auxiliary teacher, and earning a small payment. Assistant teachers were also introduced; these are, of course, more experienced than the pupil-teachers, and more highly paid.

Teachers were now sufficiently numerous in proportion to the number of children to render it possible to break up the school into distinct classes, each one under an assistant teacher or pupil-teacher. It was desirable to separate the classes one from another, and yet not to remove them from under the teacher's eye, so that if the pupil-teacher got into difficulties the head teacher might perceive it quickly and come to his help. When this system was first worked out in British schools, these classes were planted about in different parts of a large room, an arrangement to this day adhered to in many places, and, to be found in nearly all Sunday schools, and if I mistake not in some of the elementary schools of Scotland and of Yorkshire.

But the isolation to be obtained in this way is very incomplete; there is no mitigation of the noise of teaching, and no means exist of preventing the children's attention from being constantly diverted from their work by what takes place in any other part of the room.

The Committee of Council introduced an arrangement which very much diminished these evils. They recommended that classes should be arranged along one side of the room only, and fixed—partly, I believe, from motives not directly connected with

school discipline—16 feet as a minimum and 20 feet as a maximum width for the school-rooms, and they prescribed that the children should, when in class, sit no more then three deep.

This, of course, led to very long narrow rooms, which were often shaped like an L or a T on plan. Curtains were generally provided for the spaces separating the classes, but from the angle of the L or T the head teacher could pretty well see all the classes. Of the width of these narrow rooms less than half is ordinarily occupied by the three benches and their desks, so that there is ample space for the teacher to draw out a class from their seats and make them stand round him. Such school-rooms generally have windows on both sides, admitting good ventilation but often giving cross lights; they are carefully arranged so that no fire-place or door shall interfere with the unbroken continuity of the wall against which the classes are planted. One or two class-rooms were thought ample for a large school of this sort; and the whole arrangement, with which probably every one in this room is personally familiar, though open of course to objections, has many points of practical excellence to recommend it. It is appropriate to the system of teaching; it admits, generally speaking, of being economically carried out, and yet it may be made picturesque; but its chief merit was that it was the plan, and I believe it is correct to add, the only plan towards carrying out which the Committee of Council would sanction money payments so long as these payments were under its control.

The passing of the Elementary Education Act has opened the door for fresh modifications to be introduced, and it might perhaps be interesting to enquire in how many different directions modifications have been attempted by different School Boards throughout the country.

It will however, I think, be more useful to describe what has come under my own immediate notice in the plans introduced by the School Board for London, which are the results of thoughtful and practical consideration of the problem by many persons of varied and great experience. These plans in several essential particulars depart from the original programme of the Committee of Council, and the changes introduced into them constitute an immense step in advance.

In crowded neighbourhoods where land is very dear, accommodation for large numbers had to be provided, and it consequently seemed essential to have high buildings. Schools of two and three stories, with in some cases covered play grounds, were accordingly decided upon.

The stereotyped arrangement of desks three deep had not been strictly adhered to by all teachers. Many found it quite practicable to teach children four deep and even five deep without disadvantage. It was accordingly decided from the first to abandon it, to build wider school-rooms, usually 22 feet wide, and to arrange the children in deeper rows. After a time the whole question of placing the children was revised, and fittings, by which their desks and seats are arranged in pairs, so that every boy or girl can be readily reached by the teacher, were adopted. To these we shall return later on.

More radical, however, were the changes desired to be brought about in the accommodation of the classes, and in the lighting of the children's seats.

In most of the Board-schools half the of children are taught in the school-ro half in class-rooms. The Revised Code for six grades of proficiency in the child this has led to the idea that six classes sho rule be provided for in planning a In practice, there are more children lower grades than of the higher in school, but those in the higher grad larger children, and require more space, so common custom has been to provide in a ment (that is to say in a boys' or girls three class-rooms and a school-room ca seating three other classes. In many ca classes are placed side by side in what is double class-room, which can be divid two by closing a moveable partition. means follows that these arrangements form. Sometimes there are four class sometimes the class-rooms are built fo larger classes than those in the school-r sometimes the opposite is the case, but the tion has been generally pretty well The class-rooms at first were required all direct out of the school-room. It is n sidered desirable—which it was not at have the power of assembling or dismissin working in a class-room without its being to pass the children through the school-roo class-rooms are generally 20 feet from back; this gives, if 10 feet of floor is for each child, 20 feet as the width of a cl for 40, and a room 20 feet by 20 can conveniently seated for 40 with dual desk is I think the minimum area per child in room or class-room.

The class-rooms are ordinarily provi windows on at least two sides, and the room with windows back and front, an possible, at the ends. These afford goo of getting through ventilation, and a fair of left-hand lighting, in fact two of t classes in class-rooms, and one class of in the school-room, can obtain a good l light.

The reason why lighting from the left will be obvious when you reflect that in wr cyphering this is the only side light wh vents the shadow of the hand from in with the work. The advantage of side l light from behind the children is that th is not dazzled, the children's faces are to the teacher, and the children do not si own light. The advantage side light over light from behind the teacher is that dren are not dazzled, and that their te his diagrams are easily seen.

The rule of lighting from the left c completely carried out, except when the is in class-rooms, for if in a school-roo several classes are taught, you attempte the children with their seats at right ang wall, you would be landed in a series veniences so grave that they could not be Nor can the rule of lighting only from be easily reconciled to that passion for ventilation by means of a direct current from window to window which has so hold upon those experienced in school ma as well as hospital management in Engl

cordingly, the practice with regard to school-rooms has been at the best a compromise. As much side light as is obtainable has been in some of the recent London schools procured from the ends of the general school-room, but for the majority of the classes there taught windows both back and front are commonly supplied.

In Prussia, where school management has been deeply studied and carefully thought out, it has long been a cardinal rule that every class occupies a separate class-room, and that every scholar in the class shall receive the light from his left hand. What has been done in the London schools is an approach towards applying these two rules, but falls short of perfect conformity to them.

It is not, perhaps, easy, so long as the pupil-teacher system prevails, to conduct the whole teaching in class-rooms, but if the conditions are manifestly better than those obtainable in a school as at present conducted, it seems clear that a strenuous effort ought to be made to secure the advantage of the class-room system; and if it and the pupil-teacher system seem to clash, such modifications should be made in the latter as will suffice to reconcile the two. The difficulty arises from the fact that a teacher, shut up in a room with forty, fifty, or sixty children to manage, requires to be a person of much more experience and judgment than an ordinary apprentice, and that therefore a school made up of class-rooms seems to call for a series of highly-paid assistant teachers. I venture, however, to think that by working the class-rooms in pairs, two together, a close approach to the perfect class-room system may be made without giving up pupil-teachers, and without that revolution in our mode of training instructors for elementary schools, and that considerable increase in the cost of conducting such schools which has been pleaded by those who advocate retaining the present compromise in place of adopting the class-room system in its entirety.

For instance, the Code contemplates a certificated teacher and a pupil-teacher for sixty children, and the addition of another pupil-teacher for an additional forty children, that is to say, one certificated teacher and two pupil-teachers for 100 children. If these were divided into two classes of 50 each, taught in adjoining rooms with a door of communication, it would probably be quite easy for a certificated teacher, spending part of his time with one class and part of his time with the other, and keeping a pupil-teacher in each room, to keep the two class-rooms going throughout the day with success and without exceeding the amount of teaching power contemplated by the Revised Code.

I have, however, now to return to the London Board-schools as they are, and resume the description of some of the details which have not yet been touched upon.

I have just referred to sliding partitions as employed to divide a class-room into two smaller ones with the power of throwing the two together. There can be no doubt that this power is a valuable one, and that it is perhaps desirable to put up with some drawbacks of another sort for the sake of securing this advantage, but it is fair to point out that drawbacks exist. There is less perfect separation of the rooms by means of a sliding partition than when they have a wall between them. No sliding partition is entirely free from danger to the children, and of course the opening and shutting it is, as far as it goes, a disturbance of tranquillity.

The older sliding partitions were constructed to rise and fall in grooves like a sash-window—the modern ones are usually made to roll horizontally, being hung from a rail above, and also allowed to rest on the floor below. Though sometimes a roller-blind has been suggested for the purpose, it cannot prove efficiently sound-proof. I have employed Mr. Stones' partition, which contains felt enclosed between two thicknesses of boarding, and found it fairly sound-proof, but I do not believe it to be possible thoroughly to isolate a class-room by means of any sliding partition, and, like all compromises, imperfection attends their adoption. The Americans, whose schools are not yet well-known in this country, have, it is understood, employed sliding partitions to a very large extent in many of their public elementary schools.

I have been speaking of what is usually called a department, that is to say the boys' portion or the girls' portion of the whole school. The London Board-schools have not been mixed schools except in the case of infants' schools, and each department, for boys or girls, has had a floor to itself. Consequently there are at least two floors, one above the other, in every "graded" school; indeed, the buildings are commonly three stories high, and therefore, the necessity for staircases has arisen.

The staircase most suited for children's use is one where the open space with which we are familiar by the name of well-hole is replaced by a brick-wall. The steps ought not to be too long, as it is rather desirable not to induce children to go up or down more than two abreast. I believe a length of 4 ft. 6 in. to be ample, and 4 ft. or even 3 ft. 6 in. enough. The steps should not be high, not more than 6 in. rise. There ought not to be any "winders" (the name by which the steps triangular in plan which wind round at the turn of most staircases are called), and in their place there should be landings; lastly, the flights of steps should be short, and the whole ought to receive plenty of light and air. These precautions are taken to reduce to a minimum all chance of serious accident, and to promote the comfort of the children. In a school of any size it is not only desirable to have two staircases, one for boys and one for girls, but it is an excellent plan to arrange the steps so that two sets of stairs may occupy the space of each staircase, an arrangement which it is not often difficult to carry out. When this is done each class-room may open into the landing of a staircase if wished.

The tall buildings which require such staircases are no doubt proper in a large city, where land is very dear, where daylight is apt to be much interrupted near the ground, and where a rather purer stratum of air is to be met with in the upper stories of the building than is to be found below; but where there is sufficient space, free air, and ample light, one-story'd buildings are best. The covered playground, formed under a lofty building by carrying it on piers and arches, is often less desirable and comfortable than a shed built for the purpose. It

is more apt to be draughty, gloomy, and damp, and when it is adopted it should be carefully arranged, so that the sun may shine well into it for some considerable part of the day.

How to warm, light, and ventilate a large school house is, perhaps, the next question which presents itself. The lighting, as has been already observed, should be as far as possible from the left hand, and the windows should be ample. An area of 1 foot of window surface to 80 cubic feet of interior space in the room ought to be sufficient, if the windows are well placed. For infant schools a top light, and for drawing classes a north light high up are required. The best aspect for a school is a subject that has been debated, some advocating a north aspect as securing the steadiest, purest light, and being free from the inconvenience of glare, others preferring a south aspect, notwithstanding the fact that occasionally during the summer blinds are needed, and inconvenience is felt from the sun's direct rays.

I believe there can be little question that the last is the soundest opinion, that sunshiny rooms are far more healthy and far more pleasant than those which the sun never reaches, and that, in a climate so cheerless as ours, this consideration ought to prevail over every other. The question of gas-lighting requires perhaps more attention than it often receives; good burners, plain strong fittings, and a place for the lights which will bring them tolerably near the children, and at the right positions for giving left-hand light, are the chief requisites.

The question of heating is, to a certain extent, mixed up with artificial ventilation, and both ought to be looked at together. During the summer months the windows afford what is now often called natural ventilation, and an unsparing-ing use of this suffices if the windows reach to the ceiling, and are capable of being freely opened without draughts, to keep the school and class-rooms fresh and sweet. The best form of window for this purpose I take to be that often known as a hospital-window, fitted with a series of casements, each of which is hinged at the bottom and opens by its top falling back inwards towards the room. The external air is freely admitted by these windows, but its current is directed upwards towards the ceiling, and a very ample volume of air will enter without perceptible draught. It is quite possible to open and close casements so arranged by an apparatus which is simple and effectual, and which I have had made by Mr. Gibbons, of Wolverhampton, and have applied to two London Board-schools. This I name, because in some hospitals a very costly method of doing the same thing may be seen at work, and committees have, I believe, been deterred from using this, the best form of school window, by the fear of being obliged to go to great expense in providing gearing by means of which to work the casements.

For many months in the year in England, however, it is not comfortable, or indeed safe, to carry on a school with open windows; and during a part, perhaps we may safely say nearly the whole of the same period, heating by some artificial means is necessary. This circumstance offers an inducement to make the motive power furnished by the heating arrangements, as far as we can, ventilation also.

In small schools, and in places where f cheap, the open fire, which every one can u stand, is on the whole the best means of war as it combines a powerful ventilating agency chimney, with direct radiated heat.

It is very desirable, however, to combi inlet for fresh, warm air with the open fire grate. Many contrivances for doing this use, and it is only necessary here to say tha almost all proceed on the principle of utilisi otherwise waste heat radiated from the bac sides of an ordinary grate to warm a volu fresh air which is poured into the room. (and flues (adjoining the chimney smoke flue sible) should also be provided in order to ca readily a portion of the vitiated air, and these inlets and outlets are at all well propor to the size of the school or class-room to they are connected, and are disposed with ment, they will supply a very considerabl useful amount of constant, insensible venti

In large schools it must be held to be the economical and more scientific course to heating apparatus for the whole building. cheapest apparatus, both as to original and probably also as to the amount of he tained from a definite consumption of fuel, hot-water pipes carried into the school-room class-rooms, and exposed in the rooms. A amount of heat is directly radiated from heated iron surface, and a large amount i distributed by the circulation of the air of the which becomes warmed by contact with the rises and is replaced by another portion of co But this circulation in no way assists ventil the pipes themselves are an obstacle, someti dangerous one, to free circulation, and the ra heat is often extreme; while if the system i as to permit the surface of the pipes to be l above a very moderate temperature (and this case in all systems which I have had an tunity of examining where the pipes are of bore, and the circulation is at high pressur air becomes desiccated (and I believe ozonized), and general discomfort ensues, s militate seriously against the efficiency of the school.

My belief is, that a system in which the external air is heated within a chamber in the ment by contact, not with a furnace, but mass of low-pressure cast-iron hot-water or flanged vessels, and is then conveyed th flues or channels to each room of the buildi the best system of warming for a large s corresponding flues or other suitable being provided for the outgoing current, for of course, provision must be made in the or construction of the building. It is not chea if efficiently done, as it has been fo by Messrs. Price in one instance, and Mr. in another, it provides at one and the same warmth and fresh air.

Such buildings as I have now described a appropriate and convenient home for a sch which the three departments of infants, girl boys are distinct, in which, in either boys' or school, there are a head teacher, a certain n of certificated under-teachers, and a certain

ber of pupil-teachers. This, as I have already mentioned, is not the system in the most advanced schools on the continent of Europe. In Switzerland, Austria, and notably in Prussia, schools are arranged so that every class shall have its own class-room. The building contains class-rooms seating ordinarily about sixty each, connected together by suitable corridors and means of approach, and a large assembling-room called the aula or hall, not usually large enough to receive all the pupils at one time, and not used as a school-room, in the sense in which we employ the term, at all. The whole forms a very compact square block of buildings, admirable as a rule in every particular except its ventilation, which is generally defective.

It was desired, when the School Board for London commenced work, to try the experiment of building a school on this plan, and it eventually fell to my lot to design and carry out for the Board the school which they built on the class-room system, or as it is often called, the Prussian system, at Jonson-street, Stepney. This school, originally designed for 1,000 children, was subsequently re-planned on a still larger scale, and as built affords accommodation for 1,675 children, of whom 575 are infants. With regard to the infants' school, which occupies the lowest floor, no special remark is necessary except that it is divided into two equal and similar schools.

On the first and second floors occur the departments for boys and girls respectively. Each school possesses eight class-rooms, intended for sixty children each, and these rooms are grouped round a large hall, measuring 40 feet by 75, of which they occupy one side and the two ends. In this hall is an end gallery, and it is intended that both in the hall and on the gallery a class should be taught. The original cost of this building was extremely moderate, comparing it with the cost of many Board schools in London and elsewhere, not exceeding £7 12s. per child, and though it would not have been quite so economical if built for a much smaller number of children, still a school of the same general plan need never be a costly building.

This building varies to a certain extent from the Prussian model. The variations were partly due to the determination to obtain a very large hall, in which all the boys and girls could be assembled at one time, and partly to my desire to secure through ventilation. The ordinary Prussian school is a very solid compact block, and often has a central corridor, and so there is really no chance of ventilating the class-rooms completely. At Jonson-street I suppressed the corridor, making the class-rooms open directly into the hall, and I introduced windows at the sides of all such class-rooms as are corner rooms in the building. Elsewhere I introduced large windows in the wall, separating the class-room from the hall, treated the latter as a magazine of fresh air, and by this means secured the through ventilation of every class-room. In winter the warming by warm fresh air, accompanied by a system for the extraction of vitiated air, keeps the class-room sweet and airy.

I regret extremely that a second school of the same general character, but smaller in size, which I had been intended to erect, from Mr. Robson's designs, was abandoned. It would have been an interesting experiment and extremely likely to prove successful. The plans of this school, as well as those of my Jonson-street one, are engraved in Mr. Robson's excellent book on "School Architecture."

This class of school, though the time has not yet fully come for it to be built in this country, is the elementary school of the future. It or something very like it is the middle-class school of the present day, or to speak more corectly, the leading principle of it, *a class-room for every class, and a general room for assembly*, is the leading principle upon which middle-class schools are being designed, built, and conducted. I may refer to the Cowper-street Middle-class School, the magnificent new Merchant Taylors' School, and the schools proposed to be built by the Grocers' Company as examples of the class-room system. As time goes on there can be little doubt that elementary schools will conform to this model. Already, taking one of Lancaster's schools of seventy years ago as at one extreme of the scale, and a complete Prussian school as at the other, the planning of English school buildings has advanced at least half-way. By slow degrees a greater and greater amount of isolation for the classes has been introduced.

First, came the breaking up of Lancaster's Macedonian phalanx into classes, and grouping them about a large room in full view of each other; next the placing those classes all on one side of the school-room, with curtains separating them; then came a single class-room; then two or three each to open solely out of the school-room; and now one half the school receives class-room accommodation, and the class-rooms are made so far independent of the school-room that the pupils taught in them have distinct means of entrance and exit.

These steps are all in one direction, and though at the present moment members of school boards may be unable to see their way further, there can be no manner of doubt that when next a change is made it will be made in the direction of more class-rooms; it seems thererefore matter for some regret that among the very many elementary schools now being erected in Great Britain so few should be adapted to the most advanced mode of education practised in Europe.

Of the fittings required by a school, the benches and desks are by far the most important, not only because they are wanted in large numbers, but because they directly influence the success or failure of instruction and discipline, and their size and arrangement dictate the dimensions and shape of the school-rooms and class-rooms. The desk is required to accommodate the book for reading, the slate for cyphering, the copy-book for writing, and perhaps the music-book for singing, and it must provide storage for books not in use; its height, slope, shape, and distance from the bench must be regulated accordingly. I will dismiss at once those hybrid contrivances in which the unfortunate desk is also required to form part of a tea-table, or to disappear altogether and become the back of a church bench, believing that every such complication adds to the difficulty of making it efficiently perform its legitimate functions. The bench ought to be exactly at the right height for the pupil, both as regards its height from the floor, its height below the desk, and its

distance from the front of the desk, and it ought to be of the right shape for easy sitting. The length of the desk and bench, and the spacing generally, are to be regulated by the desirability of gaining easy access to each child's work.

In many old schools these conditions are barbarously violated, and you have only to watch the distorted attitudes of the pupils at work to be convinced that they are getting no good from sitting in narrow benches too far from the desks, without backs, and with the desks too far off and probably too high. Mr. Liebreich, whose pamphlet on the subject of school fittings attracted a good deal of attention, demonstrated the necessity of closely studying the requirements of the pupil; and both before him and after him, many persons of experience have devoted themselves to the same subject. The old desks sanctioned by the Committee of Council were in long lengths, and confusion necessarily arose when a child near the centre had to enter or leave; they were also not well adapted to facilitate the necessary access which the teacher ought to have to every scholar, and they were in other respects imperfect.

Many improvements have been lately brought forward. The one adopted in London by the London School Board, is what is known as a dual desk, that is to say it is a desk and bench only long enough for two children; the desks are forty inches long, are placed five deep, and between every two sets of desks a gangway is left, of sixteen inches wide, which gives access both for teachers and children. The seat inclines very slightly, and has a back rail at a moderate height, rather higher for girls than for boys, and a foot-board. An essential feature, and one which has been attacked by some school managers and by many school-fitting manufacturers, as open to objections, is a rising flap to the desk. When this flap is down, the sloping part of the desk is a foot-board, and its front edge is exactly over the front edge of the seat-board, a position very convenient for writing, but not allowing the pupil to stand up in his place. The front five inches is hinged, and when turned up leaves ample space for the pupil to stand and also itself forms a good desk for music. This contrivance permits great economy of space, and when the children are drilled in the use of it, seems to give satisfaction, but it has been objected to that it is a complication, and therefore liable to break, that it is possible for children to injure themselves in it, and that, if one pupil happens to raise the flap before the other is ready, books, &c., may be thrown down. This is exactly one of the questions which experience will decide, and, as there is now a very large amount of experience accumulated, the point ought to be capable of a solution in this room to-night. Below the desk is a book-shelf, and there is in the back of the desk an ink-well and an opening for a slate for each pupil. The standards are of iron. This fitting is extremely complete, and on a level with anything in use elsewhere, except perhaps in the best German schools; it is also expensive, as might be expected, from its elaboration. In Sweden and in America each child has a separate desk and seat, and in Sweden the difficulty about obtaining standing space with a seat and desk in proper relative positions for writing is met by making a flap-seat in place of a flap-desk.

When economy is of importance it woul worth while to try whether the principal feat of these desks and benches could not be reta without iron standards. Stout wood is durable and very strong, and plain fittings ent of wood could, I think, be designed and structed at somewhat less cost than the mixtu materials now in fashion necessitates. At le know that some years ago, when iron was che than it now is, I personally tried the experin and with success.

The other fittings of a school, while of co they require care, are not of the same vital portance as the benches and desks, and need n think, be dwelt upon here. Nor shall I att to do more than name, and that in the most cur way, some of the miscellaneous matters of w the school architect ought not to lose sight. indispensable to a well-ordered school for i have ample water supply and efficient drain proper lavatories; sufficient cloak-rooms cap-rooms; adequate conveniences in a deta building, approached under cover, and of si construction; a covered playground to department; a supply of pure drinking water the children; a class-room so lighted as to s drawing-class; in some girls' schools a class-r of large size as a needle-work room; one or teachers' rooms; accommodation for a resi care-taker, or sometimes a teacher's reside storage for fuel (and sometimes a commit room), ought all to be provided in every com school. There should if possible be no corri and where they occur they must be roomy, di and well lighted. A playground of due size is necessary for each department, and there shoul provision for lighting it on dark evenings if t be gas in the buildings. If possible the entranc boys should be in a different street from that girls and infants; at any rate it should be dist

Nothing which can get out of order sh be introduced if it can possibly be avoi Everything should be of the best and strong for it will have to stand rough usage. Noth through which an accident can occur should introduced; and if it is found that by mischi any place where a child can fall through, or over, or any dangerous spikes or open w cisterns are within reach of an adventurous they should be at once removed at any cost completely protected. Nothing by which a c can be hurt should be knowingly permitted, discovered allowed to remain; no dark corners places where fresh air cannot come should on account be tolerated; and no pains should spared to make the smallest details of the build and of its furniture as appropriate as possibl the purposes of the school—and here let me the managers, the teachers, and the archi should work together. Many minor matters best understood by those who have the pract working of a school, and if it were possible, as a school-house approaches completion, to secure principal teachers, and to give such finish touches to the arrangements as would suit th methods of working, there can be no doubt t after-expense would often be saved, and increa satisfaction would be felt by the manag Lastly, but by no means least, all these matt should be thought out in good time, and at su

and leisure, so that they may be introduced into the original contract for the building, and the very additional cost which always attend modifications made during progress may be avoided.

In bringing these remarks to a close it is, I feel, necessary to apologise for the amount of dry detail introduced. Every practical undertaking, like the planning, carrying out, and fitting up of a building, depends for fully half of its success upon an incessant attention to minute detail. It is quite true that the general plan, the design grasped as a whole, and the skill with which the leading divisions of the building are adapted to their purpose, are of great importance. But it is equally true that the best design in the world, if carried out without painful attention to details, will be found full of small defects when tried by working experience; and consequently, that even in attempting to give a comprehensive and general view of such a subject as a building and its fittings, I have been unable to avoid much detail, for in no other way could I have rendered even the slight sketch of school buildings and fittings which I have attempted to lay before you trustworthy so far as it went.

It has been my especial desire to embrace this opportunity of advocating before an audience capable of forming a judgment upon them the claims of the class-room system. So many classes, so many rooms, is the rule in many schools in Scotland, and Scotland is ahead of England as to education. The same thing is the universal rule in Prussia, and Prussia also is ahead of England. It cannot be denied that absent from the noise and the distractions of a large common school-room the class can better concentrate its attention upon its work, and its teacher can better give his energies to what he has to do. It seems certain that the same teacher would do better work in a class-room than in a general school-room, not only from the fact of being undisturbed, but also from being more thrown upon his own responsibility. He has, in the general room, the head-master to fall back upon in any difficulty, but while shut up with his class in their own room, he has far more need of self reliance and firmness, and will certainly be a better man. The system seems undoubtedly destined to reach elementary schools in time; but if it really be the best system, it appears a matter for regret that at the present moment, when schools are being established by hundreds, and millions are being laid out upon costly and permanent buildings, we should rest content with a compromise, and should not some of us at least boldly decide to adopt the very best method that we can in our school management, and should not construct our buildings in such a manner as to be capable of being worked on that method.

DISCUSSION.

Sir John Bennett said he wished all the members of the School Board had been present to hear so admirable and practical a paper, which showed that some substantial progress was being made towards a real school system. They knew very well the difficulties with which School Boards had to contend, for even some of their members were not so anxious as they might be that a really sound system should be adopted, and some were reluctant to give full play to such a system as they hoped would soon be established throughout England. It was easy to frighten the ratepayers and public on the ground of expense, but they were beginning to understand that the most costly luxury in which any community could indulge was the ignorance of its people, and the great bugbear of expense would, he believed, soon be lost sight of. He believed also that the boldest plan would be found eventually the cheapest and wisest, and if it were bravely carried out, parents would soon learn the value of a good school system to their children. No more magisterial compulsion would then be necessary, but parents being educated to see what was for the benefit of their children, they would be willing to make sacrifices which at present they were reluctant to submit to. Such schools as those of Prussia would not then be considered too large or expensive, nor would there be seen two children at one desk from motives of economy. In America there was always a separate desk to each child, and even the poor Irishman who went there with a large family of children, none of whom could boast of any covering for either head or foot beyond that which nature provided, found that each one was entitled, as of right, to a separate seat in the finest building in the town. And, wherever it was possible, the finest site in the town was selected for the school; for they would have air and light, and, if possible, a pleasing outlook for such buildings. Some fifteen years ago, when he was in the habit of going every year to Switzerland, he found in a village in Neufchatel, that notwithstanding they had infants, primary, secondary, and normal schools, they were still dissatisfied with their educational arrangements, and wishing to perfect the education of the boys in order to get superior workmen, and thus turn out first-class work, they determined to expend no less than £20,000 in erecting new and commodious school premises. Government gave £12,000, £4,000 was raised by subscription, and the remainder was obtained by a loan on the security of the rates. If such things could be effected by a comparatively poor population, what ought to be done in London, which might be said almost to be suffocating in its own wealth? In these schools most of the teaching was for the most part oral, few books being used, but the teachers entering with great heartiness into their duties, and the labour being thoroughly subdivided.

Mr. Robins thought the class-room, or Prussian system, would be gradually introduced, and if followed as described by Professor Newman at Lucerne, might be found economical. There each teacher took a particular subject, and went from one class to another, instead of one teacher being confined to one class and teaching all subjects. In a large school, say of 1,000 children, this plan would not require probably so many teachers as the other, and first rate teachers might be secured. The system adopted by Miss Buss in the North London Collegiate Schools was different, the elder children being divided into classes of about thirty and the younger into classes of fifty each; and one teacher, with an assistant, having the sole charge of each, a small class-room being provided into which about twenty pupils could withdraw if required for the purpose of any special study. The London School Board system seemed a modification of the two. Miss Buss had single desks, and he thought these preferable in many respects, even if in order to save floor space they were placed close together.

The Rev. J. G. C. Fussell, as a school inspector, said there were a few points on which he differed from Mr. Smith, though in many he agreed with him. With regard to class-rooms in connection with infant schools being a novelty, he did not know how far back Mr. Smith's experience went, but he had been an inspector in London for twenty-three years, and never remembered the time when there were not "babies' rooms" in connection with the best infant schools. The best he knew were those of the Home and Colonial Trianing School Society, and with

them it would be very difficult indeed to find fault. As a rule he agreed that more than 250 should not be brought together in an infant school, but he would be sorry to see a hard and fast line laid down on the point, because there were exceptional men and women capable of managing a much larger number with success. He had known an infant school of 500 managed most successfully by one master, and where this could be done it was of course more economical than having two schools. With regard to infant school galleries, he differed both from Mr Smith and the published plans of the Departments, believing that there ought not to be backs to the seats, as they caused great waste of time and inconvenience when the children were called out, as was constantly required to be done. They did not want backs to lean against, because they ought not to be kept at one thing long enough to get tired; or if they did they should be allowed to go to sleep comfortably in a quiet place. He also thought the galleries should not be quite so wide as had been described, because it was a great object not to extend the visual angle of the teacher too far. The necessity of adequate playgrounds being provided he thoroughly concurred in. He considered that up to the present time the key to the English method of education had been the pupil-teacher system, and he was rather jealous of its being interfered with; and this feeling, he knew, was shared by some of the most eminent authorities, such as Dr. Rigg, Mr. Matthew Arnold, and others. He rather deprecated too extensive an employment of assistant teachers, who were very often persons who, from want of means or some other cause not always so honourable, had not undergone a regular training for their profession. The depth of the desks must depend on circumstances; but he thought five deep would be found to be rather trying to the voice, especially in the case of female teachers. The arrangement in pairs was a compromise, and no doubt in some respects it would be better to have each desk independent, as in Sweden, where, however, instead of a flap to the desk, they employed a well under the feet, which could be covered or not according to the height and size of the pupil. When the desks were arranged in pairs, with a gangway of sixteen inches between, there was the disadvantage of occupying a deal of space, especially in case of a numerous class, and consequently diminishing the teacher's power of management, and be rather inclined to the old method of a long desk, but with a separate seat, with a back for each child. He had adopted this plan some fifteen years ago in his own school in the country, and believed it possessed all the advantages sought, with none of the disadvantages. The London School Board desk he considered positively objectionable in some points; it was shown at the Vienna Exhibition, as was also Dr. Liebreich's desk, but the jury did not think either, or indeed any which were exhibited, worthy of commendation. It was claimed as an advantage for the latter that it prevented the children lolling about from side to side, and thus altering the focal distance of the two eyes, which of course was detrimental; but his reply to that was that any good English teacher would not allow such lolling about to take place at all; and that these desks were objectionable on that very ground, because the children would all lean against the back of the seat, and place their books for reading on the ledge, and then of course the focal distance of their eyes not being identical, what would suit one would not be so comfortable for another. He thoroughly agreed in the importance to be attached to ventilation, and should have liked to hear Mr. Smith's opinion as to the use of air chambers over the ceilings. He did not like the open roofs which were sometimes seen, because a flat ceiling served to reflect the light, and if there were large openings into an air chamber above, with proper provision at the gables for changing the air of that chamber, ventilation was easily effected. He did not like a large opening pouring down cold air in a current, but the use of perforated zinc would get rid of any difficulty of that kind. The class-room syste thought, should be carefully introduced, if at all; had in his eye the case of a master who had been slightly successful in a small school, but who was n charge of one of the largest Board schools in Fins where he had proved eminently successful. It wa everyone who could be a general, but he saw no u in reducing all generals to the rank of colonels. idea was to have large schools under well selected masters and mistresses, with class-rooms well under control, on the plan of the London School Board, to allow of efficient superintendence, and not to duce the Prussian method until the pupil-teachers —which would then require to be abandoned or mo —had been found ineffective.

Mr. Hammer, with regard to the use of sliding titions, said he had seen in Germany, and also in sterdam, a modification of this plan, in which there three class-rooms arranged contiguously, separat partitions partly filled with plate-glass. The sc could not see each other, but the master was plac the centre on a raised platform so that he could se two assistants, and communicate with them if nece Plate-glass was nearly sound proof, and the rest partition was constructed in the usual way, but not to slide. Ventilation was a very important poin he had often heard complaints that whilst the heat was carried off, no arrangement was made for rem the heavy air at the bottom of the room. This had accomplished very successfully in a large scho Gospel Oak-fields, built by Mr. Rickman, by mea large openings which were made use of every tim school-room was cleared. The dryness of the air a from heating apparatus also required to be gu against.

Mr. Rochussen said there was no doubt of the importance of this subject, because the furniture surroundings of a school exercised a considerabl fluence over the minds of the pupils, and there hardly be a more powerful leverage in their elev than the arousing of their *amour propre*. In con ing the school fittings, however, they must not f the teacher, and he believed this was one secret o great success of education in Holland, Prussia, Switzerland. In England the schoolmaster was ne sufficiently paid nor honoured, whereas on the Cont he ranked with, though perhaps after, the clergym

Mr. Lucraft said he should have liked Mr. Smi have given a description of the drawing-class especially now that drawing was being introduced all the London Board schools, both for boys and for he had no doubt the same would soon be do other large towns. He considered it a matter of the importance to England as a manufacturing nation. had made this question rather his own at the School B because, as a workman, he know the value of draw He also regretted that through the niggardliness o Board and the ratepayers the interior of the school in many cases been spoiled, their appearance l almost like that of a barn, whereas they should be s mens of good taste, as well as places for learning elements of education. Playgrounds were of the firs portance, and he was happy to say that the Lo School Board had decided on having them attache all their schools, and the new Board, though electe economical principles, had actually decided on spen £3,000 or £4,000 for this purpose in connection with of the schools in St. Giles's, though the first Board refused to do so. It was especially of importance in case of infants, whom he hoped to see brought into schools at the age of two or three years, thus remo the difficulty which had been found in the case of poor women who kept their elder children at hom mind the younger ones. Those philanthropic per who had formerly supported Ragged Schools c hardly do better than direct their charity to such ca

Mr. E. Hall thought it was a mistake to insist on the light coming from the left, except for drawing. The ventilation of the gas burners was another matter to which sufficient attention had not been paid, and in consequence a large amount of vitiated air and aqueous vapour was produced, especially in school and class-rooms which were occupied in the evening. With regard to the desks, he thought the moveable flaps would be very likely to lead to accidents, and if that were so, it would be necessary to forego any advantages which would be derived from them in other ways.

Mr. Smith, in replying to the various observations, thanked Mr. Fussell for the clear and practical way in which he had given the results of his experience; it was only by such means that architects and those engaged in designing school buildings could obtain the information they wanted. When he mentioned what schools he referred rather to those in the country, with which he had had some acquaintance many years ago; but with regard to the backs for the gallery seats, he thought there would be more disturbance and loss of time if a child had to come from the back row to the front, displacing perhaps four or five others, than if he went along the rank and came down at the side.

Mr. Fussell said the children in the gallery never ought to sit so close as to touch each other, or discipline could not be maintained. The proper plan was to have stripes painted at equal distances, allowing space for a child to pass.

Mr. Smith remarked that an architect had not the same opportunity of forming an opinion on such questions as those practically engaged in school work, and probably teachers would differ as to what was the best arrangement. He should have thought the backs would be advantageous in preventing those behind kicking or disturbing those in front, and in fact this point had been mentioned to him. A gallery somewhat narrower and deeper would no doubt have the advantage which had been mentioned. As to the arrangement of the desks in plans, it was only fair to say that in all the plans he had seen of German schools, the seats were represented as in short rows of three or four children each; but this again probably was a case in which teachers would differ, and probably the wisest course would be to allow every school manager to arrange the seats in the manner best suited to his own convenience and power of teaching. For this purpose, however, single seats would offer greater facilities than any other plan. It had been objected to the London School Board desk, that it obliged all the children to sit with their books at the same distance from their eyes, but that would apply to any system of seats with backs.

Mr. Fussell said in his opinion children should always stand for their reading lesson, when they would naturally hold their books at the proper distance for distinct vision.

Mr. Smith went on to observe, with regard to the pupil-teacher system, that no doubt it had its advantages, but he was not sure that it was the best, and possibly those who had been accustomed to it and valued it were liable to overlook some of the advantages of employing a larger number of higher class teachers such as Mr. Robson had referred to. He quite agreed that a flat ceiling was preferable to an open roof, especially if proper precautions were taken to change the air from the chamber above. Wherever heating apparatus was used, it was of the utmost importance that means should be taken to ensure a constant current of air, which might be arranged with a little care so as to be quite imperceptible, though adding immensely to the comfort of the building. Lastly, he would observe that the class-room system did not at all dispense with the necessity for a good head master, who, he believed, must always be considered the life and soul of any school. He would adopt Mr. Lacraft's suggestion, and add a note to the paper on drawing-class rooms and interior decoration.

A vote of thanks was then unanimously passed to Mr. Smith, on the motion of the Chairman.

Mr. Smith has since forwarded the following:—

"The great essential for a drawing-class room, is that it should have ample north light. The windows should be high up in the room, their sills probably five feet from the ground, and their heads as high as possible. A room of rather long proportions will be found convenient, and the more lofty it is the better will it be lighted. If it is very large it is best lighted from the sides, if moderate in size a light from one end will suffice. A central skylight will not be found quite satisfactory, but one running partly up the slope of the north side of the roof, if the class-room is on a top storey, may be used. More floor space will be taken up by desks and stands for drawing, however compactly arranged, than is required by children in an ordinary school or class-room. Facing the light there should be a row of strong hooks high up, from which flat plaster casts or diagrams can hang, to draw from, and rather lower down two or three large brackets on which to stand a round cast, such as a bust. If geometrical drawing is taught, a continuous table, about 2 ft. 6 in. wide should be fixed under the window sills. A closet for keeping casts and easels, and a press for diagrams and drawing materials are desirable, and it is very useful to have one or two lavatory basons immediately adjoining the drawing-class room. The walls had better be tinted of a light neutral grey colour, and the ceiling whitened. The whole of the light on a drawing in this room should come in from one side, and no cross lights should be allowed."

MISCELLANEOUS.

IMPORTANCE OF NATIONAL INVESTMENTS IN THE PURCHASE OF OBJECTS OF SCIENCE AND ART.

The following appeared in the *Economist* of November 21st:—

SIR,—I trust that you will consider that this subject comes appropriately within the scope of the *Economist*, and that you will allow me space in your columns to direct the attention of political economists, and especially members of the House of Commons, to it.

1. Political economists say that "political economy is to the State what domestic economy is to the family." Wise domestic economy induces the possessors of great wealth to invest it in the most profitable way—profitable both directly and indirectly. Every wise rich man, after providing for his necessities, devotes a portion of his wealth to the acquisition of objects which, if bought with prudence, not only increase in intrinsic value the longer they are possessed, but delight himself and confer good and pleasure on others. But at present the national policy of this country in this respect is far behind the policy of the wise individual. The vast earnings of our country are beyond comprehension in magnitude, but the amount of its investments in procuring illustrations of science and art directly useful to productive industry and beneficial to civilisation is insignificant, and it is trifling in comparison with what has been spent by continental nations. It may be said confidently that the most advanced continental nations have done in proportion to their wealth much more than we have, and that they are reaping results dangerously aggressive on our own commerce. The existence of our welfare is dependent on our retaining a supremacy in industry. Mr. Disraeli, the Marquis of Salisbury, Lord Derby, and Sir Stafford Northcote have expressed their convictions that the progress of industry depends on the cultivation of science and art, and I hope they will act boldly now that they have the power to do so. My numerous visits to the provinces assure me they would

receive the hearty support of the nation in bringing forward a bold and generous measure to promote technical instruction through examples. I am informed that at the late Vienna Exhibition upwards of £30,000 were spent by a few of the museums of Europe, in the purchase of instructive objects out of it, whilst this nation did not specially vote a single penny; and the South Kensington Museum, the parent of those continental museums which bought objects, actually bought nothing.

2. Between 1815, when the National Debt reached its maximum of £861,000,000, exclusive of terminable annuities, and 1873-4, the debt has been reduced to £727,900,000. If a tenth part of that reduction had been invested in objects of science and art, and were now placed in, say, ten provincial museums throughout the United Kingdom, freely consultable by our industrial producers of all grades, not only would the wealth, the culture, and prosperity of the nation have been greatly increased by it, but the objects themselves would still exist, and their intrinsic commercial value would have increased enormously. It may be said that, inasmuch as the nation will never sell its objects of art, they cannot properly be called "investments." The contingency of sale is remote, but recent experience has shown that millions may be demanded as ransom. We will not collect property for this reason, but the collection of works of art improves our commerce and adds to our national strength and resources, helping us to defy demands for ransom, and is more profitable, if administered with reason, than a corresponding reduction of taxation. When an individual makes an investment in land, houses, and the like for the use of his posterity, he does not contemplate the sale of it.

3. About £3,500,000, it is said, has been devoted to pay off the National Debt during the year 1873-4. This sum lowered taxation about a penny a head on the population of the United Kingdom, an imperceptible reduction; but what an effect it would have on the productive industry of this country and its civilisation if only a tenth part of this sum (£350,000) had been put aside by Parliament in the collection of specimens of works illustrating science and art applied to productive industry, especially works of foreign origin, in order to show the British nation what its competitors in the markets of the world have done and are doing. What a potential effect would be produced in the great towns of Manchester, Liverpool, Glasgow, Belfast, Birmingham, Leeds, Bradford, Sheffield, Nottingham, Bristol, the Potteries, Newcastle-upon-Tyne, Leicester, Halifax, &c. They would all be set in motion to provide suitable buildings if Parliament adopted the principle now suggested. The principle of investing should be placed beyond the power of the accidental Government of the day to alter it without the consent of Parliament. At present the surplus revenue goes by law to reduce the debt, but a given part of it should go by legal enactment to provide objects for local museums to promote science and art applied to productive industry.

4. It is beyond dispute that when works of fine art are judiciously purchased, such works increase in value far beyond the compound interest of investments in the funds. The money value of property in fine works of art will continue to increase as long as civilisation advances in the world, whilst that of any other form ot property is subject to more capricious influences. It is far cheaper to purchase when you are able than postpone it to the future. Oliver Cromwell, in about 1650, rescued Raffaelle's seven cartoons for a sum of only £300. Who can estimate the money value of them now? The value of money has not increased in the same ratio since then as the value of these cartoons has. Everybody has specific instances within his own knowledge of the enormous increase which is taking place in the value of works of fine art. The Bernal, the Soulages, and the Meyrick collections did not cost the collectors of them a third part of the sums the objects realised when they were sold. There are pictures in the Sheepshanks collections which would realise more than ten time
amount Mr. Sheepshanks paid the artists for them.

5. It will be useful to trace the history of publi
seums in this country, as the public feeling is now
different to that when we were fighting all ove
world. Such institutions are little more than h
century old. In 1816, the year after Waterloo,
was no public want felt for museums and gall
There was no National Gallery of pictures, and
Liverpool's Government even declined to accept th
of the *bourgeois* pictures now at Dulwich. Ther
no National Portrait Gallery, no Botanical Muse
Kew, or Geological Museum, or South Kensingto
seum. The British Museum was the only nation
stitution which was supported by Parliament, an
institution had been bought by a lottery, a proce
which the present age would not tolerate. It w
part of the public policy of this country to care fo
cation, science, and art, or for institutions to pr
them. Parliament voted no funds for national
tion. It did not begin to do so until 1833-4, when
Russell obtained a modest grant of £20,000 for th
pose. It was not till 1838 that money was voted to
industrial fine art, through schools of design, on t
vocacy of Mr. Ewart and of Poulett Thompson,
wards Lord Sydenham. Mr. Henley, in 1852, w
first minister who followed the advice of Adam
and spent public money for some elementary ind
science teaching. He recognised practical geome
useful to carpenters, masons, and the like. Sinc
the nation has created departments of education
science and art—*i.e.*, national galleries in L
Dublin, and Edinburgh, and industrial museu
South Kensington and Edinburgh; a national p
gallery, now at South Kensington; a "patent"
seum; a botanical museum at Kew; one, too, at
burgh, and one at Dublin; a museum at Bethnal-
&c. But the purchase of objects of science an
however, is not regulated by any fixed principl
has hitherto been most capricious, dependent
personal whim of the Chancellor of the Exchequer
work is of so much national importance that it m
have a good settled responsible organisation, well
stood, and sanctioned by Parliament.

6. The national value of local museums to th
ture and industrial progress of the country has n
been sufficiently recognised by Parliament, wh
accustomed to limit its votes annually to museum
galleries almost wholly metropolitan in their
But there are signs all over the country that
ment will soon be asked to admit the claims of
towns to be assisted in establishing their muse
science and art. Half a century will not pass
before our country has its public museums as nu
as those of France, Italy, and Germany. I h
doubt that the present Government is fully aw
this probability. Promoters of public museum
feel certain that the present Chancellor of th
chequer, having advocated the extension of scien
art instruction so persistently, as a chairman
Select Committee of the House of Common
the President of a School of Arts, and by hi
quent public addresses on the subject during th
twenty years, will, now that he has the power,
best to influence the Government to act and giv
to his long-cherished convictions, and thus ma
mark on the civilisation and productive industry
country.

7. I trust the Government and Parliament n
inspired with courage to do for the nation wh
rich individuals do for themselves, and to lay dow
beginning of a fixed national policy, by investin
of each annual surplus revenue in the judicious pu
of objects of science and art; not for the exc
benefit of metropolitan institutions, but especial
the benefit of provincial museums.—I am, &c.,

HENRY C

UNITED STATES CENTENNIAL EXHIBITION.

The principal buildings in which the International Exhibition of 1876 will be held are the Main Building, the Art Gallery, the Machinery Hall, the Agricultural and the Horticultural Hall. In the aggregate they cover a floor space of about 40 acres.

The building is in the form of a parallelogram, extending east and west 1,880 feet in length, and north and south 464 feet in width.

The larger portion of the structure is one story in height, and shows the main cornice upon the outside at 45 feet above the ground, the interior height being 70 feet. At the centre of the longer sides are projections 416 feet in length, and in the centre of the shorter sides or ends of the building are projections 216 feet in length. In these projections, in the centre of the four sides, are located the main entrances, which are provided with arcades upon the ground floor, and central facades extending to the height of 90 feet.

Upon the corners of the building there are four towers 75 feet in height, and between the towers and the central projections or entrances, there is a lower roof introduced showing a cornice at 24 feet above the ground.

In order to obtain a central feature for the building as a whole, the roof over the central part, for 184 feet square, has been raised above the surrounding portion, and four towers, 48 feet square, rising to 120 feet in height, have been introduced at the corners of the elevated roof.

The areas covered are as follows:—

	Square feet.	Acres.
Ground Floor............	872,320	20·02
Upper Floors in projections	37,344	·85
" " in towers ..	26,344	·60
	936,008	21·47

The general arrangement of the ground plan shows a central avenue or nave 120 feet in width, and extending 1,832 feet in length. This is the longest avenue of that width ever introduced into an exhibition building. On either side of this nave there is an avenue 100 feet by 1,832 feet in length. Between the nave and side avenues are aisles 48 feet wide, and on the outer sides of the building smaller aisles 24 feet in width.

In order to break the great length of the roof lines, three cross avenues or transepts have been introduced of the same widths and in the same relative positions to

ART GALLERY, PHILADELPHIA EXHIBITION.

each other as the nave and avenues running lengthwise, viz., a central transept 120 feet in width by 416 feet in length, with one on either side of 100 feet by 416 feet, and aisles between of 48 feet.

The intersections of these avenues and transepts in the central portion of the building result in dividing the ground-floor into nine open spaces free from supporting columns, and covering in the aggregate an area of 416 feet square. Four of these spaces are 100 feet square, four 100 feet by 120 feet, and the central space or pavilion 120 feet square. The intersections of the 48 feet aisles produce four interior courts 48 feet square, one at each corner of the central space.

The main promenades through the nave and central transept, are each 30 feet in width, and those through the centre of the side avenues and transepts 15 feet each. All other walks are 10 feet wide, and lead at either end to exit doors.

The following are the principal dimensions of the different parts of the building. The measurements are taken from centre to centre of supporting columns:—Length of building 1,880 feet, width of building 464 feet. Central Avenue or Nave—Length 1,832 feet, width 120 feet, height to top of supporting columns 45 feet, height to ridge of roof 70 feet. Central Transept—Length 416 feet, width 120 feet, height to top of columns 45 feet, height to ridge of roof 70 feet. Side Avenues—Length 1,832 feet, width 100 feet, height to top of columns 45 feet, height to ridge of roof 65 feet. Side Transepts—Length 416 feet, width 100 feet, height to top of columns 45 feet, height to ridge of roof 65 feet. Central Aisles—Length at east end 744 feet, length at west end 672 feet, width 48 feet, height to roof 30 feet. Side Aisles—Length at east end 744 feet, length at west end 672 feet, width 24 feet, height to roof 24 feet. Centre Space or Pavilion.—Ground plan 120 square feet, height to top of supporting columns 72 square feet, height to ridge of roof 96 square feet. Towers over Courts—Ground plan 48 square feet, height to roof 120 square feet. Corner Towers—Ground plan 24 square feet, height to roof 75 square feet.

The foundations consists of piers of masonry. The superstructure is composed of wrought iron columns which support wrought iron roof trusses. As a general rule the columns are placed lengthwise of the building at the uniform distance apart of 24 feet, and the sides of the

building for the height of seven feet from the ground are finished with timber framed in panels between the columns, and above the seven feet with glazed sash. Portions of the sash are movable for ventilation. The wrought iron columns are composed of rolled channel bars with plates rivetted to the flanges. The roof trusses are similar in form to those in general use for depots and warehouses, and consist of straight rafters with struts and tie-bars.

The work is progressing rapidly, and there is now understood to be no doubt of the completion of the undertaking by the required time. The foundations of the memorial hall are finished, and at least two-thirds of the granite base course is completed. The interior walls of brick are up to the commencement of the second storey. Work on the finer granite is rapidly progressing at the quarries, and the stones will be ready for delivery and setting in the early part of next spring. A wide-gauge railroad for a steam derrick has now been extended around the building, with a turntable at each corner, in order to facilitate the quick transit of the ponderous machine to any part of the structure where it will be needed. Nearly all the grading on the plateau of eighteen acres, designed for the exhibition pavilion, machinery hall, and horticultural conservatory has been finished up to the river road.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for October have been received up to the present date:—

	Number of Visitors.
British Museum	*
National Gallery (Trafalgar-square)	†
Kew Gardens and Museum	17,121
South Kensington Museum	75,622
Bethnal-green Museum	39,436
Geological Museum, Jermyn-street	3,310
Patent-office Museum	24,159
Edinburgh National Gallery	7,753
Edinburgh Museum of Antiquities	7,127
Edinburgh Museum of Science and Art	37,625
Royal Dublin Society:—	
Natural History Museum	†
Botanic Gardens, Glasnevin	†
Dublin National Gallery	†
Zoological Society, Dublin	5,645
Museum of Irish Society, Dublin	†
Tower of London	10,517
Royal Naval College, including Greenwich Painted Hall	19,747
Naval Museum (opened 12th October, 1874)	3,774

* Return refused.

† Return for this month not yet received.

According to an American paper an establishment in Pennsylvania turns out about 70 tons of sheet iron, by the use of fuel of natural gas drawn from an abandoned oil-well situated about one-fifth of a mile from the works. The iron made by the use of gas commands from 10 dols. to 20 dols. per ton more than the same class of iron made by the same firm at other works where coal is used for fire.

The production of petroleum during 1873, in Pennsylvania, was estimated at about 8,000,000, barrels, an excess of nearly 2,000,000 barrels over that of the previous years. The exports from the United States were 237,481,633 gallons, against 150,162,419 gallons in 1872. The exports to the United Kingdom were largely in excess of those of previous years, being 21,778,651 gallons, against 7,845,272 gallons in 1872.

A committee has just been formed at Faenza for the promotion of an agricultural and industrial exhibition, that will be held in that town in August, 1875. The provinces constituting the Romagna are invited to take part in it.

THE CONDITION OF SERVIA.

The soil of Servia is fertile and productive, but fourths of its surface are uncultivated. There i and no lack of mineral resources beneath, but the have only just begun to be worked, concessions h been made to two English companies. Worst remarks Consul-General Longworth, is the almos absence of native skill and industry. What the most indulge in, since the Turks have been dispo of this fine province, is an exemption from labour, as it was formerly for the benefit of their task-m was naturally considered as an unmitigated har It might, under these circumstances, have been policy to have encouraged immigration from civilised countries in their neighbourhood, by land in thinly populated districts would have ac a more than nominal value, and the Servians them have been stimulated to exertion by salutary ex and conviction. So far, however, the only encou ment of the kind is extended to swarms of iti artisans, a class of rough, unskilled architects, m and carpenters, who flock together every year fro adjacent Turkish provinces of Albania and Mace To these the rural population, consisting of nine- of the inhabitants, is entirely indebted for the con tion of their houses and cottages, their earnings at a moderate computation, estimated at £200,000 To this annual drain may be added the loss arising neglect of agriculture, three-fourths of the land uncultivated from the unwillingness of the free Se to work either as servants or farm labourers. this all; by the wasteful extravagance of these p lords of the soil the fine forests of the country hav to a great extent devastated, and this at a time the slender capital of the merchants has been devo speculative schemes of forest exploration in Hung

The exports, the produce of the country, consist cipally of wheat, Indian corn, and other cereals, an and their skins, wood, gall nuts, dried prunes, wa tobacco, brandy distilled from prunes, wine, wool, t wax, honey, and butter. Of these exports upwa one-half of their total value consists of swine, whicl the staple commodity. Compared with former yea exportation of 1872 shows much improvement number being 472,700; that for 1870 being only 36 It should be observed, however, that the value of exports may vary with the condition in whic animal, whether fat or lean, may reach the de Steinbrück, in Hungary. Much depends also o year being rainy or otherwise. The pigs are fe acorns during September, October, and November the chief food when a scarcity occurs is such past the fields and forests afford during the remaining months. They are also fattened upon maize whe season is favourable. The importation of grain, st to say, is much larger than the exports, and this o ring in a country three-fourths of whose surfa uncultivated, would seem an unaccountable anoma

The peasant Parliament, by whom the Govern is to a certain extent controlled, have very narrow superficial notions of the public interest, though few of its members, and among these officials edu abroad, may be more enlightened; but the se reverses, agricultural and commercial, consequent failure of crops for three successive years, awakened attention to these matters. The war b shows a yearly expenditure of £100,000 for a l organised militia, which might be wholly dispensed in a principality secured by the collective guar of the Great Powers. For better arrangement economy, by which means the finances of the cou might be largely recruited, on such points the Gov ment might advantageously consult the directors o banking establishments—safer guides than the poli agents from whom they usually seek advice. have in this manner borrowed their military orga

tion from France, and their system of law and jurisprudence, wholly unfitted to the requirements of the country, from Austria. Not long since an employé of the ministry of finance was despatched to Berlin to inquire into the German system of taxation, with instructions to pursue his financial studies in Belgium and Switzerland. The pains they thus give themselves are superfluous whilst the reforms required in their fiscal system are so obvious. If in lieu of a poll tax they instituted a tax on property, the Servians, who have become a nation of squatters, would have to cultivate the land in their own defence, and the revenue would be proportionally augmented. These measures, coupled with encouragement to immigration, would become a main means of development, and the sooner they can be adopted the better for the future of the country.

CORRESPONDENCE.

SANITARY APPLIANCES AT THE INTERNATIONAL EXHIBITION.

SIR,—In the explanation given by Mr. Homersham in your *Journal* of the 6th instant, of the exhibits of Sanitary Appliances at the International Exhibition, it is stated that my friend, Mr. Field, who is connected with me as joint patentee of the Self-acting Sewage Regulator, is associated with me also in the exhibit of Intermittent Downward Filtration. It is due to the authorities of the International Exhibition, who requested me personally to exhibit an illustration of this method of sewage disposal, that I should distinctly explain that this is not the case, and that Mr. Field's association with me is limited to the regulator, as the description on the exhibit states.

With respect to the Regulator itself it may perhaps be as well now to state that though the syphon has been adopted in consequence of the example afforded of its utility by Mr. Field's "Flush Tank," the principle upon which the patent was based does not rest upon the means of discharge, but upon the arrangement made to regulate and deliver to a given quantity of land used for irrigation or intermittent downward filtration the exact quantity of sewage which such land is intended to cleanse, or which the crop growing upon it will appropriate. It matters not whether the discharge is effected by a syphon or otherwise so long as it is done automatically.

With regard to Intermittent Downward Filtration, I having had now four years' experience of the process, and in saying I must take a view upon many points the very opposite of that expressed by Mr. Homersham. As an evidence of the power of soil to absorb and cleanse sewage, I may state, that in a case in which I have been concerned, the sewage of a town of 15,000 inhabitants, diluted with 100 gallons of water per head, is being daily applied to less than five acres. The land not only rapidly absorbs and discharges the sewage by means of under-drains laid 7 feet deep, but the effluent is purified within the standard of purity recommended by the Rivers Pollution Commissioners; and at the same time a crop has been grown, of which a deputation from the town of Barnsley, after inspecting the work, say "the large yield affords additional testimony to the fertilizing effects of fluid sewage upon vegetable products."—I am, &c.,

J. BAILEY DENTON.

22, Whitehall-place, London, S.W.
13th Nov., 1874.

NEW YORK has now 400 miles of water pipes; Chicago has 350 miles; Brooklyn, 200 miles; Boston, 350 miles; Baltimore, 210 miles; Detroit, 170 miles; St. Louis, — miles; Louisville, 75 miles; Cleveland, 70 miles; and Brooklyn, 45 miles.

OBITUARY.

The Right Hon. Sir A. Y. Spearman, Bart.—The death has just been announced of the Right Hon. Sir Alexander Young Spearman, Bart., Controller-General of the National Debt Office. He was the elder son of the late Major Alexander Young Spearman. He was born in 1793, and originally served in the Commissariat Department, his commission as Assistant Commissary-General being dated October 10, 1816. From 1836 to 1840 he served as Assistant Secretary to the Treasury, and on his retirement from that office was created a baronet. He then became Controller-General of the National Debt Office, which post he resigned in March, 1873. He was sworn a Privy Councillor in 1869. He was Treasurer to H.M. Commissioners for the 1851 Exhibition, and acted in a similar capacity with regard to the Prince Consort's Memorial Fund.

GENERAL NOTES.

Cutting Steel Rails Cold.—The cutting of a file in halves with soft iron was an old lecture experiment. The soft iron formed a disc about 6in. in diameter, mounted on a lathe spindle, and run at about 2,000 revolutions per minute. A file held to the edge of the disc was cut in two in about ten or fifteen seconds, the disc being unharmed. The shower of sparks rendered this a brilliant experiment, very popular with a general audience. The principle involved is now being applied to a practical purpose. Mr. Charles White, manager, Sir J. Brown and Co.'s Works, Sheffield, has found the cost of cutting off the ends of steel rails cold in the ordinary way so enormous that he resolved to try another expedient. For experiment, he last week had an ordinary rail saw put in the lathe and all the teeth cut off. The revolving disc was then mounted on a spindle and driven at nearly 3,000 revolutions a minute. The disc was 3ft. in diameter, so that its circumferential velocity was about 27,000ft., or over five miles a minute, or 300 miles an hour. Steel rails forced against the edge of this disc were easily cut through in three or four minutes each. The rails weighed 65lb. to the yard. Sparks flew in abundance, and the disc appeared to melt the rail before it; but after cutting five rails the disc itself was not sensibly warm. The experiment was such a complete success that the firm intend putting up a very powerful saw for the purpose of cutting cold steel rails.—*Engineer*.

Gold Yield of Nova Scotia.—The value of the gold production of Nova Scotia from the autumn of 1860 to the close of the year 1873, at £4 sterling per ounce, amounts approximately to one million pounds sterling, of which £910,893 7s. are distinctly traceable and officially accepted. Of this sum, £896,950 3s. 6d. was derived from vein stuff, and £130,943 3s. 6d. from alluvial washings. Since the 1st January, 1863, leaseholders and millowners are compelled to make returns, upon oath, of the quantity of material raised and crushed, the gold obtained, and the number of days' labour expended. The largest declared aggregate yield in one year was £109,258 for 1867; the largest annual yield of any separate district, £57,617, for Waverley, in 1865; the largest annual yield of any single mine—not including a large amount known to have been stolen—£34,910, from the Tudor, at Waverley, in 1865; and the largest bar of gold ever cast was 1,200 oz. (£4,800), in June of the same year, from the same mine, then the property of Mr. Leopold Burkner. The largest aggregate amount obtained from separate mines owned by one syndicate is £250,000—the Wellington and Palmerston at Sherbrooke, the Ophir at Renfew, and the American at Waverley, contributing respectively £80,000, £36,000, £72,000, and £62,000, the whole of the worked claims not exceeding 1,800 ft. in length. The largest amount produced from a mine owned by one person is £72,000, from the Tudor, at Waverley.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Minutes of the Proceedings of the Institution of Civil Engineers, Vols. 37—8. Presented by the Institution.

Commentaries upon International Law, Vol. 4, by Sir Robert Phillimore, D.C.L. Presented by the Author.

Technological Dictionary, in English, German, and French. Part 2, English—German—French, by Alexander Tolhausen.

Catalogue of the Books in the Library of Christ's Hospital.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol 17. Presented by the Institution.

On the Modified Turkish and Vapour Bath, and its Value, by J. L. Milton. Presented by the Author.

Lecture on the Principles of Estimating Safety and Danger in Structures, by James Thomson, LL.D. Presented by the Author.

American Life Offices in Great Britain, with special reference to the Tontine Savings Fund Assurance of the Equitable Society of New York.

Patents and Patentees (Victoria), Vol. 7. Indexes for the year 1872, by W. H. Archer. Presented by the Registrar-General of Victoria.

Bolivia. Extracts from a work written by Avelino Aramayo.

The following works have been purchased for the Library:—

La Dentelle—Histoire, Description, et Bibliographie, avec Cinquante Planches Phototypographiques, par Joseph Sequin.

Scientific London, by Bernard H. Becker.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

DECEMBER 2.—"The Expediency of Protection for Inventions," by F. J. BRAMWELL, F.R.S.

DECEMBER 9.—"The Protection of Buildings from Lightning," by Dr. R. J. MANN.

DECEMBER 16.—"The Sandblast and its Application to Industrial Purposes," by W. E. NEWTON.

CANTOR LECTURES.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows:—

1ST COURSE.—"Alcohol: Its Action and its Use." by Dr. B. W. RICHARDSON, F.R.S.

2ND COURSE.—"On the Material, Construction, Form, and Principles of Tools used in Handicraft," by the Rev. ARTHUR RIGG, M.A.

3RD COURSE.—"On some of the Forms of the Modern Steam Engine," by F. J. BRAMWELL, F.R.S., President of the Institution of Mechanical Engineers.

The following is the syllabus of the course:—

LECTURE I.—MONDAY, DECEMBER 7TH.

The history of Alcohol in relation to its varied s to mankind—in the Arts and in Science.

LECTURE II.—MONDAY, DECEMBER 14TH.

The Alcohol group of organic bodies.—Resp action of different Alcohols.

LECTURE III.—MONDAY, DECEMBER 21ST.

The influence of Common or Ethylic Alcoh animal life.—The primary physiological acti Alcohol.

LECTURE IV.—MONDAY, JANUARY 18TH.

The position of Alcohol as a food.—Its effects animal temperature.—Hygienic considerations.

LECTURE V.—MONDAY, JANUARY 25TH.

The secondary action of Alcohol on vital functi Physical deteriorations of structure—general and —incident to its excessive use.

LECTURE VI.—MONDAY, FEBRUARY 1ST.

Influence of Alcohol on the nervous organi with special reference to the mental phenomena i by its use.—Summary.

Members are privileged to introduce *two* f to each of the Ordinary and Sectional Meeti the Society, and *one* friend to each Cantor Le

SCIENTIFIC MEETINGS FOR THE ENSUING W

MON. ...British Architects, 9, Conduit-street, W., 8 p.m.
Institute of Actuaries, 12, St. James's-square, S.W. Discussion upon some points contained in Macalm and Hamilton's report to the Board of dated 10th July, 1874.
Medical, 11, Chandos-street, W., 8 p.m.
Social Science Association, 1, Adam-street, Adelphi 8 p.m. Further adjourned discussion on Mr. Hare's paper "On the Construction of a Muni for the Metropolis." Mr. Robert Rawlinson, Esq in the chair.
Royal Society, Burlington House, W., 4 p.m. Meeting.

TUES. ...Civil Engineers, 25, Great George-street, Westm S.W., 8 p.m.
Pathological, 53, Berners-street, Oxford-street, W.
Biblical Archæology, 9 Conduit-street, W., 8½ p.m
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7 Gower-street, W.C., 7 p.m

WED. .. SOCIETY OF ARTS, John-street, Adelphi, W.C.,
Geological, Burlington House, W., 8 p.m. 1. Mr Seeley, "On the Femur of *Cryptosaurus* Seeley, a Dinosaur from the Oxford Clay of Gransden." 2. Mr. Henry Hicks, "On the Suc of the Ancient Rocks in the vicinity of St. D Pembrokeshire, with special reference to the and Llandeilo groups and their fossil content Messrs. John Hopkinson and Charles Lap "Descriptions of the Graptolites of the Aren Llandeilo Rocks of St. David's."
Microscopical, King's College, W.C., 8 p.m. Dr. Hudson, "On some Male Rotifers."
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p
Obstetrical, 53, Berners-street, Oxford-street, W.,

THUR. ...Antiquaries, Somerset House, W.C., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Sir Lubbock, Bart., "Observations on Bees and W 2. Professor Huxley, "On the Classificati Animals."
Chemical, Burlington House, W., 8 p.m. 1. M N. Hartley, "On the colour of Cupric Chloride Mr. Sydney Lupton, "On the Formulæ of the Alu
Inventors' Institute, 4, St. Martin's-place, W.C., 8

FRI. ......Geologists' Association, University College, W.C., 8
Philological, University College, W.C., 8 p.m. Stamford, "Imported Words."
Archæological Institution, 16, New Burlington-stree 4 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,150. VOL. XXIII.

FRIDAY, DECEMBER 4, 1874.

[illegible] for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

POLLUTION OF RIVERS.

The Council have determined to hold a Conference on Thursday, December 10th, at 3 p.m., "On the steps to be taken to ensure prompt and efficient measures for preventing the pollution of rivers." The Right Hon. Lyon Playfair, C.B., M.P., F.R.S., LL.D., has consented to preside.

JUVENILE LECTURES.

The Council have arranged with Prof. McLeod, of the Indian Engineering College, Cooper's-hill, to deliver two lectures (on dates to be hereafter determined) during the Christmas holidays. The subject will be "The Work and Food of the Iron Horse."

THIRD ORDINARY MEETING.

Wednesday, December 2nd, 1874; JAMES FITZJAMES STEPHEN, Esq., Q.C., in the chair.

The following candidates were proposed for election as members of the Society:—

Arbuthnot, Sir Alexander, 62, Redcliffe-gardens, S.W.
[illegible], Richard Wade, 105, New Bond-street, W.
[illegible], Robert E., Mayor of Portsmouth.
Lloyd, John Horatio, Q.C., 100, Lancaster-gate, W.
[illegible], C., Native Guano Company (Limited), 9, [illegible]-chambers, Westminster, S.W.
[illegible], G. Bailey, 7A, Laurence Pountney-hill, E.C.
[illegible], Frederick, St. Peter's Iron Works, Ipswich.
Ward, Reginald, 36, Lincoln's-inn-fields, W.C.
[illegible], Frederick Thomas, 12, Lincoln's-inn-fields, W.C.

The following candidates were balloted for and duly elected members of the Society:—

[illegible], W. T., Eastern Telegraph Company, 66, Old Broad-street, E.C.
[illegible], Alexander, 28, Clifton-gardens, Maida-vale, W., and 24, Ethelburga-house, E.C.
Badger, Rev. George Percy, LL.D., 21, Leamington-road-villas, W.
Baker, Sir Samuel W., F.R.S., 19, Seymour-street, W.
Baker, William, 23, Lansmere-terrace, Victoria-park, E.
Barnard, Alfred, Upper King-street, Norwich.
Beach, Charles M., Hartford, Connecticut, United States, America.
Beaufoy, Mark Hanbury, South Lambeth-road, S.W.
Bell, Andrew, 44, Gloucester-road, N.W.
Bell, Asahel Pilkington, The Vicarage, Sowerby-bridge, Yorkshire.
Brassey, Henry A., M.P., Preston-hall, Aylesford.
Carew, R. Russell, Carpenders-park, Watford.
Clark, Frank William, 52, Amhurst-road, Hackney, E.
Cobbett, Henry, Jun., 29, Sackville-street, W.
Coffin, Dr. Charles Read, 94, Cornwall-gardens, South Kensington, S.W.
Coles, F., Bethnal-green Museum, E.
Cripps, Edward, London Brighton and South Coast Railway, Electric Telegraph Department, London-bridge, S.E.
Cunliffe, E. T., Handforth, Cheshire.
Currey, Rev. R. A., Whittington-college, Highgate-hill, N.
Davidson, J., 59, Redcliffe-gardens, S.W.
Davis, Herbert Hall, 110, Cannon-street, E.C., and 56, Gresham-park, Brixton, S.W.
Defries, Henry, 50, Tavistock-square, W.C.
Duckham, H. A. F., 12, Oxney-villas, St. John's-road, Upper Holloway, N.
Edmonds, John Thomas, Cwmavon-house, near Pontypool, Monmouthshire.
Elkington, George, Jun., 95, Cannon-street, E.C.
Emanuel, Maurice, 101, High-street, Portsmouth.
Farrell, Martin James, Wexford.
Foster, Alfred P., M.A., Ph.D., 3, Lower Sackville-street, Dublin.
Gawler, Colonel John Cox, Tower of London, E.C.
Gerson, Isidore, 5, Rathbone-place, W.
Gilder, Sherrington A. E., M.D., Montpellier-villa, Torquay, Devonshire, and Brisbane, Queensland.
Gooch, William Frederick, Wargrave, Newton-le-Willows, Lancashire.
Gordon, William, M.P., 11, Leinster-terrace, W.
Graves, James, Anglo-American Telegraph Company, Valentia Station, Ireland.
Harley, Colonel, Junior United Service Club, S.W.
Harris, Alfred Ellis, 130 and 136, Mile-end-road, E.
Hearson, C. E., care of J. T. Constantine, Ludgate-circus, E.C.
Hŏward, Joseph, J.P., The Green, Tottenham.
Hunt, Edwin, Lea-brook, Wednesbury.
Hutchinson, Consul Thomas J., Chimoo-cottage, Mill-hill, N.W.
Huxley, Charles Rodney, M.R.C.S.L., 1, Gloucester-place, Portman-square, W.
Jekyll, Lieutenant H., R.E., 2, Morpeth-terrace, S.W., and Postal Telegraph Office, 101, Cannon-street, E.C.
Leitner, Dr. G. W., 22, Aberdeen-place, Maida-vale, N.W.
Lord, Edward, Canal-street Works, Todmorden.
McIsack, James, Alma-villa, Station-road, Barking, Essex.
Marshall, James, Britannia Iron Works, Gainsborough.
Morton, Robert, Stockton-on-Tees, and Alliance Chambers, Borough, S.E.
Muir, Richard, 12, Soho-square, W.
Oliver, Edwin, Natal Land and Colonisation Company, 41, Threadneedle-street, E.C.
Owens, Samuel, 22, Whitefriars-street, E.C.
Payne, Alexander, 4, Storey's-gate S.W.
Payne, William, The Keep, Forest-hill, S.E.
Phipps, Pickering, M.P., Northampton.
Powell, Harry, B.A., Glass Works, Whitefriars, E.C.
Rawlins, John, The Birches, Saltley, near Birmingham.
Reid, H. G., Newlands, Middlesborough.
Reynolds, Edward, Messrs. Vickers, Sons and Co., River Don Works, Sheffield.
Robertson, Donald, 5, Great Winchester-street-buildings, E.C.

Rowatt, Thomas, Radsworth-street, Baldwin-street, City-road, E.C.
Schröder, Frederick H., Old Swan-chambers, London-bridge, E.C.
Scovell, Edward, 86, Ladbroke-grove, W.
Sherriff, Miss Emily, 18, Cadogan-place, S.W.
Smith, Henry, 5, Ivy-lane, Paternoster-row, E.C.
Smart, Alfred, Crosby-house, 95, Bishopsgate-street, E.C.
Spagnoletti, C. E., Great Western Railway, Paddington, W., and Sussex-house, Slough.
Sparkes, J., The Lawn, 39, South Lambeth-road, S.E.
Thomas, Joseph Lee, 16, Holland-road, W.
Thorpe, George, 21, Eastcheap, E.C.
Williams, G. C., 92, New Bond-street, W.

The paper read was—

THE EXPEDIENCY OF PROTECTION FOR INVENTIONS.

By F. J. Bramwell, C.E., F.R.S.

I shall make no apology for bringing this subject before you to-night; its great importance is a sufficient reason for adding one more to the number of papers that within the last few years have been wirtten upon it.

There is a difficulty in dealing with "Protection for Inventions" or in other words, the recognition by the State of property in inventions, which it is believed does not affect any other subject on the law of which papers are written.

In other cases, when discussion is excited, the extreme scope of the contested questions does not go beyond the modification of the law under consideration. All parties agree that there must be a law of some kind, but with respect to the subject of patents this is not so, for there are certain persons who insist there should be no Patent-law at all; they hold it to be wrong in principle, and they endeavour, not to improve the existing law, but to make an end of it once and for all. Therefore, in a paper on the expediency of protection for inventions, written by one who believes that some kind of Patent-law is desirable, two things may well be treated of, the one, "Aye or No, shall there being any Patent-law at all"; the other "Assuming a Patent-law, what are the best provisions to embody in it?"

To properly consider, even in the merest outline, both these questions, would occupy far longer time than accords with the fair limits of a paper to be read before this Society; therefore, on the principle that it is no use dealing with details when you are in doubt about the very essence of a matter, or, to borrow the language of Parliamentary Committees, that it is idle to go into "clauses" before you have proved your "preamble," I propose in this paper to consider, and to consider only, the broad question, "Is it expedient that there should be a Patent-law for the protection of Invention?" And as I refrain from discussing the alterations of any clauses in the existing law, I must be prepared, and I am prepared, to deal with the question on the following issue:—Assume that the existing law with all belonging to it is to remain unaltered and unimproved, is it expedient that there should still be protection for inventions?

I will not urge before you the "Right" of property in invention. I am aware that advanced political economists can demonstrate there is no such thing as "Right," and thus they admit (when they are discussing questions of political economy, but prob not at other times), that the houses they liv the clothes they wear, and the money in pockets, are not theirs because they are "rightfu theirs, but because it is "expedient" for the b fit of the whole community that the possessi property should be secured to individuals.

I will deal with the consideration of the P question upon this hard and wholly unsentim ground, and I will abstain from appeals to feelings of natural justice which are outrage the suggestion that although a man who goe dredges up an oyster, and finds within it a pe to be the legal possessor of that pearl, and call upon the laws of his country, and not vain, to secure it to him against all co another man, a Cartwright, a Watt, a Cromp Neilson, a Bessemer, a Siemens, is to have n perty in his inventions, inventions whic pearls of great price, and are destined, n the private enjoyment of the finder, but to the fit of mankind. More especially does it see fair to inventors when we consider that pearls have been obtained, not by a few ho mere toil of the body, but by the employm years in anxious thought and weary experim

Having made these preliminary remarks, now consider the question, "Is it expedie the interest of the community as a whole, there should be protection for invention?"

I will take it as conceded that it is exp there should be improvement in manufa Clearly all must be interested in obtaining l stronger, more elegant, more numerous, cheaper articles, the product of manufa and of patentablé invention. In this age have recently had occasion to remark in m dress to the Institution of Mechanical Engi as President) it should always be remembered is not an article of food, there is not a garment, is not a portion of the house we live in, there i book that we read, nor a ton of the fue warms us, that does not come to us on easier better in every way, and cheaper in conseque mechanical improvement, and, under our p law, nearly all such improvements constitut manufactures, which that law recognises as su of patentable invention.

Take our home-grown food; it is, und blessing of the Almighty, the product of th of the intelligent farmer, and of the labo hard-working men, but of those backed by Not capital alone, as capital, but capital in in steam ploughs, in machines for sowing, in ing machines, in steam-engine power, in tr engines, and in the vast number of implements, which, year by year, make the of the Royal Agricultural Society one o most interesting of all exhibitions, to a thou man who has the welfare of the great agric industry of England at heart. It is by the such inventions that the English farmer, t weighed down by heavy rental, by taxes, b labour, and by uncertain seasons, is enab hold his own in the face of free trade, adm (in fact welcoming) the unlimited introduct food from all parts of the world.

And with regard to that food, whether it be flour, cattle, Australian preserved meat, c coffee, or sugar, most of this has been prepa

machinery, and machinery propels the vessels by which these products are brought to our shores.

Again, in our towns, water is laid on through every street, circulates there to supply the wants of all, and does it by the aid of mechanical inventions. And in most of our towns also, light, in the form of gas, circulates and owes it origin to a happy combination of chemical and mechanical invention.

As for clothing, it would be a waste of time to enlarge upon the extent to which mechanical invention comes into play. The cotton manufactures of Lancashire, the woollen and linen manufactures of Yorkshire, the lace and hosiery of Nottingham and Leicester, all are the results of mechanical invention. Again, our movement from place to place (unless the journey be a very short one) is due to some of the highest developments of mechanical skill, in the locomotive, and in the iron steam vessel.

So much for the conveyance of our bodies. Next for the conveyance of our thoughts, whether this be done in the form of letters, carried by the post, or of books, printed and circulated all over the world; or, whether, when more urgent need arises, it be done by the instantaneous telegraphic message, once more invention has to be acknowledged with gratitude. The paper, the steel pen, the type, and nowadays, even the very setting-up of the type, the electrotype plate, the steam printing-press, all matters in the domain of letter writing and book producing, are the offspring of mechanical and chemical invention, while the electric telegraph, from the comparatively coarse covering of the deep-sea cable, to the delicate instrument by which signals are transmitted and received, involves a combination of some of the most excellent inventions that have ever emanated from the human intellect.

The foregoing matters may be called the necessaries of life, but the luxuries and adornments are equally under obligation to mechanical and chemical invention. Furniture for instance; the woodwork has been prepared by the strong and the simple sawing machinery, afterwards it owes its form to modelling machines capable of producing the most exquisite carving. The covering of chairs and couches, the materials for curtains, and carpets for our rooms, are the produce of the chemical art of the dyer, and of the engineering skill of the spinning-machine manufacturer and of the loom maker. Our windows and looking-glasses are the result of scientific chemical combinations, producing in the first instance a material translucent, but not transparent, until it is submitted to a succession of ingenious mechanical operations, in which large invention is displayed.

Passing from these peaceful and happy uses of invention, and dwelling for a moment on warlike considerations, one finds, that within the last twenty years (that is to say, since the period when the mechanical engineer took up the subject), the art of the gunner and of the artilleryman has become converted into a science, and thus even in the profession of arms acknowledgment is due to mechanical invention.

Not an unnatural sequence to the consideration of a public calamity,—"war," is the train of ideas which proceeds from the more private disaster of fire. In this instance it is by mechanical engineering a supply of water is brought within a few yards of the conflagration, and it is to mechanical engineering that we are indebted for the steam fire-engine, that wonderful concentration of great force, within the minimum of space and weight, by the aid of which tons of water are poured forth above the highest buildings.

Having thus endeavoured to call to your minds how absolutely dependent we are for every necessary and for every comfort upon invention and improvement, I trust you are prepared to agree with me, that although there may be persons who oppose protection for inventions, there cannot be any who will not admit that we have largely profited by inventions up to the present time, and that it is most desirable inventions and improvements should continue. This being so, let us see whether improvement is more likely to be made with or without a Patent-law.

The opponents of a Patent-law say (among other things) that an ingenious man can no more withhold himself from inventing, than a musician can abstain from composing, and that whether the invention is to result in profit or not, the genius must invent, and he will do so, not only in the absence of all pecuniary reward, but even in the absence of the glory which it is supposed might arise from the publication of his invention. I think this is a very unfair estimate of the nature of a really ingenious mind, and also an unfair illustration. The musician composes, perhaps, to gratify his artistic taste, but having composed—which really means having committed his idea to paper—he has done all that any musician could do; for him there is no further step to be taken. A real inventor, however, cannot rest contented with this committing of his ideas to paper, he must see them practically carried out, and above all he must do so if he be of the useful class of inventors; that is to say, a man distrustful even of his very ingenuity, acquainted with the difficulties that arise in practice, and knowing therefore, how necessary it is that the thought of the mind should be developed into practice, such a man must see his improved steam-boat engine at work on the high seas, his improved locomotive drawing an express train, his improved hot blast at work reducing refractory iron ore. A real sound inventor who had no hope of thus perfecting his invention would, in despair, cease to invent, and the inventors who remained would be either the impracticable, visionary men, whose so-called inventions are useless, or they would be persons engaged in manufacture, who would make inventions of detail in their special trade, and, if these inventions were of any real value, would strain every nerve to keep them secret.

The opponents of a Patent-law further say that in its absence inventions would continue, because an inventor would reap his due reward by embarking in the manufacture of his own invention, and they say he would do so on favourable terms, for not only would he have the start of all other persons, and a more intimate knowledge of his own invention than any one else could have, but his would be the best trained workmen, and from these causes he would be in an excellent position as a manufacturer, and his products would have credit with the public.

Those who put forward such a mode of reward

appear to forget that commercial success, which must be attained to get the reward, demands, not merely skill of invention, but demands capital, business habits, the art of organising and controlling a staff of workmen, and the equally great, if not greater, art of finding a market and selling to a profit; and also that if the inventor is not living in a suitable locality for the manufacture, he must be prepared to break up his connection with the place where he may have been for years, involving the surrender of any occupation he might have held there, and must recommence life elsewhere.

And just one word as to his retaining the skilled workmen, trained in the exercise of this invention. Would not the very first step in rivalry of manufacturers, be the procuring the services of the workmen who had been taught by the inventor? A few extra shillings a week would be a sufficient inducement to secure them and all the knowledge they could impart, and thus the inventor would have the mortification of seeing his workmen taken from him, one by one, as they become competent, and would find himself in the position of constantly teaching beginners, with the certainty that they were to go to his rivals, as soon as they had learned enough to be of any service to them.

This is no mere imaginary state of things, it happened in the case of Crompton, the inventor of the spinning mule. I shall have to refer to him on more than one occasion, but I will say here that when his unpatented invention became public, and he was left to the product of his manufacture for his reward, the spinners in the neighbourhood, not content with tempting away his workmen as soon as they became competent, so that, to use Crompton's own phrase, "he was always teaching green hands," actually bought over his own sons, to become the teachers and assistants of the rivals of their father.

Reverting to the suggestion that inventors can be rewarded by becoming manufacturers, I will consider, first, the case that appears to me most favourable to the success of such a system of reward, that is, where an invention has been made by a manufacturer in some branch of his trade, where he has all the appliances of an established business, so that he can readily make his preliminary experiments, carry his invention into practice if these experiments succeed, and also find a market among his connexion. I will assume, moreover, the invention to be of such a nature that the inventor may have reasonable hopes of carrying it out as a secret manufacture.

I do not know whether those who say it is inexpedient to protect invention have considered the question of secret manufacture, nor whether they are of opinion that the increase of such manufacture is, or is not, to be deplored. To my mind, nothing could be more lamentable in a moral point of view. The proprietor of a secret manufacture lives in constant fear of discovery; he hardly dares to increase his product, because, in doing so, he has to add to the number of persons whom he must trust; he is obliged to pay these persons large sums, not really for wages, but as hush money, and these payments have to be charged upon the article manufactured, which thus must be unnecessarily high-priced. This limitation of manufacture and the high prices are obviously injurious to the public—the consumers. We have seen that worth the while of manufacturers to buy Crompton's workmen, even when his proce no longer a secret, and when all that hi could impart would be some detail of skill in pulation; how much more would it be wor while of manufacturers to buy away workm could disclose the actual secret of an improve cess. The inevitable result must be a co tempting of the fidelity of the workmen, t tion which must be counterbalanced by heav ments on the part of the employer, and th workman is put in a false position, which r it almost impossible for him to preserve l rightness, and to do his duty.

Sooner or later the secret is all but sure out, and I think I have shown that in mos it cannot be preserved for any length o Thus, those who are of opinion that an i may derive his reward from the profits of a manufacture, are, it appears to me, in this di either the secret is not kept, in which c profits it might bring are not made, a inventor is not rewarded, or, if it be kept, men are demoralised, production is limite is increased, and the public are injured.

Crompton commenced by a secret manu at his house called the "Hall in the Wood he was compelled to give up the secrecy unable to support the systematic siege he there. In spite of barricades to doors an dows, his house was literally broken open, who were truly burglars, for they came t commit a robbery, the robbery of his inven

But even if there were no objections to manufacture, and it could be carried on with demoralisation and risks of discovery I have to be attendant upon the exercise of it, manufacture is applicable only to those case vention, where the improvement is in the m process, and not in the article produced. A fabric, similar in its structure and appear those already known, may be better becau cheaper, having been produced in an im loom, and dyed by dyes, the use of whi hitherto unsuspected. In such a case secret facture is to a certain extent practicable, the mere appearance of the cloth does not r what means it was so cheaply made. As the weaving, however, the difficulty of would be great, but with respect to the concealment might be more easy if the i ment consisted in the application of an in which could be added by the inventor himse some one or two persons whom he might t

But in the large class of inventions, wl product is an improved one, and the very tion of it reveals the improvement, sec obviously impossible. Let me, as an illus refer you to the Giffard Injector. This in (to which I shall again have to allude) is plicable to the supplying of steam boilers w feed water, and replaces the steam donkey formerly used for that purpose. The ve mechanical engineer into whose hands one injectors came would take it to pieces, once ascertain the nature of its constructi such an instance as this there can be no re secret manufacture.

In the case I have assumed, where it may

be possible for an inventor to carry on a secret manufacture, I have taken (in favour of the advocates of such a system) the instance of a man having made an invention in his own trade, and being possessed of every facility for bringing that invention to a commercial result; but I believe it is not among inventors and inventions such as these that we must look for great improvements; the fact is, that the bulk, one might almost say the whole, of real substantive inventions have been made by persons not engaged in the particular pursuit to which those inventions relate.

Take a few instances. Watt was not a maker of steam-engines, the fire-engines of his day, but he was a mathematical instrument maker; Arkwright, the inventor of the "water twist," was a barber; Cartwright, the inventor of the power loom, was a parson; Neilson, the inventor of the hot blast, was wholly unconnected with smelting operations, he was the manager of a gas works; Wheatstone, who has done so much for electric telegraphs, was engaged in the manufacture of musical instruments; and Ronalds, the very originator of the electric telegraph, had nothing to do with the visual telegraphs in use in his time; Bessemer, who has so enormously increased the manufacture of steel within the last quarter of a century, was in no way connected with that industry. The fish-joint for railways, the greatest improvement in permanent way that has been made since railways were introduced, was the invention of a carriage builder. I trust I have given instances enough to establish my position, that the great substantive inventions are made by persons unconnected with the manufacture or art to which those inventions relate, and we can readily see why this should be. The person who has been brought up to pursue any particular manufacture has, even before he had sufficient knowledge to be able to appreciate the merits and the principles of the processes he was taught to follow, been trained in the belief that "certain ends are to be obtained by particular means."

Under such circumstances, it is difficult for even a powerful mind to break through the trammels which have been imposed upon it, and to approach the consideration of the subject of the particular art with the same broadness of view, and power of detecting and grasping the true principles upon which that art is based, as would be possessed by a mind devoting itself to the subject for the first time, and thus the man untaught and unprejudiced in the art is more likely to make a substantive invention than is one who has been trained in it from his youth.

Improvements of detail such a person may make, but there, in all probability, will be the limit of his inventions.

One can understand that a man who had been taught from his boyhood to make steel by the process of cementation, that is, by packing bars of wrought iron into brick boxes containing charcoal, and exposing the whole for several days to considerable heat, and thus carbonising the iron and producing blistered steel, might, not unnaturally, devise some improvement by which this process could be expedited, though one can hardly imagine such a man breaking with the traditions of the industry, and casting away the whole process of cementation. But one bringing a totally fresh mind to the consideration of steel manufacture would, in all probability, study the question from the very beginning, and would say, "What is steel? What is wrought iron? What is cast iron?" and when he discovered that steel was something between cast iron and wrought, that is to say, it contained less carbon than the one, and more than the other, and when he found that cast iron was a cheaper article than wrought iron (wrought iron being commonly produced from cast by practically abstracting the whole of its carbon), would seek a means by which he might abstract from cast iron, not the whole of the carbon, to leave wrought iron, but so much of the carbon as would leave steel.

To one brought up in the steel trade, the very word "steel" would be associated with the addition of carbon, and it would be most unlikely that he should attempt the manufacture by a process which had for its object the taking away of carbon.

Once concede that the great inventions are made by "outsiders," then it appears to me that to continue this, the highest class of invention, protection is an absolute necessity. An inventor must nearly in every case make trials and experiments, and these, as a rule, can only be conveniently done in places where the manufacture is being exercised; but now we are assuming that the inventor is not engaged in the manufacture; he has therefore either to incur great expense to make his experiments, an expense in many cases prohibitory, or to forego the experiments altogether, or else he must seek the aid, and trust to the honour of, some manufacturer.

Imagine a country clergyman who has a knowledge of chemistry making an invention of an improvement in smelting iron ore. If he were a man of real ability, as I have supposed, he would appreciate the great complexity, and the many practical difficulties, of that process, and he would know that nothing short of a trial of his invention in the actual furnace could assure him that his method would not be frustrated by some such difficulty.

What, without a Patent-law, is that inventor to do? Forego the trial? Devote five thousand pounds of the large property which usually belongs to a country clergyman to the erection of an experimental blast furnace; trust to the honour of a manufacturer; or give up the invention? I think the probability is, he would pursue the last course, and that thus the invention would be lost to the community.

But even supposing the preliminary difficulty of a practical trial not to exist. Assume for example that the invention be one such as that of the "Giffard Injector" already mentioned, one of the most substantive of the present day. This might have been tried in private by its inventor without insuperable difficulty, even although he were wholly unconnected with any of the mechanical arts, and he might have perfected his invention in every detail. But when he had done this, what would have been his chance of reward, how would he have set about reaping the pecuniary benefit which he would desire, and which would be his reasonable due? Would he make up his mind to forego all his usual habits of life and to become a manufacturer?

Say that he did so, and that in spite of the

difficulties to which I shall have to revert, he succeeded in making a certain number of the injectors for sale, and that then he knew enough of business to obtain purchasers for them, what would be the inevitable result. As I have already said, when taking the instance of this implement as one impossible to make the subject of a secret manufacture, the very first mechanical egineer (a steam-pump maker) into whose hands one of these injectors fell, would say "Here is an implement that appears likely to compete seriously with the use of steam-pumps. Why should not I make it? At present I know it is being manufactured by the inventor only, a person who was not brought up to trade, and who is living in a purely agricultural district; it is a hard case if I cannot hold my own against him."

Thereupon, the steam-pump maker goes to work, with all the advantages of an established factory, with its befitting plant, its staff of superintendents, its foremen, and its body of workmen to produce injectors, and with a whole system of travellers and agents, and the advantage of a large connection, to dispose of the injectors when made.

What chance would the inventor have, in his capacity of manufacturer and seller, against such an organisation as this; obviously none, therefore, as it seems to me (equally obviously) he (foreseeing this) would not have bestowed the thought necessary to invent, and even if he had, he would not have incurred the labour and expense of experimenting upon his invention.

Having shown (as I trust I have) that in those cases where the invention is one that could be exercised by the inventor, his chance of profit in the majority of instances would be but small, even if he could carry on a secret manufacture, it is almost surplusage to show, as I am about to do, that there are numerous instances in which (whatever might be the position of the inventor, as regards command of capital, business habits, and residence in an appropriate locality) it would be impossible from the very nature of things for him to reap an adequate reward.

Take the case, again, of the fish-joint on railways. This great improvement requires for its carrying out, at each joint only two bars of iron and four bolts and nuts. These can be produced at every iron works in the world, without the exercise of any unusual skill or intelligence; they are mere common articles of manufacture, yet, when applied to rails in the way directed by the inventor (a way which after years of study of the question of how to improve the admittedly defective railway joints no engineer ever thought of), it makes a joint which has added to the life of permanent way and of rolling stock, and has contributed in a great degree to the comfort of the traveller.

Take an instance of another kind, one wherein the invention does not consist in a simple "Application" of a common article of commerce, but in a "Process," say the Bessemer Steel Manufacture. Notwithstanding the trammels of a Patent-law (as the opponents of such laws would say, or rather aided by the provisions of such a law, as I should say) the Bessemer invention in 1873 produced, in England alone, 400,000 tons of steel, while in 1851 the total production of cast steel was but 30,000 tons. It seems to me fitting that one who has so far benefitted manufacture and merce should have a large reward.

By the aid of a royalty it was possible for Bes to obtain, by a small percentage on the price steel, a substantial reward, but I do not see this could have been secured to him by the derived from being himself the manufactu that which, even on the largest development works, could only have been a small fraction whole. The very magnitude of the results invention would be a bar to an adequate re unless that reward were spread over the manufacture.

There is one other class of invention nature of which renders it impossible fo patentee to be adequately rewarded (even the most favourable circumstances) by ma ture. I will instance the Regenerative Furn Dr. Siemens. This furnace, of which ther diagram on the wall, has for its object the of fuel and the attaining of high heat. La objects these. Let us see how Dr. Siemens them. He makes a large chamber, calle "Producer," capable of holding, say, three tons of coal or coke. At the bottom of this ch there is a small fire-grate, immediately above a portion of the fuel is undergoing combust the ordinary manner. The heated carbon resulting passes up through the fuel, tak carbon from it, becomes converted into ca oxide, and escapes (with any hydro-carbon may have been driven off by the heat, if t be coal) through an ascending pipe, and is le by mains to any place where a Regenerative F is to be in operation. The Regenerative F has below it two pairs of stacks of cellul pigeon-hole, brickwork. Through one divi one pair the gas from the Producer is ascen though the other division of the same pair pheric air is also ascending; the air and ga in the chamber of the furnace, combustion and heat is developed. In an ordinary f the heated products of combustion escap the air by a chimney, and, as they must lea furnace at a higher temperature than t which it is necessary to maintain the m under operation (or otherwise they woul that material), the products of combust ordinary furnaces must in all cases where temperatures are necessary, carry into t and waste a large amount of heat. I the Siemens' furnace these outgoing pr are compelled, on their way to the chi to pass downwards through the two divis the second pair of blocks of pigeon-hole bric and in their passage they give up their heat brickwork so effectually that, although the have been issuing from a furnace above th perature of melted steel, they will, on reachi chimney, not have heat enough remaining i to char a piece of wood. At the end of a time, say half or three-quarters of an hour, which control the direction of the currents and air, and of the outgoing products of co tion, are shifted, and the gas and air are now to ascend through the pair of masses of c brickwork which have just been heated by th going products of combustion, while thos ducts are directed downwards through the pair of cellular structures, which have

cooled by the passage through them of the gas and air, and thus are fit, being cool, to take out from the products of combustion the heat which is in them, and to store it to heat up the gas and air, when they, on the next reversal of the valves, again pass through them.

The success of this plan has been complete; the advantages in economy of fuel, and in the capacity to give high heat, have been all that could be desired. Moreover there are large contingent benefits, into which I will not now enter. No one will dispute that this is a most meritorious invention; it saves our coal, and it renders possible certain processes, which, with the temperatures formerly attainable, could not be carried out. But how, in the absence of protection for invention, could Dr. Siemens have derived any adequate reward? Not by practising his invention, for that, from the very universality of its application, would have been an impossibility. His furnaces are used by the manufacturers of wrought-iron, by the makers of steel, by the producers of plate and flint glass, by enamellers, by copper smelters, by nail makers, potters, and by those engaged in numerous other branches of industry requiring furnace power.

I should like to ask the advocates of the system of rewarding inventors, by letting them carry out, as manufacturers, the objects of their invention, whether they would suggest that Dr. Siemens was to embark in all the businesses to which his invention is applicable. They might say, "No; we never intended anything so absurd. His invention is a furnace, and he should embark in the manufacture of furnaces, as the inventor of an improved loom should embark in the manufacture of looms." But the answer to this would be, a loom is a self-contained machine, capable of being manufactured in one place and conveyed for sale to another, and is an ordinary article of commerce; but the Siemens' furnace is not self-contained—it is not portable. The furnace demands nothing more for its construction than the employment of ordinary materials set in a particular way, the way of the invention, and any intelligent furnace builder, to whom a drawing of the invention is shown, or who has seen one furnace, could carry out the invention.

I will now consider another class of cases, those cases where the inventors are poor men, and where, therefore, it must be admitted that whatever advantage they may have of locality, or even of business habits, they lack the greatest of all aids to prosperous manufacture—capital. How can these men, by becoming manufacturers of that which is the subject of their invention, obtain a fair reward for their ingenuity? It is said by the opponents of a Patent-law, let such men go to capitalists, explain their invention, and thus obtain the aid that wealthy men can give. What would be the result? The capitalist would say,—why should I embark my money in perfecting an invention, and putting up suitable machinery for its manufacture, with the certainty that if it turns out a success I shall have the whole trade in competition with me, and competing on better terms than those under which I should be working, because they would stand by to watch my results, and would wait until I mastered all difficulties? You are asking me to run a special risk to reap (even if successful) no more than the reward of ordinary manufacture. Moreover I don't wish to trammel myself by associating with you in business, and I cannot pay you a sum of money, because I have no security that you will not go and re-sell your invention to others.

But suppose the invention were one that afforded reasonable grounds for believing that it might be carried on by secret manufacture, that the inventor were to point this out to the capitalist, and that he were inclined to embark in that most unsatisfactory kind of business. What security has the inventor that after he has communicated his secret to the capitalist, the latter will not abuse the confidence that has been reposed in him, and either take the invention without any reward, or with only a very inadequate reward? A man can often contrive to act in such a manner without wounding his conscience. He goes to his foreman, or he consults a friend, and these tell him, "Oh, there is really nothing new in this; twenty years ago the same idea (I don't mean you know to every detail, but practically the same idea) occurred to me, and I should have carried it out, only the condition of the trade at that time did not warrant my going into fresh expenses; there really is nothing in this except the bare detail, beyond what we knew before," and so the inventor is shown to the door, and the confidential communication is abused.

I may be asked why are you to suppose knavery of this kind; why not assume that the majority of mankind are not only honest in the legal sense, but that they have a feeling of honour which would not permit them to act as you have suggested? What warrant have you for believing that inventors might not trust others with their secrets? Again, I refer you to the life of Crompton. After the trade had (as I have told you) laid siege to his house, and kept him there barricaded, and all but a prisoner, he was so wearied out that he proposed terms to his persecutors. He would reveal his secret to them if they would undertake to pay him a certain sum of money on his doing so. Many "honourable men" agreed, in writing, to pay him the sum set against their respective names, sums varying from one guinea to five shillings, and making the magnificent total of £106. Crompton kept his part of the bargain, he met his honourable fellow townsmen, showed them the machinery, explained everything, and what happened? Out of the number who had made this bargain with him, many never paid one farthing, but, furnished with the information, at once went to work in competition with Crompton, and (after having broken the eighth commandment by stealing his invention) proceeded (as I have told you already) to break the tenth by coveting their neighbour's servants; and as is usual they did not stop at coveting, but they enticed them away, and they made their temptation so strong that even Crompton's own sons deserted him and went to his opponents.

How different is the condition of the poor (comparatively poor) inventor who avails himself of our Patent-law. For a few pounds he can get provisional protection, and, the moment he has it, he has possession of a property which the law secures to him, as effectually as it secures the enjoyment of house or land. Armed with this right, he can go to the capitalist, not only without fear that his confidence will be abused, but with a

strong inducement to the capitalist to advance his aid. There is no longer a dread that when all the expense has been incurred to perfect the invention, and to bring it into actual use, the benefit will be reaped by others without special reward to those who between them have made the invention and have risked the money to work it; and thus it is that we find inventors aided, as Boulton aided Watt, and from such aid the happiest results flow.

I remember that a gentleman who had made a most meritorious chemical invention, by which a substance that had always been considered as nothing but a waste product of the most offensive kind became converted into a highly valuable article of commerce, stated before Section F of the British Association at Exeter, that he had required an outlay of £10,000 in order to test by actual trial whether or not his invention, successful as it was in the laboratory, would be equally so in actual work. He added that he was as unable to find £10,000 from his own resources as he was to pay off the National Debt, but he was able to find money enough to obtain the protection of the law for his invention, and having got this he submitted his plans to a capitalist. He advised that capitalist to call in the highest chemical assistance, for the inventor, protected by his patent, no longer required secrecy, on the contrary he courted the fullest investigation. The chemists examined, they reported favourably; the money was advanced; the whole thing was a success; and now, added the speaker, I find myself a comparatively rich man, and have beside the satisfaction of knowing that I have caused one of our manufactures to make a most important step.

I have, by a few typical cases, exposed (at least I trust I have) the fallacy of those who say the inventor, in the absence of any Patent-law, would still invent for the hope of reward, because he might reckon on gaining that reward by becoming the manufacturer of that which he had invented; but there are other opponents of patents who do not hold forth a hope of gain in this way; they say, a wise and beneficent Government should reward the "citizens who have deserved well of their country." I believe I have caught the language of the formula. I don't think these men talk about fellow-subjects of the Queen. However this may be, they gravely propose that a portion of the revenue of the State should be adjudged each year to meritorious inventions. I find it difficult to treat such a proposition as this seriously, but I suppose I must do so.

Let us see how it would work. What inventions should be rewarded? None but those which had come into actual use, or, in addition to these, inventions which were only just published. If the former, how deal with objections that would be urged by a host of men who would spring up to allege that the man who put himself forward as the first inventor was the merest visionary, and that had it not been for their real practical skill the whole thing would have remained a useless scheme. Moreover, as I shall, I hope, hereafter show, years in all probability would elapse between the publication of an invention and its adoption, if there were not protection for inventors, and in this way the unhappy inventor might be dead, or in his dotage, worn out by hope deferred, before the reward was adjudged to him, even if it were ever so adjudged, looking at the competition of pretenders that would be sure to arise. But take it to avoid this delay in compensating the inventor, it should be in the power of the tribunal to give the reward to originators of untried inventions, only imagine the cloud of schemers, both in and out of Bedlam, who would commit their crude conceptions to paper and send them to the tribunal, confident that they must get the reward. By what possible machinery could such a tribunal act to investigate novelty, degree of merit, and practical feasibility of inventions that had nothing but a paper existence. I believe that in their despair and disgust many men of intelligence and character who might have been on such a tribunal would retire from it, and that it would degenerate into a clique for perpetrating the vilest jobs.

Fancy the pressure brought to bear on such men by the member for some borough who has been assured by half-a-dozen of his constituents that their "talented townsman," Mr. Smith, is a most meritorious inventor, that he has designed a machine, which on being worked by one man, succeeds, through an arrangement of leverage and the aid of a screw, in giving off as much power as has been estimated to be equal to a good 10-horse engine. Models have been tried which conclusively proved that if (there is always an if) they had been properly made these results would have been fully attained. I may perhaps be told there must be on the committee men of sufficient sense to know that such statements were ridiculous; but in some cases I should be very sorry to abide by the opinion of any body of men, in the absence of trial, whether an invention could succeed in practice or not. I will give you an instance. Next to Earl Dundonald, one of the earliest inventors in the art, now so extensively followed, of sinking cylinder foundations, was Dr. Potts. He published an invention in which he told you, that if you placed a cylindrical hollow cast-iron pile with its open mouth upon, say the gravel bed of a river, and if you covered the top of the pile, and then exhausted the air from its interior, the pile would penetrate the ground, and would do so although, from the nature of the soil, it would be all but impossible to get the pile down, even a short distance, by the heaviest blows that could be given to it by a powerful pile driver. Dr. Potts was right in this, but, in the absence of experiment, would not the members of the Inventors' Reward Committee have come to the conclusion that the Doctor was a visionary, and that his invention could be proved to be chimerical; would they not have said that, in the instance of a pile of a foot in diameter, the utmost pressure that could be got upon it by the exhaustion of the air, even in the impossible event of a perfect vacuum, would not be quite three-quarters of a ton, that in practice it would not be more than half a ton, and that such a force, a statical one, must obviously be far less powerful than the effect of a ton weight suffered to fall on the pile through a drop of several feet, and that thus Dr. Potts's exhaustion plan could not send the pile down at all, or if it could, the pile, when down, would clearly be unable to support any load worth speaking of?

But those gentlemen who thus would have withheld all share of the national reward from Dr. Potts, on the ground that his invention must be

useless, would have been wrong, for the fact is that Dr. Potts's plan, although it only imposes on the head of a one-foot pile a pressure of about half a ton, does send such a pile down into soils which offer so much resistance that the pile when thus driven will support many tons weight without the least yielding. It being a fact that the pile did go down, and equally the fact that the mere pressure of the air upon its top was wholly inadequate to account for its being driven, attention was directed to the subject, and we know that the pile descended in consequence of the removal of the soil from below its bottom edge caused by the rush of water into the exhausted cavity of the pile.

It appears to me the suggestion of rewarding inventors generally by Government grants is an absolutely impracticable one, and that it never could be successfully carried out. There have been some particular instances of this mode of reward. I will only allude to one, and again it is Crompton to whom I wish to direct your attention. After years of the disappointment and loss to which I have referred, and after not only his townsmen and neighbours, but the kingdom itself had become enriched by the general adoption of his invention—there being between four and five million spindles at work—some persons in his neighbourhood backed up a memorial he presented to the ministry of the day, and, after much discussion, Government awarded to Crompton the munificent sum of £5,000, and at the age of 60, after having devoted 30 years of his life and all his property to the advancement of his invention, one of the very greatest that has up to the present time been made in the spinning of cotton, he received a sum equal to a stipend of £75 a-year paid to him throughout those 30 years. Probably among those who supported Crompton's memorial to the Government were to be found some of the honourable men who did not pay their promised subscriptions; perhaps their consciences had awakened, and these gentlemen thought a cheap way of satisfying them would be to make the nation discharge their private obligations, thus reminding one of the definition of charity, that A never sees B in want without feeling a strong desire to relieve those wants out of the goods of C.

If a system of national rewards were instituted, I am certain that the sums to be awarded must be wholly inadequate to compensate the really meritorious inventor, who thus would not be tempted by them to invent. That if awards were not to be made until commercial success had certified to the value of the invention, reward would be delayed and would be frittered away among numbers; that if untried inventions were to be rewarded, good inventions might be rejected, because, as in Dr. Potts' case, they would not be understood, while the whole host of pure visionaries would be encouraged, and finally that the invention which was supported by the most plausible and persistant advocacy, whether of the inventor or of his supporetrs, would obtain the reward that should be given for real merit only.

I now come to the last class of reward suggested as being sufficient to secure new inventions, and not mere inventions, but inventions carried to practical result.

This class of reward, if rather shadowy, is cheap—the honour. The meritorious inventor who has "deserved well of his country" is to be rewarded by some honorary distinction. A statue, a tablet, a public recognition in his Town-hall, and an address from the Recorder, or something of that sort; and, moreover, after such public recognition, the honoured inventor, as he went along, would hear, "Look at that man; he is the great the celebrated, Mr. Smith, who invented—what—if the steam engine or the electric telegraph, the phrase used might be understood and command respect wherever civilisation extends; but there are many great and most useful inventions which relate to manufacture, having technical terms—terms which are absolutely gibberish to those outside the trade, or if they convey any meaning at all, convey an erroneous one, and frequently an absurd one.

Once more—take Crompton—there goes the man who invented "the Mule;" that does not sound very well, but the mule itself has details. One is "Twist at the head;" imagine a man being introduced into London society as the inventor of "Twist at the head," a pretty burden his life would be made to him. Imagine Stephenson's claim to respect and attention being based upon his improvement of the "Gab Motion." It would be an unpardonable waste of your time to multiply examples. Moreover, statues, even if good, and public addresses, though eloquent, would not pay our taxes nor find us in clothes. I feel that in this room I ought not to undervalue honorary rewards. Its walls are adorned with pictures showing that in times gone by competitors were content with the applause of their fellow men, or at the utmost a crown of leaves gratified all their ambition, but I doubt whether those ages produced many inventions, except improvements in weapons, to enable man to more conveniently kill his fellow-man. Further, in those golden ages and genial climes, I think we may take it men were but lightly taxed, and certainly the tailors' and dress makers' bills (to judge by the representations on the wall) must have been at a minimum. Under such circumstances men might be content with honorary rewards; the hard realities of our times and our climate, however, make such rewards, alone and unaccompanied by something more substantial, a mere mockery of the need that they were destined to cheer. For the last time I will refer to Crompton; he, or rather his spirit, has had honorary reward. Long after his death the town of Bolton erects a statue to his memory; there was an unveiling, there were speeches. The opponents of a Patent-law might say, "What more can a man want, to cause him to devote his life to improvement, than such a posthumous reward as this?" In answer to such a demand, I think the inventor would refer the opponent of a Patent-law to Shakespeare. What says he of honour?

"Who hath it? He that died on Wednesday. Doth he feel it? No. Doth he hear it? No. Is it insensible, then? Yes, to the dead. But will it not live with the living? No. Why? Detraction will not suffer it, therefore I'll none of it."

Among all the papers on the Patent-law that I have read, and among all the discussions on that question I have attended, I do not recall any other suggestions put forward by the opponents of Patent-law, as affording adequate grounds for the

continuance of invention in the absence of such a law, than those I have now considered :—1st, That an inventor cannot refrain from inventing; 2nd, that the inventor is the man who of all others can best reap a profit from the commercial exercise of his invention; 3rd, that there should be a system of national rewards; 4th, that there should be a system of purely honorary rewards.

I can have left you in no doubt as to my opinion of the inadequacy of each and all of these suggested incentives to invention, and I will trust that most, if not all those, who honour me by their presence here to-night concur in my views; but there are men who say, "Be it even as you state, and take it that in the absence of a Patent-law there will not be an adequate incentive to invention, still it is expedient that such a law should not exist, because greater evils arise from it than would arise from a cessation of invention."

They say the evils are :—

Interference with the freedom of trade.

That British manufacturers are put at a disadvantage, as compared with those of countries where there is not a Patent-law.

That a patent for an invention, by barring the road, stops further inventions.

That patents are granted for useless things.

That patents are granted for things which are old.

That the existence of patents gives rise to expensive and difficult litigation.

That patentees are great losers by patents, and that it would be a charity to protect them against themselves.

Let us, as briefly as possible, examine into the value of these charges.

"Interference with freedom of trade." This I admit has a solemn sound; it is enough to cause many wise heads to be shaken; but don't let us be frightened at an expression, let us examine and see what it means.

Some forms of words are very startling when heard for the first time.

Let me give you an instance. Within the month, a letter was written to the *Times*, by a person using the initials F.R.S., entreating that the *Devastation* should not be sent to sea, as she must be unsafe because she had "heavy weights above her centre of gravity." This is a most alarming statement until it comes to be considered, and then it turns out to mean no more than that the *Devastation* is not a floating miracle, as she must have been if she were the first body in creation that had not as much effect from the weights above its centre of gravity as from those below it.

Now, as to interference with freedom of trade. It is said, were it not that the inventor blocks the way with his patent, manufacturers generally would use the invention, and thus the public would be benefitted. I unhesitatingly assert, as the result of many years' close attention to this question, that such a statement is entirely at variance with the facts, and before I have done I hope you will agree with me.

Take any one of the important industries, industries such as cotton or wool. The very last thing the established manufacturer wishes for is a substantive improvement, and for the following obvious reasons :—He has got his good business and his connection; his customers are pleased with that which he makes, and are satisfied with price they have to pay for his production, bec they have no experience of any better qualit of any more advantageous price, inasmuch as the supposition, this manufacturer is a man d as well as the bulk of those in his trade. his foremen, and his workmen are all customed to their own way of work, and don't want to learn a fresh system. But the one reason, of far more consequence than all together, and that is, the manufacturer many thousands of pounds embarked in machinery with which he conducts his manu ture, and that machinery is of the full valu which it stands in his books, but, compel hi adopt a substantive invention in his manufac what will then become of those thousand pounds worth of machinery? They will lose worth at once, they will be degraded their condition as machines to the stat old metal, and their value will fall many thousands to perhaps not the same n ber of hundreds, and contemporaneously this fall will be the necessity of finding a larg to be expended on the machinery required by new process. Coupled with this, there is annoyance of partial stoppage of works d alteration, of bad work being produced for time under the new process, because it is and has to be learned, of the chance of offen customers by delay, and by the inferiority of ducts arising from the bad work of which I spoken, and all this has to be incurred i hope of success by the new process, with the tainty that directly it is found to succeed, petitors in trade will one by one follow example, leaving the adopter of the new m no better off in comparison with his compe than he was before the alteration, and wit certainty that if the plan fails, even if he b ruined, he will be laughed at for his pains. M over, there is not only the difficulty of tea men new ways, there is also to be overcom frequent exhibition of sullen ill humour breaks forth when a proposition is made to trusted and honest, but narrow-minded mana foreman, that the process he has so long fol can be improved. What is the "consecrated pression used under such circumstances? " have I been working man and boy for forty at this work, and my father before me, and to be told that some man, who is ten year junior, and who never worked at the trade a knows more than I do, and can teach me my business." This is a dire offence. I hav much of it, and it has practically a greater w than might, on a first consideration, be attri to it. Remember that frequently the princi a manufactory has to rely on such men f questions connected with the manufactur that even in those cases where he knows e of his own business to be able to judge for hi the amount of resistance to improvement th be offered by men of the class I have been sidering is most serious, and they can offe resstance covertly and passively, withou possibility of their employer being able them with an absolute disobedience of c or with an active opposition. I will as to let me give two instances. One oc

about five-and-twenty years ago, at a Government victualling-yard, when an improvement in grinding wheat was being tried by the Government, at the cost, as I need hardly say, of the patentee. The improvement, if successful, as it was, would have lessened the hard work of the men, but beyond that would not have interfered with them or their foreman in any way, and yet in this case there was a great amount, not of mere passive, but active resistance offered. An inquiry was demanded and was held; it resulted in some of the offenders being discharged, while others were reprimanded. In this instance men in government employment, where they might have counted on being retained during their working life, and pensioned in their old age, risked and forfeited these advantages, and for no other cause than that their self-love was injured.

Another instance, much more recently, relates to the introduction of Siemens' furnace into a large works. This was met with covert opposition by the foreman of the department, who used to report adversely of the furnace generally, while admitting that at times it would work well. The principal having privately made his own observations, and satisfied himself that the furnace would work perfectly if it had fair play, called his foreman, and said to him, "You say the Siemens' furnace works well sometimes. Now, the furnace is not varied in construction, therefore when it does not work well, it must be because it is not properly managed. The management is under your charge, and if in the course of the next three months you cannot manage it so that it shall work well at all times, I must get another foreman who will see that it does work well." The furnace worked well from that day.

I trust I have given you reasons enough and to spare why a prosperous manufacturer, instead of seeking about for changes in his manufacture, looks upon all innovation with dislike, and wishes that, so far as his trade is concerned, "Finality" may have been reached. Pardon my using a coarse, but expressive phrase, which is that you want somebody to "thrust improvement down the throats" of manufacturers. A patentee is in the position to do this. He has his patent. Very likely he is not a manufacturer; his capital is not embarked in machinery adapted to an old style of things, he has every inducement to devote his time to persuading some one that his invention is valuable, that it will turn out so on trial; he offers to superintend all the experimental work, and thus to relieve the manufacturer from the loss of time and from the distraction of attention from his trade which must ensue if he himself or his staff have to work up an invention to the practicable stage; and then, provided with his patent, he can make an agreement with the person who first tries his invention, to the effect that if successful that person shall be rewarded by a share in the patent, or by being allowed to use the invention free of royalty or at a reduced royalty. By these means a patentee does frequently succeed in getting his invention put to work by the manufacturer, but all these means are needed to obtain this end; and, even with their assistance, it is commonly a work of years before an invention is taken up. When taken up, and when proved a thorough commercial success, then, indeed, under the pressure of the competition of the improved process, other manufacturers may wish to work the invention, and, finding themselves unable to do so except on the payment of a royalty, may raise the cry, "Patents interfere with the freedom of trade." But is this so? What freedom has been interfered with? The industry as it stood before the invention is as open to them all as it ever was, but the power to exercise the invention itself cannot be had without payment of a toll. How are manufacturers damnified by this? Suppose the inventor chose to carry on his process as a secret manufacture, it cannot I presume be contended that such a course, however undesirable, should be made illegal, and if not, those manufacturers who had not the secret would be unable to pursue the manufacture. Would anybody seriously call this "Interference with freedom of trade?" Assume that a landowner were to go to a number of manufacturers in his district and were to say to them, "There is a large and unfailing supply of water on the other side of that hill. I have had the levels taken. I have consulted geologists, and I am convinced it is practicable to make a tunnel through that hill. If it were made you would bring here a water power which would save each of you a thousand a year in the cost of coals you now use for your steam engines. I should be willing enough to make the tunnel had I the money to spare. I have not, but the water and the hill are mine, and I will contribute the water and give a right of way through the hill as my share towards the realisation of the plan if you will subscribe among yourselves the necessary funds, and when the work is completed I shall expect to participate in the profits." Suppose the majority of the manufacturers turned a deaf ear to this proposition, did not believe in it, looked upon it as hopeless that a tunnel could be made through such a rock, dreaded the great cost of water wheels, and were afraid of finding the value of their steam engines reduced to one of the purely nominal character belonging to discarded machines. Suppose, I say, the bulk of the manufacturers addressed pursued this course, and refused to aid in the work of bringing the water to the district, would it be for them to raise the outcry of "Interference with freedom of trade," or would such an outcry be just, when those of their body who in conjunction with the landowner had succeeded in overcoming every obstacle, and in bringing the water power to their side of the hill, were to refuse to let those participate in the benefits who had not helped in the works. These men might truly say, "Your trade is just as free to you as ever it was. We have taken nothing from you, but we have by our own skill and at our own risk changed the conditions of our manufacture for the better. We can obtain power cheaper than of yore, but our refusal to let you share in it is simply a refusal to give up that which is our property." If such a refusal as this is to be called "Interference with the freedom of trade," then every man who carries on a manufacture where he gets water power for nothing, if he refuses to share that power with his competitors in the neighbourhood, interferes with the freedom of trade, and every merchant who has a wharf which gives him better access to a navigable river or to a canal interferes

with the freedom of trade, unless he shares his wharf with his rivals. Such propositions one says at once are absurd, and could only be tolerated in a society of advanced Communists. But I confess I fail to see how the proposition that the use of an invention should be open to all, is not as rank communism as the condition of things I have assumed.

The second of the alleged evils is—That British manufacturers are put at a disadvantage as compared with those of countries where there is not a Patent-law.

What is the practical answer to this? Great Britain, the United States, and France, all have efficient Patent-laws, and must it not be admitted that in no other countries are manufactures so vigorous, or improvements so rife? Few countries claiming to be civilised are without a Patent-law. Switzerland has none. Holland has recently given up her Patent-law. Are these countries of progress or countries of invention? What do they do to advance manufactures? I once heard Lord Houghton say, at a discussion on Patent-law, when the absence of a Patent-law in Switzerland was cited, that he never heard of Switzerland being famous for any manufacture beyond alpenstocks and long hotel bills. So far from the existence of a Patent-law putting the country which possesses it to a disadvantage, it is the means of causing ingenious foreigners to bring to that country their various inventions which, did they cease to become property when they reach its shores they would withhold and would keep in their own land. Not only does a good Patent-law bring in foreign inventions, but it attracts good men to come and reside amongst us, and to establish works in our country. A distinguished man, whose inventions I have referred to this evening, said on the occasion of a discussion on Patent-law in Section F of the British Association, that he left his own country to settle here, mainly because the Patent-law of that country was so defective he could get no adequate protection for his inventions. That gentleman, Dr. Siemens, is a naturalized Englishman; he has vastly improved many of our manufactures, and he is at this time an employer of some thousands of workmen, and is so in manufactures which have to a great extent arisen out of his inventions.

The consideration of such facts as these makes it clear to my mind that a good Patent-law attracts improvement to a country which possesses it; and that, therefore, the manufactures of that country, instead of being placed at a disadvantage as compared with those of countries which have it not, are much more favourably situated.

The third charge against a Patent-law is that "A patent for an invention by barring the road stops further invention."

This I say, unhesitatingly, is contrary to all experience. Progress in an industry may be dormant, as it was for years in the steel trade. At last an original mind comes and makes a great improvement. After a longer or a shorter time, dependent on various circumstances, this improvement developes into commercial facts, and excites general attention. The immediate result is that a number of other ingenious men are set thinking of the special manufacture, and there follow forthwith a large number of inventions in relation to it.

It may be said, What good is this, if the in[vention] cannot be used because the first patent[ee is] there barring the road?

The answer is, that this inventor has not [...] and the law will not give him, a patent for [all] modes of obtaining his end, but only for his sp[ecial] mode, and that all inventions of improve[ment] which do not clash with this can be freely u[sed]. And further, that if the subsequent invent[ions] be for improvements upon the mode of the [first] patentee, the practical result in nine cases ou[t of] ten is that the first patentee and the subseq[uent] improver come to terms, and work their invent[ions] in common.

The fourth and fifth charges are—That pat[ents] are granted for useless things, and also for th[ings] which are not new. In some instances this [may] be so, but who except the foolish patentee suffer[s? In] the first place if the subject of the patent be not [new,] or be not useful, the patent, if not void, is void[able.] In the second place no one wants to use that w[hich] is useless, and everybody may use that which is [not new.]

The sixth charge brought against a Patent-la[w is] "That it gives rise to expensive and difficult lit[iga]tion." This, no doubt, is true, but to what ex[tent?] To ascertain the value of the fact, when conside[ring] whether or not it forms a sufficient ground for [the] abrogation of the law of patents, one should [ex]amine as to what proportion the litigation bea[rs to] the magnitude of the subject. As I have alr[eady] pointed out, there is hardly an industry in [the] kingdom which does not employ in several o[f its] branches patented processes and machines. [The] annual value of their products must [be] enormous, and must form a very large [per]centage of the value of the total mercan[tile] and commercial transactions of the coun[try.] It appears that rather more than 5,000 actions [and] suits are tried and heard each year in the sup[erior] courts of common law and equity, while in t[hese] courts 18 proceedings only relating to patents [are] commenced, and that 8½ only out of these 18 [are] pursued to a primary decision; thus, notw[ith]standing the magnitude of the interests invol[ved,] and the alleged incentive to litigation arising [out] of the nature of patents, the number of proce[ed]ings initiated is only one-third of one per c[ent.] of all other actions that are tried and heard, [and] the number of patent cases in which a prim[ary] decision is given are only 8½, or one-sixth of [one] per cent.

I do not say there may not be instances w[here] persons have been most improperly put to he[avy] expense in maintaining their rights aga[inst] patentees by whom they have been unju[stly] assailed, but is not this true of every other ri[ght] which is guarded by a law? Yet no one sugg[ests] that thereupon the remedy is to do away with [the] law and the right together. Endeavours are m[ade] to amend the law, and if this cannot be done, [the] chance of cases of hardships is submitted to, [as] being the price to be paid for a law which, [in] its general terms, is for the good, and as a [whole] contributes to that common good.

From my boyhood, until within the last yea[r or] two, certain houses at the corner of Stamfo[rd-] street were shut up, and were allowed to go i[nto] decay, and to disfigure the street with t[heir] shattered windows and broken shutters, seriou[sly] affecting the value of the opposite and adjoin[ing]

property. Here was a case of individual hardship upon the neighbours, but it was the result of a general law, which gave the control of the condition of houses (so long as that condition was not dangerous) to their owners, and no one suggested that because under such a law this mischief could be wrought, the law must be abolished. The law was a good law, but being human, was imperfect, and might be, and in this instance was, abused.

Again, we are not, even now, suffered to forget the "Claimant" and his pretensions. Here was an instance where under the operations of laws which enable a person to recover possession of an estate from which he has been displaced, a low adventurer had it in his power to harrass the rightful owners of a property by years of litigation, and to put them to an expense said to amount to over a hundred thousand pounds, to say nothing of the nearly equal expense to which he has put the nation, and all this without the slightest foundation for his claims. Here was a case of the grossest individual hardship, but no one dreams that because a fraudulent claim was made to an estate, the law under which such a claim could be made should be abolished, or that it would be wise to prevent the repetition of such an attempt at the cost of being without any law by which a rightful owner could recover property that was withheld from him.

The last statement made as to the evils of patents is, "That patentees are great losers, and that it would be charity to protect them against themselves." That patentees are, taken as a whole, losers by the time and money they expend upon their inventions, is, I think, likely, but we are considering whether the community as a whole is a loser. If we are to make classes, and to divide the population into those who take out patents and those who do not, I say that the community as a whole is largely benefitted. The amount received in royalties from successful patents would, possibly, if thrown into a common fund and distributed over all the patents that are taken out, give but a very poor return to each—a return so poor that it would not be worth while for persons to take out patents if that were to be the utmost measure of their reward. But surely the general public ought not to complain of this; they get all the intelligence, the invention, and the labour of patentees as a body for a confessedly inadequate remuneration; and they get it at this cheap rate because the reward is not uniform, but is varied—so varied that the high prizes are worth the efforts of the best men. Sydney Smith has told us, in his letters to Archdeacon Singleton, on the Ecclesiastical Commission, that if you wish to get the best services at the lowest rate of remuneration you must do so by making that remuneration unequal. He says:—"It seems a paradoxical statement, but the fact is that the respectability of the Church, as well as that of the bar, is almost entirely produced by the unequal divisions of their incomes;" and he goes on to show how men of capital and of education are drawn towards both professions by the hope of the prizes, while if the total gains were evenly distributed there would be no adequate inducement to cause any man of position to enter either profession. So it is as between the great bulk of the public and the inventors; the inventors are tempted by the few prizes, and the public thus get their invention as a whole at the cheapest possible rate.

The public, as I have said, are benefitted, the national revenue is benefitted, for the State get us much as £90,000 per annum from patent fees, and the inventors are contented; if they do not get solid gains, they live in hope; and I think it is not too much to ask, that so far as their interests are concerned, it will be time enough to do away with a Patent-law and their hopes together, when the inventors as a body come forward and demand the destruction of both.

I will say no more in support of my two propositions. The first, That in the absence of a Patent-law there would be no adequate incentive to the continuance of invention. The second, That the Patent-law is unaccompanied by any evils such as would justify its abrogation.

I may be asked, if these propositions be true, why is it that the question of the withdrawal of protection for inventions is from time to time brought forward, while it is rare to find a paper written to express satisfaction with the existing state of things?

In answer to such questions, I would say "Contented men don't discuss," "people don't run about proclaiming their content." It is the man desirous of change who makes himself heard; and further, I would ask, who are these men desirous of change? Not the inventors, that is clear; and I will undertake to say not (with very few exceptions) the manufacturers. Who are they, then? They are generally men who (with the best possible intentions) occupy their leisure in schemes for the improvement of society. Able men, honest men, and men capable, as a rule, of arriving at just conclusions when reasoning from sound premises. But it behoves such men to be extremely careful. The very position and ability that enable them to do much good when they are right, make it inevitable that they do infinite harm when they are wrong, and they are wrong if they rest their arguments upon inadequate information; and I believe it to be extremely difficult for them to obtain the necessary data, for, as I have said, they are neither inventors nor manufacturers, and therefore they have not that thorough acquaintance with the manner in which, in actual practice, inventions are originated and developed, and with the manner in which such inventions are incorporated into commercial pursuits, that should be possessed by those who undertake to be our guides in the subject of protection for invention.

In the absence of this knowledge, the very best reasoning must lead to erroneous results.

I have attended the reading of many papers adverse to the continuance of the Patent-law, but I never yet heard one of a practical character, and I never yet knew the writer of one of these adverse papers able to answer the arguments which were brought forward, in the discussions that ensued, by speakers possessed of competent knowledge.

The conclusion of such writers as I have described have very great weight with certain sections of the public, who are not at the pains to investigate the hollowness of the foundations upon which these conclusions are based. But I trust that the members of the Legislature, upon whom devolves the serious responsibility of determining

whether or not protection for invention shall be continued, will examine with the greatest care into the true state of the case, and will not lightly, to satisfy the most unwise desires of the few, determine that there shall no longer be protection for inventions. Should they unhappily take this course, my firm belief is—and I say it with the utmost earnestness—that the result would be, first the stoppage of all substantive improvement in the manufactures of this country, and then year by year the gradual falling back of its position among the nations, deprived as it would be not only of the foreign inventive talent which now so readily seeks development here, but deprived also of the talent of the most ingenious of our fellow subjects, who would be driven to foreign shores to find that reward for their skill which they could no longer obtain in their native land.

I believe also the very best of our artisan class would feel that, by the abrogation of the Patent-law they had lost the most legitimate source of aid which they had for raising themselves in life; and hard indeed would be the task to persuade these men that those who withdrew such protection did it for the good of the community.

And, lastly, I will ask, are we prepared to see the abolition of copyright? If not, we must retain a Patent-law, for depend upon it the natural sense of justice of the inhabitants of this country would never suffer so gross an anomaly as this, that while the inventor of a machine, which he had perfected by anxious thought and large expenditure, was to have no protection, the describer of that machine in a book was to have, gratuitously, a protection not only in his own land, but, by the operation of international law, in nearly all the civilized countries in the world.

DISCUSSION.

Sir Antonio Brady desired to say a word or two from the inventors' point of view; but, in the first place, he must express the intense pleasure he had felt in listening to this most exhaustive paper. The Patent-laws had recently attracted a great deal of attention, and lately at the workmen's exhibition at the Agricultural Hall, Islington, they had been able to get temporary protection for the inventions of workmen there exhibited. On that occasion, the inventive genius of English working men was displayed in such a manner as to surpass the most sanguine expectations, and the Inventors' Institute had been thereby induced to consider what means could be devised for developing and utilising the inventive genius of the country; because, much as they owed to the Patent-laws, it was evident to all who had considered the subject that they were as yet far from perfect. But for these acknowledged imperfections, many poor inventors would now be rich men, because at present they were unable to obtain all the protection to which they were entitled. Though there were two or three points which they considered of essential importance, they had determined on not going to the Government with any particular scheme, but to point out the great advances which had been made in the Patent-law of America, and the advantages possessed by inventors in that country. He was glad to find that in consequence of the deputation which waited on the late Lord Chancellor, shortly before the change of Government, steps were being taken to provide a respectable patent museum in the new building at South Kensington; and he thought there could be little doubt that this would be [illegible] towards promoting that technical education which so much had been heard of late. Allus[illegible] been made to the law of copyright, and he m[illegible] he was unable to see why an author should be [illegible] to protection for 40 years, and to 7 years after hi[illegible] and the patentee to only 14 years, with a possib[illegible] longation for 5 years additional.

Major Hotchkiss thought the argument of Mr. [illegible] well was unanswerable on every point. With r[illegible] the Patent-law of the United States he might [illegible] that America was young and growing, with [illegible] stricted supply of human labour, which had to be [illegible] mented as far as possible by invention. The [illegible] ment, therefore, had endeavoured to foster in[illegible] genius by protecting inventors, and not he [illegible] unsuccessfully. He had had the privilege, whe[illegible] of being a neighbour of Mr. McCormick, and k[illegible] meadow in which he had worked by moonli[illegible] order to avoid the ridicule of his neighbours—[illegible] reaping machine which had made him so famo[illegible] also recollected the genial and generous old [illegible] squire who had assisted him, and purchased [illegible] machine, which naturally being but rudely cons[illegible] was soon consigned to the lumber room. [illegible] McCormick, however, still went ahead, an[illegible] others stepped in, as they soon did, to cl[illegible] invention, he took his case to the supreme court, [illegible] machine was fetched out of the lumber-room an[illegible] before the judges, when judgment was at once [illegible] his favour. This showed the value of cheap an[illegible] justice in such cases, for Mr. McCormick wou[illegible] been totally unable to conduct an expensive and [illegible] litigation. He was thus encouraged to go on, [illegible] machines he now made bore a printed label show[illegible] he had taken out no less than twenty successive [illegible] for improvements of various kinds. In the [illegible] States it only cost £3 to file an application for [illegible] and this secured an impartial investigation [illegible] merits of the invention, which was speedily accom[illegible] for there was a staff of 70 examiners connected [illegible] Patent-office, viz., a commissioner, 2 assistant [illegible] sioners, 3 examiners in chief, and three cl[illegible] examiners of 22 each divided into three grades. [illegible] an application was filed it was referred to the [illegible] which it belonged, and then came on for examin[illegible] rotation. If the first examiner rejected it, and t[illegible] cant were dissatisfied, he had a right of appea[illegible] first place to the Board of Examiners in chief, an[illegible] also reported adversely, to the Commissioner of [illegible] to the Supreme Court of the District of Columbi[illegible] the Supreme Court of the United States succ[illegible] but practically very few cases went beyond the [illegible] office. In case of rejection the examiners were [illegible] state the reasons for their decision, and if the i[illegible] had been previously patented to state when and [illegible] Nothing could be more simple, the patent and c[illegible] law being classed together, though separate [illegible] were allotted to each department, and the syst[illegible] been found to work very successfully in fosterin[illegible] tive genius throughout the country. The whole [illegible] obtaining protection was 35 dols. or about £[illegible] was found that a large proportion of inventio[illegible] from men not professionally mechanicans, in fac[illegible] every rank and business in life contributed. [illegible] often the most valuable suggestions were mere [illegible] tions of existing patents, and in such cases th[illegible] generally a combined patent embodying the mo[illegible] results. Inventors from all parts of the world [illegible] take out patents in America because the foreig[illegible] the citizen stood on the same footing, except in [illegible] of a renewal, when there was a distinction. He [illegible] it would be much to the advantage of England [illegible] a similar system, for many improvements were [illegible] secret and jealously guarded, simply for want of [illegible] and easy mode of obtaining protection, the cons[illegible] being that in many large establishments it was

sible for a visitor to gain admission unless he made a positive statement that he was not interested in the particular manufacture. He hoped the day would soon come when there would be not only international copyright but international patent right, and at the least possible cost, because he held it to be essentially objectionable for the State to receive a revenue from patent fees.

Mr. W. Newmarch, F.R.S., said the current of opinion on the subject of Patent-laws seemed to be undergoing a change, there having been, some seven or eight years ago, very formidable manifestations in favour of abolishing such protection. The argument during the last four or five years, however, very much owing to the efforts of Mr. Bramwell, had been turned in the opposite, and, as he believed, in the right direction, and, after the paper they had just heard, it really required some amount of ingenuity to see what could be said on the other side. He had followed with care the course of the discussion for some years past, and so far as he could appreciate the case on the other side, he thought the arguments resolved themselves into objections grounded on the practical effects, rather than to the general principle. It had been urged, with some force, that one effect had been to stop inventions because one man, by recording a patent in somewhat vague terms, and not following it out, prevented others pursuing a similar line, and thus retarded improvement. He was not prepared to say that cases might not be adduced to bear out this view to some extent, but after all this was only a matter of detail in administration, and not an argument against a Patent-law generally. Most persons, while firmly asserting the propriety of a Patent-law, were painfully sensible of the improvements which might be introduced into its working, and assuming, as they fairly might, that the most numerous classes of inventors would be found amongst intelligent workmen, it was obvious that two essential points were simplicity and cheapness, neither of which qualifications could be claimed for the English Patent-law by those most anxious to defend it. But there was no reason why it should not be made both simple and cheap; an enormous revenue was derived, he considered most unjustly, from patents—Mr. Bramwell said £90,000—but he believed it was even more; for he agreed with Major Hatchkiss that to levy a tax on patents was a greater violation of the principle of free trade than to tax even food itself; in fact, in a country dependent upon her manufactures, and which with the progress of natural science must be more and more dependent for the extension of those manufactures on the application of invention to them, it was an obvious error. Amongst the most pressing wants were a proper index, a better organised office, and proper buildings where models might be exhibited; and if these were supplied many of the objections now raised would fall to the ground. With regard to the question of litigation, the number of patent cases tried was certainly not very large, but he had known instances in which they had gone on for days and weeks, involving enormous expense, and ending in a result satisfactory to neither party. And this seemed inevitable with the present system, under which they were tried before an ordinary jury, the majority of whom were probably totally innocent of any mechanical knowledge; and though he should be the last to suggest that English judges did not possess all the accomplishments which might be looked for in persons occupying their exalted position, it was no derogation to a man who had spent his life in mastering the intricacies of the law, to say that he was not best fitted to give a decision on an abstruse point of mechanics or chemistry. If patent cases were tried in a reasonable way, he thought provision should be made for a professional expert sitting with the judge as assessor, and for properly selecting the jury, and if these suggestions, which had been made over and over again, were carried out, he believed great benefit would result. Fortunately, the Attorney and Solicitor General had no longer that personal interest in the fees which they formerly possessed, and this was certainly a step in the right direction. He hoped the Society would make a strong representation in the proper quarter, stating specifically what was required, and urging that the efficient protection of inventors was a national necessity. The mere fact of Dr. Siemens settling in England in order to enjoy the benefit of its Patent-laws was a powerful argument, but it was only a repetition of what had taken place in former times. The cloth manufacture had been introduced from Flanders, and the silk trade from France, in a similar way, because England was the safest place to live in, and its laws were fairly and impartially administered, Other countries were now overtaking her in these respects. and it was therefore eminently desirable that her Patent-laws should be made the cheapest, simplest, and most efficient in Europe.

Mr. Galloway, as an inventor, begged leave to endorse all that Mr. Bramwell had said as to the necessity for protecting inventors, the hardships to which they were subjected, and the absurdity of supposing that honour alone was a sufficient recompense for their labours. He mentioned instances in his own experience and that of others, in which inventors had been deprived of the due reward of their exertions, and expressed a hope that an attempt would be made to secure a better application of the patent fee fund.

Mr. J. Horatio Lloyd, Q.C., said he was one of those who had the misfortune not to entirely agree with the opinions expressed by Mr. Bramwell, though he regretted that time would not allow of his stating his objection in detail, which, however, he should be happy to do if the discussion were adjourned. In 1851, when giving evidence before the House of Lords' Committee on this subject, he ventured to express the unpopular opinion that the Patent-laws not only produced no good results but actually did positive mischief, both to the community at large and to inventors. The twenty-three years which had since passed had in some degree modified his conclusions, because he had seen many valuable inventions which he should be sorry to see go unrewarded, and he had never yet been able to discover what adequate recompense could be substituted for the protection afforded by a patent. If any scheme could be devised by which the State could reward a meritorious invention, he should still adhere to his original opinion, but at present he had not been able to satisfy himself that any such method could be suggested which would work satisfactorily.

Mr. C. H. Healey said that the objection mentioned by Mr. Newmarch that patents stopped the progress of invention would generally be found to arise in cases where only provisional protection had been obtained, and to meet this difficulty he would suggest that it might be advisable not to publish the provisional specification. A suggestion which had often been put forward was that a thorough preliminary examination should be made before any patent was granted; but he took it that the present system of provisional protection, though capable of improvement in practice, offered valuable assistance to inventors, inasmuch as it gave them time to elaborate their inventions before accurately defining them. If under such a system it was laid down that the State ought not to take fees for an invention which had been already claimed by another person, they must either refuse applications of a similar nature to one for which provisional protection had been granted, until the six months had elapsed, when, in case it were not proceeded with, the invention might be lost altogether, or else the examination must be deferred until the complete specification was deposited, when, in case of rejection, the original fee ought to be returned, which would lead to great complexity and inconvenience.

The Chairman said that every speaker, with the qualified exception of Mr. H. Lloyd, seemed to agree

with the general principle that the Patent-laws ought to be maintained, though it had hardly been doubted that in their administration they were capable of great improvement. It seemed to him that Mr. Bramwell had omitted one argument which would have very powerfully supported his case, when he stated at the outset that he would put aside any consideration of what he described as natural justice, for he seemed rather to concede for the sake of the argument that property in a patent stood on a somewhat less firm foundation than that in other things. For his own part, however, he was inclined to hold that of all forms of private property—and he was far enough from sympathising with communism in any shape or form—property in patents and copyrights was that which most strongly commended itself to our sense of justice. He did not consider that he at all surrendered anything of the sacredness of private property by saying that it, like all other human institutions, must find its justification in the broad general principle of its obvious expediency and necessity for the general welfare of mankind, and he did not know on what other basis any institution could stand. If that were so, it must also be conceded that private property, in particular cases, was open to certain obvious objections, which had been made the most of, and carried to an extent which had led some ingenious persons into what appeared to him to be great extravagances. For instance, to take the broadest illustration, they all knew the objections to the existence of private property in land (which, he believed, would be found on examination, to be perfectly idle); but in the case of inventions, he could not see that any rational objection whatever could be urged against their being the subject of private property; he could not conceive how anything could be more natural, rational, and convenient than that a man should, to some extent, enjoy the produce of his own ingenuity and intelligence; and that if he invented a steam-engine or wrote a book, he should be protected in the enjoyment of what he had produced. He could understand, though he did not sympathise with, persons who said it was a strange thing that merely because a man happened to be in a particular position he should inherit a large portion of the earth's surface, and exclude everybody else from it. There was some plausibility at least about such a remark; but how did the inventor exclude anybody from anything? He was only secured in the use of that which he had made, and which but for him would not have existed at all. He therefore considered that on general principles property in inventions and in the copyright of books was the most sacred of all; nor did he think that position was in the least degree affected by the fact that it was only as society advanced, and as the importance of inventions and literary productions made itself manifest, legal protection was given to that form of property. We could not but agree with those who said that considerable improvements might be introduced into the law of patents, and that the expenses of litigation were often heavy. He had taken part in proceedings which certainly were conducted in a very dilatory and expensive manner, and this must to some extent be avoided; but, whilst fully admitting all this, there was another point of view from which the subject must be considered. It was said that the Patent-law did no good, because there was so much litigation involved in it; but his experience led him to the conviction that the fact of a great deal of litigation taking place on any particular subject showed that the subject matter was of great value. It was like saying that you ought to abolish physicians because they made large fortunes; and, therefore, while he would do everything possible to improve the Patent-law, as he would medicine and surgery, he found in the expense incurred in the one as well as in the other a proof of the importance of the subject to which it was applied. A short time ago a gentleman showed him a machine standing in a most magnificent range of buildings, and told him that it had cost him, partly in litiga[tion] a quarter of a million of money before he could g[et it] to work; but it had not only repaid that outlay [but] built the mill into the bargain. That showed [the] value of patent property, and although everyone w[ould] rejoice if it could be obtained at less exp[ense] it proved the enormous importance of protec[tion]. Too much must not be expected from reforms in [law], though he admitted their importance, and had done [all] he could to advance them; because it was impo[ssible] to make the decision of a difficult question an [easy] matter. Something had been said about experts, [and] the notion seemed to be that if you had a gentlem[an of] this sort instead of a lawyer unacquainted with chem[istry] and mechanics, he would be able to settle the [whole] matter at once. But this was a great mistake, and [those] who had had practical acquaintance with litigati[on of] this kind knew that the part which fell to the la[wyer] was just as much highly skilled labour, which i[t was] necessary to employ and to pay for at the market [price], as that of the engineer or chemist. Therefore, wh[en all] possible reforms had been effected, there would sti[ll be] patent cases with heavy fees, long bills, and great [dis]satisfaction on the part of the defeated, some[times] even on that of the successful party. The questi[on of] the validity of the patent did not arise pure and si[mple], but was often mixed up with questions of contra[ct], bona-fides, of book-keeping, and mercantile questio[ns of] all kinds, and the whole got into an extraordinary t[angle], which would prove a very difficult task for an [ex]pert to unravel. He would conclude by moving a c[ordial] vote of thanks to Mr. Bramwell for his valuabl[e and] exhaustive paper.

The motion having been carried,

Captain Selwyn, R.N., moved the adjournment o[f the] debate to that day week, as there were many gentl[emen] still anxious to speak upon it.

Mr. F. W. Campin seconded the motion, whic[h was] supported by **Mr. Hilton**, and unanimously agreed [to].

Models of Mr. Huckvale's improved railway [signal] and locking apparatus, and of his patent safety f[acing] point lock were exhibited during the evening.

THE STREET-PAVEMENT QUESTION.

The following paper has been communicat[ed to] the Committee on Road Traction by J. H. E[...], a member of the Society, and for a [...] many years member of the Common Council [and] Deputy of his ward in the City of London:—

It would not be easy to find an illustration [of the] waywardness of public opinion, and of the inab[ility], mental or moral, of the great mass of people, to [form] righteous judgment upon the various facts whic[h come] before them, clearer than appears in the contro[versy] carried on as to the merits of wood and asphal[te] pavements.

Interest and caprice struggle against manifest [public] utility, and it will be by accident, or by something [less] sordid, that the best will win. When these two [forces] contend, public good is too often used on either sid[e as a] mere pretence.

1. It is submitted that impartial examination [of the] facts determine the conclusion that asphalte is th[e best] known pavement. It has more of the qualities th[at are] useful, and less of the undesirable, than any [other] substance.

2. Friction—resistance to moving bodies—is th[e un]avoidable difficulty in the way of easy and rapid [street] transit. Asphalte causes the least friction. It is a[lmost] as smooth as the iron rail itself, and it is mor[e] elastic. Hence horse-power is by it economised gr[eatly]. A heavier weight with equal power can be moved [over] asphalte than over wood or stone, except it be on

gradients. Equal horse power will move a greater weight, hence asphalte is a better and kinder economy. A horse will draw his old usual load—almost always the utmost that he can move—with less fatigue, thus that costly and interesting labourer, the horse, can live and work longer, and will therefore be rendered more profitable to his master.

3. The horse will have a more comfortable life of it by reason of asphalte. In these times, when such refined interest is lavished on the working classes of all sorts, the horse has some claim to be considered in public improvements, seeing that he is about the best behaved of his order, rarely requiring the policeman, and rarely deserving the whip, certainly not oftener than some other classes of workers. He joins not unions, nor strikes, in truth he submits but too quietly to sometimes very hard usage and hard fare. Greed unfortunately deprives him of the agreeable advantages of asphalte, and because he can now draw more than his former normal load, he is made to draw more. Some time ago, when it was proposed to raise and level Holborn-valley, humanity urged claims on behalf of the horse, it was said he would not be urged to draw so heavy a load up-hill. An astute person said such is a mistake, "level Holborn-hill and the horse will be the sufferer in the long run. Now, in his course from Aldgate to Oxford-street he is loaded in reference to the difficulty of the hill, and therefore he is loaded under his strength for all the long remainder of his journey. Fill up Holborn-hill, and more will be wrung out of him." This applies already to tramways, and will be applied generally to asphalte. The horse is no gainer, alas!

4. By reason also of its little friction, asphalte wears away, and abrades moving bodies less, and thus it creates less dust. Its elasticity, though little heeded, helps this. Of its own proper substance the least possible is worn away. Some say it is not worn at all, but is forced out of perfect level and rolled closer, especially when there is continued pressure in one narrow line or groove. Hence it is not so well suited for narrow streets. Probably asphalte pulverises less than any known body.

5. Asphalte is in itself clean, in itself or from its own abrasion, or it is clean compared with any other kind of pavement. It may be kept clean with the least labour and cost. All matters—and there are many—which are offensive to the senses and to the health, can be and are at once easily removed with even little or no stain. The cartway may be kept nearly as clean as the footway. Asphalte presents an even, smooth, and continuous surface. All other materials are joined, and the joinings are receptacles for the worst compounds of mud and dust. Hence the footway derives much of its dirt. Utmost cleanness is a prime condition of health and comfort. Dirt begins with the street, and ends inside the house, from the cellar to the attic, wherein are blown the unsavoury matters of the street when in the state of dust. Asphalted clean streets are now especially required, seeing that disguised under fashionable costume, ladies, *i.e.*, those who do not ride in carriages, resolutely employ themselves in sweeping the dirtiest of the streets, whether of the mud or dust. The costliest and most delicate fabrics, gracefully or not gracefully attached to their persons, do the work of the besom or "squeegee." The proper course would be to let such matters flow away along kennels and sewers, but by a sort of antiperistaltic motion they are brought up into our homes, into our very kitchens and bedchambers. Moreover, what the domestic sweeps out of the house the fine lady brings back again upon her clothes and person; thus an ever revolving cycle removes and restores dust or mud poison. No sooner is the dirt of the house swept up and out, than it is brought back in no inconsiderable quantity.

6. We cannot annihilate mud and dust, but by the use of asphalte it can be reduced to its minimum, which indeed, is all that can be done in human affairs. To diminish evils is all that we can do. These are real practical gains, but understood only by observing persons. Few care about dust if it do not quite blind their eyes or make them sneeze. The poison of it they know not, nor do they care. Dust seriously injures the shopkeeper's costly stock, whether of fabrics or of watches or jewels. Whoever has looked at Cheapside and the Poultry in the granite age, looking from the Exchange westward, will have seen in clear dry summer weather an atmosphere of almost impalpable dust like fog. Under asphalte which has been down four years this is much less, indeed it is scarcely visible. Dirt is brought into our streets from distant places by carriages and by foot people quite unavoidably. Let us not through prejudice or interest infest the City with the maximum of this noisome evil, nor by block-pavement of wood, or stone, reticulate the streets with joints or meshes, wherein is collected dirt for redistribution again and again.

7. For the purposes of cleanliness asphalte bears the same relation to wood-blocks, that modern crockery or china-ware bear to the ancient wood-trencher. Who would endure the wood-trencher of very doubtful cleanness—suspicious of sand—when he can have a smooth-glazed, absolutely clean plate of earthenware? Or who would take his ale out of a wooden cup, or a gourd, if he could obtain a beaker of crystal glass, just because wood is less breakable? Better risk the breaking by slipperiness of these smooth cleanest surfaces of these plates or glasses.

8. This is clear, that carriages of all kinds last longer, much longer, when used on asphalte. The tyres, the spoke and naves, the springs and rivets, all that belong to chariot or waggon, are less shaken and not so soon worn up. Hence the money gain must be very considerable as to the greater durability of carriages which are moved over asphalte.

9. There are two evils which do pertain to asphalte to which wood-blocks are not so obnoxious. Horses do not get a sufficient foothold by which they can draw loads over gradients of 50° or 60°. For such places as London-bridge and Ludgate-hill, blocks of stone or wood must still be used. And why not? Who would insist on the constant use day by day of umbrellas and waterproofs against the contingency of a shower now and then, or of an occasional wet day? Who would keep a drag on the wheels of his carriage for the occasional incident of a steep gradient? The admitted evil of asphalte is its slipperiness in certain but very rare states of weather, such as do not occur once in 100 hours. Surely people honest and in their senses would not abandon the best known pavement because once in 100 horses are more liable to fall, and when they are fallen cannot so easily get up. When there is frost after thaw, streets are slippery by reason of ice. People just then must be more careful, and they must drive slowly, and use other appliances. Board-schools, among other things, will soon train up an intelligent race of drivers, or they will not be of much practical use. If people will drive fast without care they must bear the consequences. Give drivers of public carriages some reward if their horses do not fall, and impose a small fine if they do fall, and an effectual remedy will be found.

10. Further, seeing how much ease and rapidity of transit is now enjoyed by reason of railways, which in the centre of the metropolis are almost continuous, it is not too much to require people, even our merchant princes, to allow ten minutes more in their crossing over the small middle passage, which is only now a few 100 yards from one railway to another. By metropolitan railways they gain time by the hour, let them submit to lose time by the minute for the greatest public improvement. So dangerous is rapid driving over certain central places, that it was once proposed that all carriages should proceed at a walking pace from the Exchange, the

corner of Lombard-street, Princes-street, &c., just to the east end of the Poultry, where seven thronged streets converge. The objection made was fatal, it would interfere too much with the dearly cherished liberties of Englishmen, a liberty to be enjoyed in this case by riding-Englishman, of running down walking-Englishmen. It is no refinement to say that by the use of asphalte the brain and head are relieved of the incessant rough vibration caused by transit over stones, and this relief must be beneficial to health. Who would willingly travel London streets paved with any other material but that which causes the least vibration, shake, or jar. This one advantage, fairly estimated, will probably quite weigh against the greater slipping for horses.

11. The remedy against this one evil of asphalte is complete. The contingency, which happens only during one hour in 100 hours, is to be overcome by the abundant use of sand or gravel, or by what is better—water. Water was tried in the City for 14 days continuously, during a large portion of which long time it was not wanted; but so far as slipping was concerned, it was an effectual preventive. Can we over-estimate the folly which rejects so admirable a pavement for a remediable evil, an evil which occurs so rarely?

12. The rival material is wood in blocks. Both are comparatively noiseless; wood is indeed, more so. Asphalte returns the blow of the horse's foot, though not the noise of the wheel friction. The evils of wood seem to outweigh this one, or at most these two admitted advantages which it has—(a), wood is not slippery; (b) it is more suitable for gradients.

13. On the adverse side, wood is continuously wet or damp. Wood is porous; it is composed of bundles of fibres. It absorbs and returns wet—foul wet especially. The fibres of the wood are placed vertically; the upper ends whereof fray out, are abraded, become like painters' brush stumps, and are about as permanently dirty; or they break up like the wooden handle of a chisel which has been struck with an iron hammer, or a wooden mallet when used upon an iron chisel. This fact is beyond all question. Wood is wet or damp more or less, except during continued very dry weather. Its structure is admirably adapted to receive and hold, and then to give off in evaporation very foul matters, which taint the atmosphere and so far injure health. The comparative condition of these rival pavements was well illustrated by King William-street and the end of Cannon-street, near the railway-station, on Saturday afternoon, August 29th. After a day of much rain, one was dry and clean, the other was intolerably muddy. Absolute cleanness and dryness is a prime condition; wood is the extreme contrary of this. It is absolutely dirty, and is almost continually damp. The joints of the wood are packed with tar, stones, and mud, and become magazines of poison whether they remain dry or not. Asphalte presents a continuous smooth surface, impervious to wet, while wood-pavement, made of reticulated meshes or net-work, collects and holds dirt and damp-poison intermixed.

14. There is another evil to which wood-pavement is liable, and it should be no further used, until more proof is obtained one way or another by the experiment of a severe winter. It is suggested that an accumulation of water will form a substratum, and then by the expansion caused by frost, will dislocate the blocks, and by their uprising will render the surface very uneven, will loosen the blocks themselves, and cause them to eject water from the interstices when the thaw comes. The accumulation of water and its subsequent ejection between the wood interstices is shown already by the present condition of King William-street, especially near the statue. We need not wait for the distinct force of frost, for to-day (September 7) there are considerable pools of water (foul water) in various places, which evidently come from below. Here is all the mud of the olden time brought back again. The asphalte close by is quite clean and dry. It is usually dry an hour or two after rain. Moreover, the wood-blocks themselves are already very much worn; the interspaces have become wider and very ragged. Wood will not endure the severe action of waggon-wheels, breaking sharp flint pebbles into saws, knives, and rough wedges. These are fast destroying the wood-pavement. Not another yard of wood should be laid down anywhere until the coming winter has passed, *i.e.*, until April 1, by which time the wood-pavement of King William-street will probably be worn into rags, like old felt roofing. If such be its present ragged condition at the end of a most favourable summer, we ought to continue the experiment during the severe trial of the coming winter before extending its use. There is no need of so much hurry, except in the interest of trading parties, who would of course rather get the streets paved with wood before its evils are better known. Mr. Heywood's report, 17th March, 1874, is admirable for logical precision. It sets forth with judicial impartiality the relative good and evil of wood and asphalte. The public is left to judge. While Mr. Heywood seems no partisan, there can be no doubt that his paper leaves the fact established that asphalte is the best pavement known. In concluding these remarks, I beg to observe that I have no interest whatever in the question, other than having an anxious wish that the comparative merits and demerits of the two materials—wood and asphalte—should be candidly examined and proved by observation and experiment.

N.B.—To meet the difficulty respecting gradients it has been ingeniously suggested that broad tramways should be laid for the wheels, and a paved or macadam footway be preserved in the middle of the streets for the horses' foothold.

MISCELLANEOUS.

CITY AND SPITALFIELDS SCHOOL OF ART.

In presenting the prizes on Tuesday last to the successful students at this institution, **Lord Henry Lennox, M.P.**, said he was happy to find himself in this eastern portion of the metropolis, because he had always desired that it should have its fair share of administrative attention. He believed that he might now refer to the Bethnal-green Museum as a brilliant success, since he was informed that not less than 700,000 persons visited the museum last year. Such a museum would enable the students of these Art schools to carry still further the education they were receiving. He had recently returned from Sheffield, where he had not shrunk from expressing an opinion that the time had come when provision ought to be made in the estimates of this country for increased Art training, and further provision for technical education. While the workmanship of Englishmen could not be excelled, their taste in Art was by no means equal to that of French workmen. This was a great disadvantage to the English manufacturer in the markets of the world. It was not enough that our work was super-excellent, but we ought to foster in our working classes taste and a love of the beauty of form. He congratulated the City and Spitalfields on the change of quarters of their Art schools, and was glad to see that they distributed 23 prizes this year, against 13 last year. At present they had only night schools, but he trusted that with the new buildings they would institute day schools, which would greatly add to the number of their students. Spitalfields had been the great nursery of the silk manufacture of this country. The earlier workmen were of French origin, who, being compelled to leave their own country by religious persecution, brought with them the art and taste of the French

nation. He should be sorry if the descendants of these men fell behind in the race. The competition which English manufactures had to sustain was every year becoming keener and more severe. For himself, he could say that during a long political career he had never succeeded when he had underrated the difficulties that lay before him, and in like manner every one should do his best in recognising and preparing for the race which we were engaged in running with our foreign rivals.

THE INDUSTRIES OF DAMASCUS.

According to the accounts furnished by Vice-Consul Kirby Green, there appears to be very little, if any, prospect of the revival of the former active trade that was carried on in the ancient city of Damascus, the causes which were in operation having apparently ceased to exist. Before the existence of the Suez Canal Damascus stood in the position of the last port of embarkation for the Hedjaz, the Mohammedan Holy Land. It was the last place where the many thousands of Moslem pilgrims coming from the vast populations of Central Asia halted, not only to recruit their strength for the perilous journey across the desert fastnesses of the piratical Bedouins, but to purchase stores, baggage, animals, and other impediments, which should lessen the hardships and dangers of their passage. The Conservative feeling of fanaticism has not been able to withstand the facilities and comforts of the sea voyage through the canal to Jeddah; whilst the levelling effect of competition in trade has forced even the merchant, who takes his profit as his trading model, to have recourse to cheap profits rather than to continue to trust his bales to the slow, expensive, and uncertain conveyance of the camel caravan.

Notwithstanding the yearly decrease in the numbers of pilgrims that go to Mecca by the Desert, the expense of despatching the "Mahmal" and gifts to the holy shrine still bears heavily upon the Damascus Treasury, for its share in expediting the caravan. Did the Turkish Government follow the example of the devotees and merchants, and send its offerings by sea, it would economise more than two-thirds of the present absolutely necessary expenditure. The season of the departure of the Hadji, however, still continues to be a sufficiently important one for Damascus, as most pilgrims, especially those of the Sheii faction, are supposed to visit it, owing to its precincts holding some of the most venerated graves of their faith, and also as Damascus manufactures many of the gorgeous costumes and silks still worn in Central Asia. Large purchases of these articles are made by the pilgrims in order that they may be conveyed to Mecca and laid in the tomb of the Prophet, whereby they are deemed to acquire some of its sanctity, and are carried back by their owners to their countries, not only for personal use, but as the most acceptable of all gifts for their protectors and friends.

Several causes have been at work recently to give an impulse to manufacturing activity in the silk tissues and mixed silk and cotton fabrics of the city. The first has been the depression that has prevailed in the silk manufactories of France, whereby the raw material of this country has failed to secure a remunerative price in European markets. The second has been the great deterioration that has taken place in the durability of imported European textures, and which has driven customers who are not obliged to consider cheapness as paramount to revert to the more costly but more enduring home-made stuffs. Vice-Consul Kirby mentions that a peasant farmer, in alluding to the flimsy nature of European manufactures of the present day, pointed out to him, as a contrast, a many-coloured jerkin that his daughter, a lass of eighteen years, was wearing. He said that it was a part of a caftan of native stuff that was made for his marriage garment, and that he had only ceased to wear it last year. In connection with the subject of cheap manufactures it appears, however, surprising that no great outcry has been raised by the British merchants abroad against the usurpation of their business wherever they have established a market for imports, by German and Swiss competitors. About twenty years ago the English houses in the Mediterranean endeavoured to prevent the corn trade of the Levant and Black Sea from being taken out of their hands by accusing their Greek rivals of resorting to questionable expedients for underselling them; but the Greeks have, notwithstanding, succeeded in monopolising this branch of commerce, and in establishing a fair reputation in London, Liverpool, and Manchester; for it has been well seen that their activity has only tended to augment the wealth of these centres of industry, and that the advantage of the Greeks mainly lay in the economical way in which their establishments were worked. On the other hand, no alarm has yet been expressed by the major part of the British mercantile community at the intrusion of the German element in its foreign markets, for the new traders apply to the British manufacturers for the majority of their wares, and although the quality of them is not equal to what is or was called for by their British clients, still the quantity taken compensates for the difference. It remains to be seen whether, when the German merchant has succeeded in swamping the markets with, and accustoming them to, make-shift manufactures, he will not be enabled to obtain his wares cheaper from countries where less skilled workmen than those of Great Britain may produce them at a smaller cost. Damascus probably is no exception to most Eastern marts, and already, where formerly all the bazaar shops exposed mostly British goods, Swiss and other foreign prints and stuffs outshine, both by their brilliant colours and their numerous varieties, the older tissues. It is nearly the same with the hardware, and it is to be regretted, Vice-Consul Kirby thinks, that Birmingham has entered into competition, as have also many other British manufacturing centres, with the Belgian foundries and other producers of second-rate articles.

In the East, up to recent years, when an article was called "Ingleze," it was synonymous with asserting it to be of first-rate quality, and the fact that the well-to-do natives are commencing to revert to productions of their own looms and forges only proves that if the British manufacturer steadily refused to execute the orders of the trader in gimcracks, he would speedily find it to his permanent advantage. One other deteriorating element, owing its origin to Europe, is also at work in this country as well as in other parts of the East, to which the artistic world has been accustomed to look for lessons in the harmonious blending of colours. The garish aniline and other new mineral dyes have already captivated the eyes of the natives, who in such matters cannot be considered as having had any merit in the combination of colours that rendered their manufactures the admiration of more tutored masters. They had followed certain traditional rules as to the contiguity of divers colours, but now these are being abandoned or forgotten, as the European fabrics have brought before them all the blaze of violent contrasts. Several eminent artists who have lately visited Damascus have noticed the evil effects of the new and cheap dyes on everything now made. The carpets, and all the various textile productions of Damascus are frequently marred in this manner; and it is now impossible to find a new house decorated with the rich arabesque of even thirty years ago, while streaks of magenta, and all the shades of mauve surrounding absurd attempts at views of the Bosphorus, form the admiration of the Damascene house builder of to-day.

It is stated from Brussels that a reward of 10,000 frs. has been instituted, to be given to the colliery owner who, in the decennial period ending 1883, shall have had the smallest number of workmen killed by explosions.

BRIDGES IN FRANCE.

Some particulars, of which the following is a summary, have lately been published respecting the principal bridges in France. From this it appears that there are in that country 1,982 bridges of importance, 861 of which were in existence at the commencement of the present century, 64 were built under the First Empire, 180 under the Restoration, 580 during the reign of Louis Phillippe, and 297 since 1848. With regard to the materials of which they are built, 854 are of stone, 9 of iron; 70 are suspension bridges, 67 with masonry pieces and wooden superstructure, 14 entirely of wood, and 20 of mixed construction. 1,067 of these bridges are on national roads, 18 on military, 6 on forest, and 891 on departmental roads. Amongst the most important may be mentioned the Bridge of Bordeaux, over the Garonne, commenced under the First Empire, 501 metres in length, consisting of 17 spans, and built at a cost of 6,850,000 francs (£274,000). The suspension bridge across the Dordogne, 545 metres in length, cost 2,200,000 francs (£88,000); the bridge of St. Esprit, on the Rhone, commenced in 1265, 738 metres in length, of 18 arches, and cost about 4½ millions of francs (£180,000). The fine bridge across the Garonne, at Toulouse, cost 2,700,000 francs (£108,000); the bridge at Libourne, across the Dordogne, 4,236,948 francs (£169,477); the bridge on the Loire, at Tours, of 15 arches and 125 metres in length, cost 4,224,639 francs (£168,985); the bridge de la Guillotière, over the Rhone, at Lyons, commenced in 1845, cost 2½ millions of francs (£100,000); it consists of 8 spans, and is 263 metres in length. The penfold swingbridge at Brest cost 2,800,000 francs (£112,000); the Pont Neuf, across the Seine, at Paris, commenced in 1578, is 231 metres long, and cost about 4 millions of francs (£160,000); the Pont d'Jena, also at Paris, built under the First Empire, cost 6,135,105 francs (£245,400); the Pont de Roane, 232 metres in length, commenced in 1811, cost 6,438,561 francs (£257,542). The total length of these bridges, as estimated by the engineer of the "Ponts-et-Chaussées," is 166 kilometres (103 English miles), and represent a value of 286,507,761 francs (£11,460,314).

NEW PROCESS FOR RENDERING GLASS HAIL AND FIRE-PROOF.

The *Salut Public* of Lyons gives an account of some experiments that have lately been made with a view to testing the value of a process, invented by M. de la Bastie, a manufacturer of Bourg, for strengthening glass so as to render it not only hail-proof, but also to resist the effects of fire and accidents.

These experiments were carried out at the railway station of the Pont d'Ain at the request of the authorities of the railway company, in order to satisfy them of the value of this invention, which naturally would be of the highest importance to them, were it possible to render less liable to breakage the glass roofs, the repairs of which form a serious item in the expenditure of railway companies.

A sheet of glass 6 millimetres in thickness, held in a wooden frame, was placed on the floor of the room, and a brass ball weighing 100 grammes was let fall on it, from a height which was gradually increased until the glass was broken by the shock. It was found that falling from a height of 24 centimetres the glass was shattered by the ball.

A sheet of glass only half the thickness (viz., 3 millimetres), but which had been prepared by the new process, was then placed in the frame, and the same weight was allowed to fall upon it, gradually increasing the height, but without any effect even when dropped from the ceiling of the room.

The experiment was next continued out of doors, and it was not until the weight had been dropped from a height of 5·75 centemetres, that the plate of glass was broken. Dropped on the ground a sheet of the prepared glass rebounded slightly, and with a sound similar to that of metal when thrown down.

Another experiment was made with a view to test its resistance to fire. A slip of common glass was held in the flame of a lamp, and at the end of 24 seconds it snapped in two. The same was repeated with a slip of the prepared glass, but the flame had no effect upon it; and even after plunging the heated glass suddenly into cold water the glass was not broken. The importance of such an invention may easily be imagined, and its application in an endless variety of ways will readily suggest themselves not only to engineers, builders, &c., but to persons engaged in almost every class of trade.

RAILWAY PROJECTS IN THE EAST.

At a recent meeting of the Société de Géographie, a letter was read from M. de Lesseps, stating that his son, M. Victor de Lesseps, and Mr. Stuart, an English engineer, had returned, after ten months' exploration on the frontiers of Afghanistan and among the Himalayas. Their observations and unpublished geographical works placed at their disposal by the Indian Government gave a choice of three routes for railway communication between India and Russian-Asia:—1. From Peshawur to Caboul, Balkh, Samarkand, Tashkend, Fort Orsk, and Orenbourg. 2. From Peshawur by the valley of the river Caboul, Chitral, the Pamir table-land, the basin of the Yarkand river, the towns of Yarkand, Kashgar, Kokand, Tashkend, Ekaterinbourg, or Orenbourg. 3. From Lahore to the course of the Seloum, the river Nedridge, Shyok, Karakorum, the rivers of Yarkand, Kashgar, the towns of Kokand, Tashkend, valley of the Jaxartes, and Ekaterinbourg or Orenbourg. The first and second of these, though practicable from an engineering point of view, seem excluded on other grounds; fanaticism and civil wars prevailing in the territory to be traversed up to the Russian possessions would even preclude surveys from being made, and both Russia and England would be hostile to any project involving their intervention in the affairs of Afghanistan. As for the third route, which alone seemed feasible to the explorers, the crossing the Himalaya and Cashmere chains would be a serious undertaking; but the explorers found out that by following the valley of the Seloum and ascending to Srinagur, the capital of Cashmere, great heights might be reached by gradual slopes, as was stated before their departure by the late M. Elie de Beaumont, whose statement that the rock to be cut in case of a tunnel between one valley and another would be softer than in European mountains, had also been confirmed. The greater length of the line would be compensated by security to life; for, whereas no traveller could go from Peshawur to Tashkend by Afghanistan without danger, a journey between Lahore and Yarkand offered no serious perils. The explorers met Mr. Russell in the Himalayas with 600 mules laden with English goods, while merchandise from Yarkand is now sold in London. Cashmere, moreover, is under a tributary of the Indian Government. Eastern Turkistan or Kashgar is governed by an intelligent young sovereign, Yakoob Beg, who had just concluded a liberal treaty with England. His capital, Yarkand, with 300,000 inhabitants, would become the junction between the Anglo-Indian and the Central Asian lines, as also the starting point of a direct line to China. When England, added M. Lesseps, sees Russia extending her railways from Central Asia to Tashkend and the frontiers of Eastern Turkistan, she will not like to remain outside the great commercial traffic which will result from it.

She will hasten to promise the survey and construction of a railway facilitating her commercial interests with Central Asia and Western China.

CORRESPONDENCE.

SCHOOL BUILDINGS AND SCHOOL FITTINGS.

Sir,—In the report of our discussion on Mr. Roger Smith's paper, which was read last Wednesday, I am made to say, in speaking of Dr. Liebreich's and other school-desks exhibited at Vienna, that "The jury did not think . . . . . any which were exhibited worthy of commendation." Pray allow me to explain that this statement was intended to apply to English exhibitors only.—I am. &c.,

James G. C. Fussell.

3rd December, 1874.

GENERAL NOTES.

Brewers' Yeast.—A new method of preserving yeast has recently been brought into use in this country, by which means it can be stored and rendered available for use at any time. The yeast is pressed and dried in cakes, which can be kept without deterioration for a considerable time. Under these circumstances a large amount of yeast can now be rendered available, whereas till lately it was to a great extent a waste product, most of our bakeries being supplied with prepared German yeast, except such as are in a position to be furnished direct from the brewers with the fresh yeast.

Paper Car-wheels.—An American paper says that the Connecticut River Railroad Company is about introducing, for trial, a set of paper car-wheels under the forward truck of one of its engines. These wheels are manufactured by bringing a pressure of 350 tons upon sheets of common straw-paper, which forces them into a compact mass, which is then turned perfectly round and the axle forced into a hole in the centre, this requiring a pressure of 25 tons weight. The tire is of steel, and has a one-quarter inch bevel upon its inner edge, thus allowing the paper filling to be forced in, 250 tons pressure being required in the process. Two iron plates, one upon each side of the paper, are bolted together, which prevents the possibility of the fillings coming out. The tire rests upon the paper only, and partakes of its elasticity in consequence.

Professional Education.—The Chamber of Commerce of Bordeaux, with the view to the encouragement of professional education, has founded a superior school of commerce and industry in that town, and to facilitate the obtaining advantageous employment by young men leaving the school, either in France or abroad, has passed the following resolutions:—1. That in future the Secretary of the Chamber will keep for the use of the public a register of all the young men who have obtained diplomas of capacity granted by the superior school, together with the age and birthplace of each, and a statement of the kind of employment desired, at home or abroad. 2. That each year, commencing with 1876, the two pupils leaving the same school with the highest examination numbers may claim of the Chamber a purse of two thousand francs, in order to enable them to migrate to one of three colonies named by the Chamber; each will be armed with a special letter of introduction to the French Consul, and will only be required in return to make a report on the production and consumption of the place. The Chamber will further invite the young men to correspond with it once a year, and to send any specimens which they may deem of interest to the museum of the superior school. Should the pupils at the head of the list decline the purses, the Chamber will consider the propriety of offering them to others who have received their diplomas. The Chamber, with the aid of the authorities of the town and of the department, have also founded eight ordinary scholarships in the school.

Paper Made from Tan or Waste Oak Bark.—There have been made for many years in Germany, packing papers and cardboard from the waste bark from tanneries. One hundred kilogrammes of this substance is soaked in a sufficient quantity of water, containing four kilogrammes of caustic soda, marking 100 degrees, or of wood ashes, in a conical revolving boiler, which is heated for over five hours with steam, at a pressure of three to three and a half kilogrammes per square centimetre. The lessive is then removed, the pulp washed, and introduced into a press. The common papers receive about ten to fifteen per cent. of this pulp, the boards for roofing from twenty to forty per cent. This pulp is not suited for fine papers; the fibre is hard, not adapted to felting, does not bleach well, and an excess of chlorine destroys the cellulose.

Iron Furniture.—Amongst recent industrial developments in Germany, says a correspondent of the *Practical Magazine*, we have to notice that of hollow iron furniture, the use of which in Austria has been popular for years. In Germany, however, it is only quite lately that the first large factory for making this class of goods has been opened. Ribbon-iron, of the best quality, is taken and converted into tubing in pieces of about five metres long, which can be bent cold into any form suitable for the making of bedsteads, chairs, tables, &c. Hollow iron is stronger than solid iron, such as that usually employed heretofore, and possesses this special advantage, that the rivets hold better, and that it does not itself break so easily, as is frequently the case in solid iron, which gives way where there is a flaw.

Treatment of Tin Scraps.—In the manufacture of tin ware it is said about 6 per cent. of the whole of the plates employed disappear in the form of scraps. The enormous trade in sardine boxes produced at Nantes, in 1869, nearly 400 tons of scrap; Birmingham produces some 20 tons per week, and Paris 50 to 60 tons per month. A small quantity of these scraps has always been used in various ways, such as the addition of a small quantity to the pig-iron intended for steam cylinders; another small portion was treated by concentrated sulphuric acid, or a solution of caustic potash; but no one treated tin scrap on a large scale until a short time since. The subject has been treated by M. Kuenzel, in the *Bergund Uttannannische Zeitung*, and an abstract of his paper is given in *Iron*. The mode employed comprises four chief operations:—1. Treatment of the scraps by means of boiling in water acidulated with hydrochloric and nitric acid, until all the tin is dissolved. 2. Precipitation by means of zinc of the tin contained in the above solution and washing of the precipitate. 3. Solution of the precipitated solution in hydrochloric acid and crystallisation of the chloride of tin. 4. Utilisation of the iron scraps when despoiled of the tin.

Petroleum in Russia.—A new industry is springing up in Russia—the obtaining of petroleum. This mineral oil is found in enormous quantities in the Trans-Caucasus, particularly at Baku. The abolishing of the excise on petroleum in 1872, which led to the sale of the innumerable oil springs to private persons, and to the establishment of the Baku Petroleum Company, gave an impetus to this business. In about eight months after the abrogation of the excise, near the town of Baku alone were established as many as eighty works for preparing mineral oil for the market. The Baku Petroleum Company are projecting many measures for an extensive development of this industry in Russia. Besides the laying down of a system of pipes or drains, leading from the oil springs of Baku to the Caspian Sea, the company proposes to erect in every considerable town of the Volga enormous reservoirs or tanks, to contain the raw oil. Refining works are to be erected. In connection with this branch of the business it is proposed also to form establishments for the manufacture of such products as machinery oil-gas for illuminating purposes. A steam navigation company has undertaken the carriage of petroleum in the Caspian and on the Volga, and are constructing special vessels for transporting mineral oil in bulk, thus doing away with casks. The development of the petroleum trade is expected to give an impetus to the steam navigation of the Volga, which has suffered a good deal of late owing to railway competition. This industry will no doubt exercise an influence on many other industries, among which the construction of machinery and plant required in that business will form no inconsiderable item. It is calculated that the company will obtain at starting about 170 tons of mineral oil in twenty-four hours.

Fine Art Workmanship in France.—For the end of October the Central Union of Fine Art, whose exhibition is still open at the Palais de l'Industrie, organised a competition in artistic and manufacturing ornamentation. The competitors had to execute, in modelling or drawing, one of three portions of the following programme:—1st. The decoration of a vase, by the reproduction of flowers and plants; 2nd, the decoration of a vase with the aid of ornaments; 3rd, the execution of a design for a time-piece for the library of the Central Union. One hundred boys and eighty girls took part in the competition; twenty of them modelled in clay one of the three subjects, while the others drew the designs in the six hours during which the competition lasted. To the boys were accorded four prizes of the first class and three of the second; and to the girls, one first prize and two second. The same judges accorded to the exhibitors thirteen gold medals, worth 100 frs; twenty silver medals, worth 50 francs; two bronze medals, and certificates of honourable mention.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for the Wednesday evenings before Christmas have been made:—

December 9.—Adjourned Discussion on Mr. F. J. Bramwell's paper on "The Expediency of Protection for Inventions."

December 16.—"The Sandblast and its Application to Industrial Purposes," by W. E. Newton.

N.B.—The reading of the paper, announced for December 9th, on "The Protection of Buildings from Lightning," by Dr. R. J. Mann, has been postponed till after Christmas.

Cantor Lectures.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows:—

1st Course.—"Alcohol: Its Action and its Use." by Dr. B. W. Richardson, F.R.S.

2nd Course.—"On the Material, Construction, Form, and Principles of Tools used in Handicraft," by the Rev. Arthur Rigg, M.A.

3rd Course.—"On some of the Forms of the Modern Steam Engine," by F. J. Bramwell, F.R.S., President of the Institution of Mechanical Engineers.

The following is the syllabus of the first course:—

Lecture I.—Monday, December 7th.

The history of Alcohol in relation to its varied service to mankind—in the Arts and in Science.

Lecture II.—Monday, December 14th.

The Alcohol group of organic bodies.—Respective action of different Alcohols.

Lecture III.—Monday, December 21st.

The influence of Common or Ethylic Alcoho animal life.—The primary physiological actio Alcohol.

Lecture IV.—Monday, January 18th.

The position of Alcohol as a food.—Its effects o animal temperature.—Hygienic considerations.

Lecture V.—Monday, January 25th.

The secondary action of Alcohol on vital functio Physical deteriorations of structure—general and s —incident to its excessive use.

Lecture VI.—Monday, February 1st.

Influence of Alcohol on the nervous organis with special reference to the mental phenomena ind by its use.—Summary.

Members are privileged to introduce *two* fri to each of the Ordinary and Sectional Meetin the Society, and *one* friend to each Cantor Lec

SCIENTIFIC MEETINGS FOR THE ENSUING W

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., (Cantor Lectures.) By Dr. B. W. Richa "Alcohol; its Action and its Use."
Farmers' Club, Salisbury-square, E.C., 5½ p.m. Herbert J. Little, "The Future of Farming."
Royal Institution, Albemarle-street, W., 2 p.m. G Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7 Mr. John Phillips, "On the Forms and Construct Channels for the Conveyance of Sewage."
Institute of Surveyors, 12, Great George-street, S p.m. Mr. W. Sturge, "Agricultural Geology (Western District)."
Entomological, 12, Bedford-row, W.C., 7 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m.

Tues. ...Medical and Chirurgical, 53, Berners-street, O street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westm S.W., 8 p.m. 1. Continued Discussion on "Am Railway Construction and Management." 2. M Dyce Cay, "Aberdeen Breakwater." 3. Mr. Roff, "Kustendjee South Jetty."
Photographic, 9, Conduit-street, W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, 1. Mr. Rooke Pennington, "Notes on some Tum Stone Circles, near Castleton, Derbyshire." 2. J. Walhouse, "Some account of a Leaf-wearing on the Western Coast of India." 3. Major Go Austen, "Further Notes on the Stone Monuments Khasi Hills."
Royal Colonial (at the Society of Arts House), "On the best means of drawing together the int of the United Kingdom and the Colonies," by th Mr. C. W. Eddy.

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., Adjourned Discussion upon Mr. Bramwell's Pa "The Expediency of Protection for Inventions."
Graphic, University College, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, 3 p.m.
Royal Society of Literature, 4, St. Martin's-place, 8 p.m.
Archæological Association, 32, Sackville-street, W.,

Thur....SOCIETY OF ARTS, John-street, Adelphi, W.C., Conference to Discuss "The Steps to be taken to prompt and efficient measures for Preventing the tion of Rivers."
Royal, Burlington House, W., 8½ p.m.
Royal Society Club, Willis's Rooms, St. James's, 6. p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri.......Astronomical, Burlington House, W.C., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 Annual Meeting.

Sat......Royal Botanic, Inner Circle, Regent's-park, N.W., 3

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,151. Vol. XXIII.

FRIDAY, DECEMBER 11, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

The Council have arranged with Prof. McLeod, of the Indian Engineering College, Cooper's-hill, to deliver two lectures on Wednesday, January 6, and Wednesday, January 13, at 3 p.m. The subject will be "The Work and Food of the Iron Horse."

COMMITTEE ON RAILWAY LAMPS.

A meeting of this Committee was held on the 8th inst. Present—Seymour Teulon (in the chair), and the following representatives of railway companies—R. Bore (L. and N.W.R.), J. Campfield (G.W.R.), M. Garrod (G.E.R.), R. C. Mansell (S.E.R.), R. Moon (L. and N.W.R.), E. M. Needham (Midland R.), R. Robinson (G.W.R.), T. S. Speck (M.D.R.), J. Strafford (G.E.R.), W. H. Stratton (L. and S.W.R.), J. Tomlinson (M.R.), E. W. Verrinder (L. and S.W.R.), with P. Le Neve Foster, M.A., Secretary.

The Committee took into consideration the various oil and gas lamps submitted to them.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held on the 5th inst. Present:—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), F. A. Abel, F. J. Bramwell, F.R.S., Dr. Mann, Capt. Douglas Galton, C.B., F.R.S., Dr. David S. Price, Capt. R. A. E. Scott, R.N., Rev. Arthur Rigg, with P. Le Neve Foster, M.A. (secretary).

The Committee considered their report and adopted it, subject to a final revision at the next meeting.

POLLUTION OF RIVERS.

A Conference was held yesterday (Thursday, December 10th), at 3 p.m. "On the steps to be taken to ensure prompt and efficient measures for preventing the pollution of rivers." The Right Hon. Lyon Playfair, C.B., M.P., F.R.S., LL.D., was in the chair.

The following papers, having been submitted to the meeting, were taken as read, and a discussion then ensued, a report of which will be given in next week's *Journal* :—

THE ACTION OF THE COUNCIL OF THE FISHERIES PRESERVATION ASSOCIATION.

The Council of the Fisheries Preservation Association have done me the honour to invite me to state briefly their proceedings on the subject of the pollution of rivers, including the public meeting they organised and convened in June last. After having been mainly instrumental in procuring the appointment of the Royal Commission to inquire into the pollution of rivers, whose elaborate reports from time to time have prepared the way for legislation, and after having sent deputation after deputation to various members of successive Governments urging upon them the necessity of acting upon the Commissioners' reports, but having failed to meet with any more re-assuring reply than that the Government would consider the matter, the Council determined to introduce a Bill themselves, so that, even if they failed to pass it, they might ascertain the amount of public sympathy and support such a measure would be likely to elicit. It should be mentioned that Mr. Stansfeld, in the Public Health Bill of 1872, had inserted clauses that would have in a great degree met the evil of river pollution, but upon great opposition being manifested to those clauses by manufacturers and others, he withdrew them from his Bill.

The Council's Bill of 1873 was introduced into the House of Lords and referred to a Select Committee; the late period of the session, at which the committee reported, did away with all hope of carrying the Bill any further that year, and it was withdrawn by the Duke of Northumberland upon the understanding that it would be re-introduced in 1874, unless Government took up the matter, which they half promised to do.

The objects of that Bill were two-fold—

1st. To absolutely prohibit placing all solid matter whatever in any river.

2nd. To make it illegal after the passing of the Bill to open any new sewage works, or any new drains or channels conveying any new liquid pollution into a river, or, in other words, to absolutely prohibit the creation of any new pollution.

With regard to the first, the pollution by solids, all persons seemed agreed upon this, that it was quite feasible to keep solid pollution from rivers, and the opposition to that part of the measure was small. It was against the second part of the Bill, that relating to sewage and liquid matter, that the opposition was directed. The clauses relating to this subject were mainly taken from the Thames Navigation Act, 1866 (29 and 30 Vict., c. 89). That Act (sec. 63) prohibits any sewer, drain, or pipe being opened into the Thames, or any sewage being allowed to pass along any drain into the Thames, or any drain to be opened into any watercourse, so as to allow sewage to pass through it within three miles of the Thames under a penalty of £100 and £50 a day. As regards pollutions existing at the time that Act was passed, it was provided that the pollution was to be discontinued within three years from its passing, or within such further time as the Thames Conservators might fix. It was considered by the Council that if these powers, which have been law for some years in the case of the Thames, were made law for the whole country, the basis of a very effective measure to prevent the pollution of rivers would be laid, and that they could point to the precedent of the Thames Act being in force as the justification for the powers they sought for in their Bill.

From the experience gained when the Bill was under discussion, there are three points to which

especial attention should be directed in future legislation.

The first, the definition of "River." The manufacturers, and those who oppose any measure for the purification of our streams, desire to narrow this definition as much as possible, so as to exempt from the operation of any legislation tidal waters on the one hand and small brooks on the other; but it is of the greatest possible importance to make the definition of "river" as wide as possible. For if pollutions of the tideway are allowed, the waters situate at the head of the tideway are kept in a continual state of impurity by the ebb and flow of the tide, and large towns situate on such parts of the river as are tidal have the accumulations of filth daily washed backward and forward before their doors, and the evils caused by pollutions are intensified. If small brooks and streams are permitted to be polluted, as many of them now are, they furnish reservoirs for polluting matter, which, if it passed as it collected into the river might possibly do comparatively little harm, but which after collecting for some time, and remaining until a storm comes and clears out the brook, forms such a mass of pollution as seriously injures and contaminates not only the brook but the river itself. It is of primary importance, therefore, in any legislation to make the definition of "river" as wide as possible.

The second point is perhaps the most difficult question of all, the definition of what substances are to be regarded as polluting. Is sewage to include all matter that comes from a sewer, whatever may be its origin or character, or only sewage proper? Unless the definition is as wide and comprehensive as possible, so as to include all deleterious substances, whether solid or liquid, the statute will be a failure. The Pollution Commissioners have given some nine standards, which were incorporated into the Council's Bill, and which the Commissioners say are the minimum amount of pollution that should be allowed; but it is much to be feared that if it is to be a question of the degree or extent to which pollution is to be allowed, the legislation will be a failure. The only effective way will be to make the discharge of all substances into a river penal, leaving the person who causes or permits the pollution to prove that no harm has been, or is likely to be done. To show that this is possible, reference may be made to the Gas Works Clauses Act 1847, 10 Vic., c. 45. That statute makes it penal for any gas company to do any act in the making or supplying of gas that shall foul any stream, reservoir, aqueduct, pond, or place for water, under a penalty of £200. The result of this stringent legislation is that pollutions from gas works are comparatively rare, and that the refuse from gas manufactories is almost always turned to account.

The last point is as to the authority to whom the execution of an Act for preventing the pollution of rivers is to be entrusted. If the Act is to be properly carried out, it must not be left to town councils, or vestries, or ratepayers, or any local authorities. They will naturally be loth to prosecute their most influential neighbours or fellow-townsmen, and still more themselves, or to incur any expense in doing away with any pollutions they themselves may cause. Accordingly, unless the execution of the Act is entrusted to some independent authority superior to local consid tions, it will be a dead letter.

These points, the definition of the word "Ri the definition of "Sewage or polluting mat and "the authority to carry out the Act," points that require the greatest care and consid tion in framing any new legislation. Other ma there are of great, but really of minor import compared with those above mentioned. How much persons may differ as to what the provi of any statute dealing with the pollution of r should be, all will agree in this, that it wou better to have no legislation at all than to an Act that nominally did great things, but w by means of narrow definitions and subtle pro would in reality leave matters very much as are at present.

J. W. Willis Bu

THE POLLUTION OF RIVERS BY BLEACH DYEING, PRINTING, &c.

The question asked me by your Secretar "What I propose more especially in referen the pollution arising from print-works and tories of that description?" Perhaps the answer would be to give a brief descriptio what I do at my own works. I carry on business of a calico printer, which consist bleaching, printing, dyeing, and finishing c cloth. On the stream above me there is a p works for blacks, and also a market bleach w The stream as it comes to me is run into servoir, and settled—then filtered. From t three million gallons are filtered daily. water after being filtered is no softer, but colourless. This water we use for the va processes connected with bleaching, dyeing, printing. The water, after being fouled in various processes, is collected, and delivered three different pits or reservoirs. One pit i collecting all the spent dye liquors from ma and its derivatives, and from alizarine. believe every print works now collects and or sells the deposit from this series of spent it is unnecessary to dwell upon this part of pollution.

The second pit is for collecting all the soap liquor. This being highly coloured dye-stuffs is a great source of pollution allowed to go into a river, and used to show for many miles below us. This second pit h division in it, making it, in reality, into two of equal contents, each containing about 150 yards of liquid, which is about one working production of such coloured liquid. This li is treated with chloride of calcium and a s addition of lime, which throws down all colouring and greasy matters along with all fibrous and flocculent matters in the liquid. deposit is allowed to settle all night. The supernatant liquor is then decanted off, and deposit put in a wooden cistern, where it i composed by hydrochloric acid. The whole tents of the wooden cistern are run on to fla cloth stretched on a frame. The fatty a colouring matters, and all the other solid mat are retained on the flannel. The liquid, whi chloride of calcium, passes through the fla and goes in to precipitate the spent soap li

made the next day. The deposit on the flannel is a highly-coloured, dirty, greasy mass, which is taken off with a spade, thrown into casks, and sold. The decomposition of soapy solutions by chloride of calcium is not new, but it is quite unreliable and impracticable with spent liquor from calico, inasmuch as the matters thrown out never settle so as to make it practical to separate properly the deposit from the liquor. The slight addition of lime makes the process unfailing, and it never requires more than one night to be thoroughly done. I have not known it once to fail of the desired result since I adopted it some years ago.

The third reservoir is for collecting and settling all foul waters or liquids of whatever sort which are not collected in the reservoirs already mentioned. Such are spent kier liquor, first washings after "boroking" or dyeing, acid and alkaline washings, spent logwood, brazil, sapan wood, and other wood dyes, &c. This reservoir contains about 6,375 square yards of surface. It was a few years ago in several divisions, and I collected several of the deposits separately. Many of such deposits I know would be valuable if they were collected at many works, so as to give sufficient quantity to make it worth exportation. The amount collected at one is not worth troubling with.

These divisions are now removed, with the exception of one, which is left for the purpose of making the surface of the polluted waters decant over to the outlet division.

In this reservoir the acid and alkali neutralise each other and lose their solvent powers, and the colouring matters and other impurities fall out. The effluent water as it flows into the brook is without perceptible colour when it is an inch deep in a white basin seen in strong daylight. It is 25 per cent. softer by Clark's test than the filtered water we start with. The acid we use is the hydrochloric or spirits of salts of commerce, and the alkali we use is soda. There results one and a half grains of common culinary salt to the gallon of water as it passes us in the brook. No allowance is made for this when I say that the water is 25 per cent. softer when it leaves us. It is actually so summer and winter.

Although I spent a deal of time, and at least double the money that I would now find necessary to make the proper arrangements, I find that by preventing the pollution of the stream I get a good percentage on all the money spent, and that after having paid all working expenses.

Black dye works of all other print, bleach, or dye works make the greatest display in the pollution of rivers. I found, in every trial I made with such polluted water, that a slight addition of lime, so light as to leave no excess of lime in the supernatant liquor, will precipitate this black colour. In fact I have used, for more than twenty years, lime in such quantity so as to throw out the black dye in our stream before I used it when required.

A friend of mine, who has such works, called upon me some time ago to say that he was served, or going to be served, with an injunction for blackening the river. I showed him what I did. He wrote me, about a year ago, that the plan was a perfect success. Since being asked by you to supply information, knowing that practical and reliable information as to such works was of even more importance to you than that about works like mine, I wrote to him saying that if he would give the result of his experience it would be useful to the present meeting. I have in my hand his reply, dated December 1st, 1874, in which he says:—"It affords me great pleasure to answer yours of yesterday. Your plan for preventing pollution of the stream has answered perfectly with us. The cost is quite nominal, and we are in hopes will be much more than covered by the sale of the refuse. Since we adopted your plan the water, with the exception of about two hours, when there was a leakage in one of the paddles, has been sent down the stream clearer and purer than it reached us."

I may add that there is no patent, royalty, nor restriction of any kind to prevent any one using this plan, in whole or in part, or to any extent, and selling any or all of the products in the open market.—I am, &c. John Thom.

Birkacre, Chorley, Lancashire.

RIVER POLLUTION.

1. It is a trite remark that the pollution of our rivers by excretal matters and manufacturing refuse has become a serious evil. Fifteen or sixteen years since, the Royal Commissioners to enquire into the best mode of distributing the sewage of towns expressed themselves as follows, and the magnitude of the evil has since greatly increased:—

"This condition of rivers has been a public and national nuisance; it interferes with the convenience and comfort of all classes of the people; it damages various and important interests, as those connected with manufacturing establishments, canals, fisheries, and so on; it deteriorates property to a large extent, and as interfering with a main source of water supply, is of serious importance to the public health."

2. Although it may be in some instances very difficult to accomplish the thorough purification of sewage water, which in the present state of our knowledge can only be effected by irrigation, or filtration through large masses of earth, remedial measures of a very simple kind, but of considerable efficacy, can always be adopted.

The Sewage of Towns Commissioners say:—

"The chief part of the nuisance arising from the discharge of sewage into rivers and streams may be obviated by simply arresting the solid matter in suspension in the liquid, for that by far the greater part of the solid matter which is held in suspension in water is readily deposited in rivers, covering the banks with mud, permanently raising the beds, gradually destroying the scouring power of water, and partially silting such rivers up; and that in some instances these deposits have accumulated to such an extent as to impede navigation, to render the surrounding country subject to floods, and to entail a vast expense in periodic cleansing. That, however, the appearance of the water may be improved after these deposits have taken place, yet the deposited matters lying in the bed of the current are under conditions favourable for putrefaction, and when the foul mud is disturbed by the prevalence of rain and during floods, it sends forth its effluvia amidst the populations which are near, and even in the course of the rivers far distant."

3. If the mere removal of the solid matters of sewage before casting it into rivers will produce so much improvement, the question naturally arises—Why have not then these simple measures been long since adopted?

4. The causes of this delay may be traced; first, to the fallacious hopes which have been excited of the profits to be derived from sewage irrigation;

second, to the pride which town councillors in common with all Englishmen take in dabbling with farming. The question has consequently turned too much upon agricultural utilisation, and although the Sewage of Towns Commissioners have contributed to giving it this aspect, nothing was farther from their intentions. They observe fifteen years since (and the condition of things which they describe is the same now):—

"Throughout the discussions that have hitherto occurred upon this question, the real issue has been left comparatively in abeyance. The primary consideration is not whether the sewage can be made serviceable to agriculture, but whether or not there exists any method which, consistently with a fair expenditure of money, falling on those who ought in justice to bear it, will practically rid us of the nuisance and danger attendant upon town sewage."

5. In truth, however, whether sewage irrigation is to be employed or not, (and it must always be borne in mind that, without irrigation or its equivalent in earth filtration, such as has been recommended by Dr. Frankland, and practised by Mr. Bailey Denton, complete purification is unattainable), no advantage is gained by the employment of the liquid in its raw condition. On the contrary, the removal of the solid suspended matters, to which the Commissioners attribute the chief part of the nuisance arising from the discharge of sewage into rivers, cannot be avoided. Mr. Hope, of Romford, than whom nobody is more qualified to speak on this subject, and who has carried sewage farming to a degree of perfection which has been unattained elsewhere, says:—

"It is because, in my judgment, sewage irrigation cannot be carried out from the utilisation point of view without storage tanks, that it becomes necessary to deal in some way with the sludge, because if you store you cannot avoid deposition."

6. If the sewage is to be completely cleansed by intermittent downward filtration, it is hardly necessary to point out that purification can be carried out on a far smaller area and with greater certainty when the solid and slimy matter has been previously removed. The great difficulty in all filtering operations arises from the clogging of the pores of the filter.

7. The following conclusion is then forced upon us, the removal of the sedimentary matters from sewage before discharging it into rivers will not only cause great diminution in river pollution, but will materially assist in any further steps in purification, and is indeed a necessary prelude to them.

8. If compulsory measures stopped at this point, the case of towns which are situate on broad estuaries and rivers of very large volume would be sufficiently met, so far as the question of polluting the water is concerned, but in the case of small streams more might be done without pressing heavily upon towns. By adopting some method of precipitation as an auxilary to subsidence-tanks, a much more perfect removal of the suspended matters is effected, and the dissolved nitrogen is reduced in amount by more than one half. The Rivers Pollution Commissioners found by trial at Leicester and Stroud a diminution of sixty per cent. of the nitrogen; a diminution of sixty per cent. took place when lime was used as the precipitating agent; 54½ per cent by the A B C process; and 52 per cent. by sulphate of alumina. Considered therefore as an aid to purification, precipitation is to be highly recommended, and if earth-filtration is to be resorted to, it is most important accessory. The Rivers Pollution Commissioners say in their fourth report:—

"We demonstrated in our report on 'Pollution,' arising from the woollen manufacture (1871) vol. i., p. 33, that very foul waste liquors from woollen dye works can be efficiently purified by intermittent filtration through earth, at the rate of about one gallon per cubic yard of earth per 24 hours. But this is a very slow rate of filtration; and we expressed a hope that it might be considerably accelerated by mixing the liquor with a small quantity of slaked lime before allowing it to flow upon the filters. This anticipation has been realised; and we have been able, as the following analytical results show, to purify approximately six times as much of the limed as of the unlimed liquor per cubic yard of earth."

9. It might, however, reasonably be supposed that inasmuch as precipitation removes from the liquid one half of the chief fertilising as well as putrescent element of sewage, namely, the nitrogen, it must be prejudical from the utilisation point of view; but we have the assurance of the most eminent living agricultural chemist to the contrary. Mere subsidence will not remove the whole of the glutinous matter of sewage, but precipitation does so. In the evidence given by Dr. Voelcker, before the Parliamentary Committee on the Birmingham Sewage Bill, he stated:—

"The chemical precipitation of the sedimentary matter, which is of very little agricultural value, removes the impediment in the application of sewage to the land, which is so great that many farmers, who I have no doubt would use the clarified liquid, will not use the raw liquid on account of the sedimentary matter, which forms a deposit, choking up the pores of the soil, and therefore in a great measure neutralising the fertilising effects which the substances in solution would otherwise produce."

10. When to this evidence is added that which was given at the same inquiry, on the question of creating nuisance, Dr. Letheby stated:—

"Sewage run upon land without being previously defecated by chemicals will be a nuisance wherever it is put on."

and in this view he was supported by Mr. Hawksley, Dr. Frankland, Dr. Odling, and Dr. Voelcker.

11. The result of this testimony was that the committee recommended the Legislature to enact that "no sewage be put upon land without having been previously defecated in tanks."

12. The Sewage of Towns Commission it is to be remembered had long since pronounced the following opinions:—

"That, considered merely as the means of mitigating a nuisance, these precipitating processes are satisfactory; that the cost of them in any case is such as town populations may reasonably be called upon to meet; that the necessary works need not, if properly conducted, be a source of nuisance; and that by modifications of the existing methods even the slightest risk of nuisance may be entirely obviated.

"The more this subject has been investigated the more convincing is the evidence that there is no town which might not, with reasonable care and at moderate cost, greatly mitigate the existing evils, where it may not be practicable wholly to remove them.

"Our conclusion, then, is that in the absence of the means for the direct application of sewage to land, the methods of precipitation at command do actually offer remedial measures of a very satisfactory character."

13. Since, then, the greatest authorities on the sewage question (agriculturists, chemists, medical men, and engineers), all agree in recommending as a preliminary to irrigation and filtration, the very

processes which a Royal Commission fifteen years since declared to offer, "remedial measures of a very satisfactory character," and a Parliamentary Committee, after a patient and protracted investigation, has concurred in the same view; what reasonable objection can there be to compulsory legislation to this extent?

14. My proposition is, that the Government may safely be advised by this Congress to enact such measures as shall readily and quickly effect:—First, "That excepting in heavy storms of rain no sewage shall be cast into any river or stream if it contains in suspension more than a certain amount of matter proportionate to the volume of the stream into which it is cast." Second, "That within a certain distance of dwellings no sewage be put upon any land without having been previously defecated in tanks."

H. Y. D. SCOTT, C.B., Major-General.

SUGGESTIONS BY WILLIAM CROOKES, F.R.S.

In a discussion on this important subject (one to which I have for many years devoted much of my attention), I think it desirable that the members of the Society of Arts and the public, through the Society's *Journal*, should have before them at the meeting called for the 10th December next, the system I advocated before the Committee of the House of Lords, in July 1873, on the Pollution of Rivers Bill. I send herewith extracts of my evidence on that occasion as they appear in the printed report, but as these may be considered too extensive for the Society to print, I will briefly summarise the opinions I then gave, founded on an experience of many years.

I would recommend—

1. That any Bill for preventing the pollution of rivers should be elastic.

2. That each river ought to have its own scale as to the required purity.

3. That each river should be under some central authority, who should be allowed a certain latitude as to its pollution by towns or manufactories.

I would recomend an Act similar to what is called the Alkali Act, which under the able inspection of Dr. Angus Smith is working well, and has caused very satisfactory improvements in all the alkali works of the kingdom. Dr. Angus Smith, who is an experienced chemist, goes round to the different works and advises how to get over a special difficulty. He is lenient with them at first provided he sees they are anxious to avoid breaking the Act and are taking measures with this view. Very few legal proceedings have been necessary, and yet practically speaking 98 and 99 per cent., and in some cases even the whole of the noxious gases, have been condensed.

4. That the waste water of manufactories should be turned into the sewers and be treated with the sewage.

I speak from practical experience on this point. At Leeds a great deal of dye liquor is thrown into the sewers. I have experienced no difficulty in purifying this dye-mixed sewage and sending out a perfectly good effluent water. I have practically proved this on a scale of about 2,000,000 gallons a day, for more than 12 months working.

5. That no liquid should be allowed to be sent into a river if the liquid contains a greater percentage of impurity than the river itself.

The rule should be stringent that no person should increase the pollution already existing in a river. As that rule became adopted all over England the rivers would gradually get purer and purer, and manufactories would have time to improve their means of purification.

WILLIAM CROOKES.

20, Mornington-road, London, N.W., Nov. 28th, 1874.

SUGGESTIONS BY FRANCIS MOGGRIDGE.

The desire that Government should legislate upon the matter of "pollution of rivers," is not confined to those who make a pastime of angling, and who long for clean water to fish in, but is one that has been long felt by a considerable number of manufacturers; and this cannot be better proved than by stating that the owners of tin-plate works, which form the staple trade in our river, the Avon Lloyd (the largest tributary of the Usk), have formed themselves into an association for protection, as far as possible, from pollution of the rivers from the drainage of refuse vitriol or sulphuric acid, from coal washings, and from the filling up of its bed by tipping into it of cinders, &c., from the iron works.

Evidence in cases arising from the two former evils are handed over to the Board of Conservators, and of the latter to the Harbour Commissioners, as our association has no power to deal with cases themselves.

The injuries under which the manufacturers suffer from the refuse sulphuric acid are incrustation, and corrosion of boilers and pipes, which necessitates careful inspection and frequent repairs, and the replacing of entire boiler plates, &c. In many instances this had to be done to new boilers in use only two years, entailing a considerable cost and stoppage of works, and also seriously endangering life.

The damage done by "coal washings" is by the filling up of pipes and gratings, rendering the supply of water to boilers uncertain, and making accidents probable with the risk of their exploding. The tipping in of cinders causes the silting up of the river bed, depriving us of storing room, causes sudden floods, and in dry seasons lessens our supply of water. The last two evils complained of have, since the foundation of our association, somewhat diminished, but still there is room for further improvements. But in the first evil, that of pollution by refuse of vitriol, which is by far the most serious, little or no improvement is perceptible; indeed during last summer the river was worse then I have ever seen it, so bad as to be unfit for watering of plants. Now, could it be shown that the prevention of this poison running into the river would entail expense, something might be said as to the hardship of a law enforcing it, but from eight years' careful working of Prighsley's patent, I can positively say that instead of a loss, a considerable profit can be made by utilising the refuse, first by the obtaining of copperas, for which we get a ready sale, and secondly, by our being enabled to use the vitriol, so reclaimed, once again —its being about two-thirds of its original strength.

Furnished with the result of my experience, I have spoken to the offending parties on our river,

but in two cases without result; the one, owner of the largest works here, although recognising its value, and having been at their request furnished by me with plans, and promising to at once adopt the process, has not, up to the present time, done so. Whether this arises from obstinancy, or from an ill feeling against the Conservators, who have had them fined for other offences, I know not.

In the other case, after its adoption, and its value being shown, the operation was suspended, the reason given being that as the Conservators were powerless to suppress the pollution caused by their neighbours above them, from which they greatly suffered, they would likewise turn their poison into the river, and defy the Board of Conservators.

With such people to deal with I am convinced that no permanent good can be hoped for, unless all works are obliged by law to consume their own pollution, and forbidden to use rivers as tipping ground for their spoil and cinders.

INTERMITTENT DOWNWARD FILTRATION AND IRRIGATION.

1. In compliance with the request contained in your circular of the 19th instant, desiring that I should transmit to you a brief statement of what I consider to be the best means of cleansing the sewage of towns, and of effecting its utilisation with economy to the coutributing ratepayers, I hasten to state that under the conditions generally prevailing throughout this country I consider the passage of sewage through land to be the only certain means of purification, though whether the area of land to be taken for the purpose be large or small must necessarily depend upon the existence of local circumstances favouring or not the profitable use of sewage on the surface.

2. The results of experience in the application of sewage to land, as well as thirty years' practice in the under-drainage of lands of varying character, lead me to the decided conclusion that wherever sewage is applied intermittently to the surface of land, and passes through the soil beneath, not only may all nuisance be avoided, and crops grown at the same time, but the effluent may be readily purified up to the standards recommended by the Rivers Pollution Commissioners.

3. It is doubtless true that in many instances land cannot be obtained in sufficient quantity for "wide surface irrigation," for which one acre to one hundred persons may be taken as a fair allowance, or, if obtainable, can only be purchased at such a ruinous price as to preclude all chance of profit; but I am not aware of a single instance in which sufficient land may not be obtained for "intermittent downward filtration," if the purification of the sewage be alone aimed at, and the sewage be made designedly to pass through the soil as well as over the surface, as originally suggested by Dr. Frankland, and first brought into practice by me at Merthyr Tydvil, for which one acre of free soil drained six feet deep is found to be sufficient for three thousand three hundred persons, though for reasons hereafter stated, I have increased this quantity to one acre to one thousand persons.

4. The operations involved in "intermittent downward filtration" and "wide surface irrigation" are totally distinct, although accidentally the practice of sewage farming in the latter case frequently partakes of the same character as the former. The preparation of land for "intermittent downward filtration" is essentially the work of an engineer, as the sewage which it has been determined the soil shall purify must be delivered to it evenly and distributed evenly over its surface in order that each cubic yard beneath shall receive and discharge the quantity it is intended to purify. And when formed, the management of the filtration areas, though very simple and easy, must be such as to ensure the perfect action of the oxidising functions of the soil. With "wide surface irrigation" the soil will, when properly under-drained, absorb the sewage, and as the sewage farmer necessarily applies it to the land intermittently to suit his crops, it is in fact intermittent filtration on a wide and irregular scale, the drawback being that the delivery of the sewage is effected without any regulation at all, and is often so copiously applied, when his desire is only to get rid of it, that the land cannot absorb it and the sewage therefore passes off the surface uncleansed into the streams. The object of "intermittent downward filtration" is to make the most of the cleansing powers of the soil where profitable utilisation cannot be attained, while that of "wide surface irrigation" is to make the most of the sewage whenever and wherever land can be got at a reasonable cost.

5. The circumstances which render "wide surface irrigation" pre-eminently desirable are, first, the power of buying the required land at its marketable price, or nearly so; and, next, the power of delivering the sewage to, and distributing it over its surface with facility. Though the experience gained in sewage farming is not at present encouraging, it may be assumed that, if the cost of the land and distribution together does not involve an annual charge, to repay principal and interest of more than £8 an acre, then "wide surface irrigation" may be resorted to, to any reasonable extent, without loss to the ratepayers.

6. In the absence of land obtainable at a reasonable cost and to be reached with facility, then "intermittent downward filtration" forms the best means of "preventing the pollution of our rivers, and at the same time of dealing with the sewage with economy to the ratepayers," for (1) not only is the sewage as effectually cleansed as in the case of "wide surface irrigation," but (2) vegetable garden crops may be grown on the reduced area, of nearly equal bulk per acre as farm-root crops, even when the sewage is passing through the soil is diluted up to a rate of 250,000 gallons per acre; and (3) this may be done at a cost which, although comparatively heavy per acre, will in no case involve a charge on the ratepayers of more than one penny in the pound.

7. To secure the greatest amount of benefit from wide surface irrigation, it is necessary to associate with it a comparatively small area of land designedly prepared for intermittent downward filtration, in order that the sanitary authorities may hold in their own hands a means of securing purification, and of delivering the sewage to the farmers who are to take it in the precise quantity they want, and at such times only as they desire to

have it. It is the obligation to take the sewage at all times and under all conditions that has been the principal, if not the only drawback to sewage farming up to the present time. With a part of the land prepared for intermittent downard filtration, and capable of cleansing the sewage under all circumstances, there will be no necessity for the farmer to take it at night, or on Sunday, or during a wet or frosty time, or when the sewage may be too dilute to be useful. It can then be run into the filtration areas.

8. In balancing the advantages of wide surface irrigation against those of intermittent downward filtration, it must always be borne in mind that the reduced area required for filtration, though absorbing so much more sewage, will command a greater rent per acre than the wider space utilised in sewage farming. The land used for intermittent downward filtration, if the three-fold system be adopted in the manner explained, becomes market-garden ground of the most productive character, and may be let annually, to the highest bidder, in small plots, while the land used for wide surface irrigation must necessarily be treated as farming land, to be let to a farmer and rented accordingly. With village communities the cottage gardens of the poor form the proper field for the use of sewage. It should also be borne in mind that the objection raised to the distribution of sewage over the surface of land, on the ground that malaria may arise from a surface saturated with sewage, is proportionally reduced by reduction of the area from which evaporation can take place.

9. It should be remembered when comparing either wide surface irrigation or intermittent downward filtration with other processes involving considerable outlay in tanks, machinery, &c., that the land which forms the material item of cost in both irrigation and intermittent filtration remains the property of the ratepayers, and may at any future time be converted into money without great loss, inasmuch as the value of landed property is certain to increase, and so counterbalance any extra price that may have been paid for it by compulsory purchase; whereas the same cannot be said in cases where the money is expended upon perishable materials and machinery.

10. In carrying intermittent downward filtration into practice, whether it be adopted by itself or in combination with wide surface irrigation, I recommend an arrangement by which the quantity of land suggested by the Rivers Pollution Commissioners as sufficient has been increased as three to one. Instead of one area, in the proportion suggested by the Commissioners, I take three areas of an equal extent, each capable of cleansing the whole of the sewage, and of growing crops at the same time. Each area is used daily for the purification of the sewage for one year only, so that two out of the three areas are devoted for two years in succession to full plant growth, which at once gets rid of all doubts as to the overcharging of the soil with organic matter. In this way a considerable return per acre will be obtained from the two areas not in daily use, as they would receive only just as much sewage as would produce the most abundant yield; while the occasional relief from sewage thus afforded to the area devoted to filtration would favour an increased production from that area also. Moreover, as the areas for intermittent downward filtration are laid out in ridges and furrows, and the liquid sewage is run down the furrows, the suspended matter in the sewage can at any time be semi-dried, and dug or ploughed into the soil. The soil, by this mixture, is rendered more capable of filtration, the more frequently and more completely the organic and perishable matter is thus dispersed.

11. In many instances it occurs that a small area of land may be obtained and reached by gravitation, while a wide area may be commanded at a higher level, involving pumping. In such instances, intermittent downward filtration may be most advantageously resorted to on the small area below, and may be there continued in use until sewage farming becomes more profitable than at present, when the sewage can at once be lifted to the upper land. The lower small plot would then be continued as the "safety-valve" to the larger one and would take the sewage when not wanted there. This illustration will apply in a variety of shapes wherein economy to the ratepayers will be best secured by a limitation of area in the first instance.

12. The only practical difficulty that has yet been experienced in the use of land as a medium of purification arises from the adoption of clay soil for the purpose when fine soils cannot be obtained. Unless properly prepared on the surface, all clay soils are liable to crack, and to allow of the discharge of the sewage through the cracks into the drains in an uncleansed state. This is only to be avoided by digging, trenching, and mixing the top soil, to a depth of 16 or 18 inches, with ashes, burnt clay, and sand, by hoeing and stirring the surface when under crop, and by keeping the ground moist with sewage during dry periods. In certain instances the effluent may be run with advantage a second time through a lower bed of soil, which upon sloping ground can be readily done.

13. The floating matter of sewage, now technically called "sludge," differing in character according to circumstances, is causing much perplexity. Sometimes the liquid refuse of towns and communities includes substances which are altogether foreign to sewage, such as the detritus of roads and the refuse of dye works, paper works, tanneries, and other special trades. These, of course, ought to be excluded altogether from the sewers, or at least as far as is practicable, and special arrangements should be made for dealing with such as cannot be excluded. The detritus of public roads ought to be intercepted by catchpits, for profitable use in building, &c., and separated from such surface waters as cannot be excluded from the sewers before the latter is admitted. If this is not done, special means of separation becomes essential at the outfall. The refuse of private trades and manufactures, in which materials are used that are prejudicial to the economical treatment of the sewage, should be altogether excluded from the sewers. With this done, and the coarsest matters properly belonging to sewage screened out of the liquid before the latter is distributed down the furrows of the land (prepared for intermittent downward filtration), nearly all difficulty is removed. The "sludge" is then reduced to perishable organic matter which, being deposited evenly at the bottom of the furrows, does not interfere with the infiltration of the liquid sewage as the

sides of the ridges up which it naturally rises are always open to absorb it. When dug or ploughed in, this perishable "sludge" actually increases the filtering capabilities of the soil instead of clogging its pores as erroneously stated.

14. I will only add, that in dealing with the sewage of small towns and villages, where the outfall is comparatively small and very irregular, the process of intermittent downward filtration and surface irrigation may now be as readily carried out, as in the case of larger places with a constant outflow, by the use of the "self-acting sewage regulator," which has been successfully tried at several places. This invention has been designed to apportion and deliver the precise quantity of sewage which selected land is intended to utilise and cleanse, and being automatic in its action, this is done independently of all supervision and of irregularity of outflow, which may at one time be extremely copious and at another little more than a dribble. Besides overcoming this evil, which has been found to be the great difficulty in dealing with small communities, the regulator secures that intermittency of application which is so essential to purification.

J. Bailey Denton.

CAPTAIN LIERNUR'S IMPROVED TOWN DRAINAGE SYSTEM.

In treating of Liernur's improved town drainage system, Dr. Egeling, the senior Medical Inspector of Holland, says:—

"For the English reader, this system has a double interest. It embodies the principles which have been demonstrated in every report on the sewage question—for the last dozen years at least—to be the only ones upon which a satisfactory solution is attainable. All culminate in this one leading thought, that the plan of removing all kinds and degrees of refuse by only one channel leads to the same perplexities and difficulties, as treating persons, merchandise, and cattle as only one kind of freight, and transporting them in only one class of railway car would do, and that it is far cheaper, in view of the ill effects resulting therefrom, to employ a different form of carriage for each variety."

Starting from this leading principle, Captain Liernur divides the work to be done into four different classes:—1. The sewers proper are made absolutely impermeable and devoted exclusively to filtered house, kitchen, and rain-water. 2. The drainage of the soil is effected by porous pipes, regulating the ground-water. They lie at a higher level than the sewers proper, and drain into them. Of course in towns that are sewered already, he makes use of the existing sewers and does not lay these subsoil drains. 3. Refuse liquids of trade and manufacture are only admitted into the sewers after being purified by their producers. 4. The fæcal matter—chamber slops, and sink sediment included—is removed by a separate system of pipes altogether, the peculiar feature of which is, that in order to avoid as much as possible the dilution, which makes transport, utilisation, and disinfection next to impossible, air pressure is used instead of water to drive the excreta out of the closet-pipes.

The causes of river pollution are:—

1st. Excrement (solids and fluids), chamber slops and the refuse of kitchen sinks.

2nd. Manufacturing refuse.

3rd. Street dirt.

4th. The dirt contained in house water.

All of these Captain Liernur keeps out of the sewers, and consequently out of the stream. His mode of doing so will be briefly described in turn.

First, as to excrement (solids and fluids), chamber slops, and the fatty and sedimentary products of kitchen sinks. These are never allowed to enter the sewer, but are collected by a separate pneumatic system of cast-iron piping, nowhere exceeding five inches in diameter. Briefly this may be described as follows. The town is divided into drainage districts of from 20 to 50 acres according to circumstances. Each house is provided with a Liernur improved water-saving closet, or a Liernur closet without water; and these are connected by branch pipes through a main or street pipe with an iron tank placed under the pavement somewhere about the centre of the district. Into this tank all the closet pipes are emptied every day by pneumatic pressure, and then the contents of the tank, and of others similar to it, are in their turn emptied in the same manner, but through separate and independent pipes into a central reservoir, serving perhaps for ten or twenty tanks, of 250 to 500 acres, also according to circumstances. The motive power for all the operations is obtained by a stationary air-pump engine at the central reservoir. Every large town may thus be divided into several districts, each independent the one of the other, and served by a separate engine. The contents of these reservoirs are by a continuous process, and without any exposure to the air, converted by evaporation in vacuo into a dry powder, which contains all the manurial elements to be found in the substance collected by the system. The drying process is effected without using additional fuel, the waste steam of the high pressure engine being found quite sufficient for the purpose. The principle is the same as that used in reducing liquid beet-root sugar. The sedimentary matters of house and sink water, I may mention, are separated from the water flowing off to the sewer by a very simple and ingenious apparatus.

My time is too short to give minute descriptions. Suffice it to say that the closet without water is more inoffensive to eye and nose than any water-closet at present in use, that no intrusion into houses is required, that there is nothing moveable in the whole network of pipes to get out of order, and that from the moment matter is deposited in a closet till after it is converted into *poudrette*, there is no possibility that either the air or the soil can be contaminated. Also that any virus or germ of disease contained in excrement is rendered innocuous by heat, the only known agency which will effectually do so.

Further, let me say, that in towns of average density of population, this resulting manure is in a concentrated form and so valuable (10s. per head per annum), as not only to cover the working expenses, but to provide for interest on and redemption of the capital invested, and to yield a handsome balance over and above.

Secondly, as to manufacturing refuse and waste water. The solution of the pollution problem is simply an impossibility as long as manufacturers are allowed to pour their refuse into sewers or streams. It is comparatively easy to clean such

water separately, when perfectly fresh, and with its volume and constituents known or easily ascertainable, but it is impossible to do so when mixed all together in the sewers with the other refuse of a town.

Captain Liernur lays it down as an imperative rule that such cleaning must be done separately, and that each manufacturer must be made responsible for so doing. The question as to who should bear the cost is one open to discussion. In most cases, the person making the profit must put up with the loss such cleaning may entail, but there are, no doubt, cases in which it should in part be borne by the community. The business of the engineer is simply to devise a means of testing whether this cleaning is done. For this purpose, Captain Liernur makes a small dip, or bend, in the branch pipe from the factory, just before entering the sewer. On this he erects a pipe accessible from the street, so that the inspector of nuisances can at any time take a sample for analysis.

Thirdly, as to street dirt. To prevent this from entering the sewers, Captain Liernur, in the first place, reduces the quantity of rain-water flowing from the surface of the street into the street gullies to the smallest possible quantity, seeing that it is this particular water which brings the detritus into the sewer. Secondly, he employs a pavement, which of itself furnishes no detritus or dust through wear and tear; and thirdly, he insists upon street sweeping being done regularly and by machines, instead of by manual labour. To reduce the quantity of street-water flowing into the gullies, Captain Liernur lays the pavement nearly flat over its cross-section, so that the rain-water, instead of rushing to the gutter and there accumulating, remains not only divided so as to obtain nowhere great depth, but is exposed as long as possible to evaporation and absorption. For the same purpose of prolonging this powerful agency for diminishing the quantity flowing off, he places the gullies as far apart as admissible for taking in roof and side-walk water. By acting in this manner, it is only in case of violent and continuous rain that any water from the streets flows in the gullies at all, and then only a small proportion of it (about one-fourth). In ordinary rains, fully four-fifths of the water are evaporated, and the remainder is absorbed, thus entering the sewer in time as percolated or subsoil water. To have no street detritus, Captain Liernur substitutes the well-known wooden pavement on every occasion that repairs of the ordinary roadway is required. Wooden pavement, besides being noiseless, yields no dust, is very durable, and is an improvement upon Macadamised or stone-paved roads. This being done, the only two other sources of street dirt are droppings from animals (which can easily be dealt with by scavengers removing them immediately), and soil brought in from the country on the wheels of vehicles and hoofs of horses. To remove this latter is easy enough when it is only done regularly. It can then be best accomplished by sweeping machines, which work very advantageously on the flat surfaces of the wood pavement prescribed. It will be seen that Captain Liernur thus keeps out of the gullies the great bulk of the street dirt, and he even retains practically the small quantity which enters them in times of violent rain, by constructing them in a peculiar way, so that the rain-water must strain upwards through a small round mat of woven straw before flowing off to the sewer. This mat casts the suspended matter down in a water-tight bucket, which can be taken out, mat and all, and emptied from time to time. The contents of the gully bucket must, of course, be removed by carts. Hence the rain-water entering the sewers of Captain Liernur's system is, as a rule, only that falling from roofs, &c., and the quantity that gets in by slow percolation is practically clean enough. Street dirt, as such, does not get in the sewers at all.

Now, fourthly, with regard to house water, it must be remembered that by the pneumatic system there is separated altogether from this (and consequently from the sewer) all excrement, chamber slops, and sink sediment. The importance of the daily separation of this last matter, the fatty and sedimentary products of kitchen sinks, must not be overlooked, as the substances are practically the same as excrement, only they have not gone through the human body, and are not so near, by three or four days, to fermentation. Until fermentation takes place it is evident that such matters can give off little or no organic matter in solution, and as they are separated from the water at the start by a simple and ingenious apparatus, it follows that the water flowing off, which may be large or small in quantity, according to circumstances, must be comparatively clean. Captain Liernur, of course, does not claim perfect cleanliness for this water, but simply says it may be admitted into the stream with impunity. Theoretical purists sometime lift up their hands exclaiming about the offensiveness of cabbage-water, &c., forgetting how infinitely little the total quantity of liquid derived from this source is in a whole town. Such people would gild refined gold.

To sum up, let me recall to your remembrance what liquids enter the sewers of Captain Liernur's system, and thus reach the stream. First, the purified water from manufactories; secondly, storm water from streets, after being practically deprived of all solid matters in suspension; thirdly, house water deprived of excrement, chamber slops, and sink sediment; and, fourthly, subsoil water after percolation through the earth. To theoretic purists who may object even to this resultant liquid, I would point out that Captain Liernur has, at any rate, produced a liquid of a simple and unvarying character which is capable of being easily dealt with. As a matter of fact it is nearly as clean as that which fills every brook in the country, and flows from the adjacent fields after a heavy rain. It is well known that this is far from clean, but it is unreasonable and impracticable to demand more. Most people will, I think, admit that every reasonable requirement is complied with, and by practicable means. These who think otherwise had better turn their attention to regulating Dame Nature first, and when they have succeeded, can try their hands on towns.

Adam Scott.

221, Gresham-house, E.C.

MOULE'S DRY EARTH SYSTEM.

At the request of the Council of the Society of Arts, I venture to present to this assembly pro-

posals both for the entire relief of our rivers and streams from pollution, and for the utilisation in the true sense of that word, not only of the valuable substances, which in causing that pollution are worse than wasted, but of all the refuse of our towns, and villages, and of detached houses. Our rural districts no less than our large towns demand the most serious attention of the Legislature.

These evils of pollution and waste are the necessary result of the daily accumulation of putrefying and putrified matter, first in the drains and sewers, or cesspools, or privy-vaults, and then in the case of the former at their outfall. To deal with such intractable substances *en masse*, and especially with a view to their utilisation, is a sheer impossibility. Such a vast evil must be dealt with at its source or sources, and in detail. These sources must either be diverted into other and separate channels, or be altogether cut off. This by means of water is just as impracticable as the dealing successfully with the accumulated mass. Under that system, however, which I would base on the general adoption of the earth-closet, it is perfectly feasible. And by it not only shall that pollution and waste be relieved, of which we have such great reason to complain, but the dwellings and the external atmosphere of our towns, and villages, and detached houses shall be relieved from foul smells and deleterious gases. For,

1st. By the general adoption of the earth-closet that substance is withheld from the drains and sewers which is the most offensive, the most uncontrollable, and, though in itself the most valuable perhaps as manure, the main cause of injury and of difficulty in any mode hitherto adopted for the disposal of sewage.

2. The withholding of this—the solid excreta—and much of the urine from the drains and sewers, obviates the now necessary flushing of the closets, drains, and sewers; and thus by cutting off 5-6ths of the consequent requisite water supply, and by the use of the earth-closet together, the accumulated mass at the outfall (or in future at more than one outfall) is reduced 70 per cent. or more—probably 80 per cent.

3. The remaining 3-10ths or 1-5th, consisting mainly of the slops and sink-water of the houses (not forgetting, however, the water used in some factories), thus relieved from any large amount of solid matter, can be so easily dealt with, that sewers and large drains would no longer be required.

4. For in smaller drains, and at comparatively little cost, it might be conveyed to suitable reservoirs, and from thence, whether by pumping or by gravitation, and before putrefaction commences, be either applied to land in the immediate neighbourhood of the town, or removed in part for the manufacture of manure for more distant places.

Now, with reference to the question of utilisation, let us first take such a town as Over Darwen, with a population of 25,000. The earth-closets (though the vault into which each would discharge its contents need not be emptied above once in three months) would yield a produce from which a company might manufacture 60 tons of manure per diem. I will say nothing here of the value of the phospho silicon manure, but only suppose that such a company could realise on this manufacture 10s. per ton. There would arise from this source alone £10,000 per annum.

But what of the liquid refuse? Let us take five gallons a head for the water supply. Three gallons would be sufficient for effecting the profits of which I am going to speak. But I take the larger estimate as the most difficult to deal with. This will give 125,000 gallons, or say 2,000 hogsheads to be disposed of daily. Now, this distributed at sufficient intervals of time over an adequate extent of land, and before putrefaction sets in, can create no offensiveness on the surface of the soil; neither can it through the subsoil pollute springs, or wells, or rivers. Supposing then 600 hogsheads of such manure per annum to be applied to an acre at three successive periods either to the soil or to the growing plant; and supposing the crops grown to be rye grass, clover, roots, or cabbages, &c., for feeding cattle, how many head of cattle, fed in stalls, would that acre carry? Let it be borne in mind that by alternate planting there may be two or three or four crops, and if the whole produce be given to them, three and even four cows might be fed on a single acre.

Now the liquid refuse of 25,000 people would yield 600 hogsheads per acre per annum to 1,000 acres. And from these 1,000 acres, with a due amount of capital and skill and labour, I feel confident that £30 per acre or £30,000 per annum might be realised. Supposing 1,000 cows to be fed thus, and a portion of the vegetable produce sold for the use of man, what an excellent supply would thus be afforded of wholesome vegetables and of pure milk! I should imagine that a company with a capital of £100,000 might do all this; and, while completely relieving the river from pollution, and the soil and the atmosphere from poison, it would very largely promote, by means on which I cannot dwell, habits of cleanliness, decency, and morality. Such is the plan I would propose for towns.

As to the country, I find by careful experiment that the liquid refuse of a family, as many as ten in number, if applied daily in due succession to the plant and to the soil, may be safely and inoffensively disposed of on 16 perches of ground. And a cottager with a garden may, from those 1[illegible] perches, from the produce of an earth-closet, an[illegible] from a pen of 20 fowls occupying a perch [illegible] ground, raise that which shall be equal to £20 [illegible] year. This fowl-pen has a second object, viz that of being a substitute for the dungheap an[illegible] the pigstye. The soil within it should be left i[illegible] its natural state; all waste matter should [illegible] thrown into it, and anything good for manure[illegible] And if it be turned over once a fortnight, th[illegible] cottager in addition to 2,000 eggs, might make i[illegible] a year one or two tons of manure. These togeth[illegible] with the contents of the closets he might sell [illegible] the manure manufacturer or to the farmer. Th[illegible] two together would be worth more than the barle[illegible] he would require for his fowls.

Now, if so much can be done on 20 perches [illegible] ground, much more readily may it be done [illegible] larger premises; and if so, then in all such cases, [illegible] least, the Legislature may most justly interfe[illegible] and cause it to be done. With such an alternati[illegible] there can be no difficulty in the way of the leg[illegible] prohibition of the privy-vault, of the hole for sin[illegible]

water at the door side, and of the casting refuse into the neighbouring ditch. But beside this the runnings from the farm yard must be equally excluded from the ditch and the village stream; and the privy-vault and the cesspool of the wealthier classes must be prohibited too. These last not unfrequently discharge their contents, or at least their offensive overflow, into the ditch, the outfall of which is into the brook, from which, at no great distance perhaps, the people draw their water. Let a law be passed and enforced that no house of any description, with 20 perches of land attached to it, shall have either cesspool, privy-vault, or drain, and half the sanitary difficulties of the rural districts would cease.

In the case of cottages and houses in villages, or small towns, which have no garden, let the proprietors be compelled either to find land for the purpose, or some means of removing the refuse of the family safely and at their own cost, and not at the cost and to the injury of others.

HENRY MOULE,
Vicar of Fordington, Dorset.

THE CARBON-FERTILISER COMPANY.

The origin of the Carbon-Fertiliser Company was hostility to the admixture of water and putrescible matter, whether voluntarily or by enactment. The motive of its action is hostility, without qualification or reserve, to the wanton corruption of water.

The hostility of the wanton admixture of water with the decaying impurities inseparable from animal life is founded upon scientific and economic reasons.

Obviously if that pollution—which by the bye is but a false word and a foolish veil for a real act—if that "corrupting" of waters is a wanton stupidity, let us discontinue the action, and the remedy is supplied by the very agency of unmolested nature.

The mode of operation practised by the company is the perfection of simplicity. All its action is directed in the opposite direction to that of water admixture and water carriage. It seeks *ab initio* to render all putrescible substances as dry, as inactive, and as portable as possible. It treats the combination of putrescible matters with water, whenever this has taken place, in small volumes instead of in an accumulated bulk.

Its action is to begin with the interception of the excreta, which is by preference accomplished at the earliest instant through the application of charcoal to the substance voided. The most rudimentary mechanical means of effecting this are the application of charcoal by a scoop from a scuttle; secondarily, any other mechanical appliance which may automatically attain the same object. Where a higher complication is applicable, a divided closet is adopted, in which the urine passes at once through a trap which is charged with charcoal into special receptacles; in other cases a larger proportion of char is used, which absorbs the entire discharge.

Automatic closet action is graduated according to the habits for which it is required. *E.g.*, in public places of resort in use in Scotland, or under like conditions, the delivery of char is carried out by means of periodical visits by a person in charge who carries a "sparmer," and attaches it to the spindle, and applies as many quarter turns as may be required to a revolving partitioned drum, which delivers char from a hopper made to discharge by an action which disturbs the hopper's contents whenever movement is communicated to the mechanism. When it is not necessary to protect the delivery of the char supply in this manner, as, for instance, in such large establishments as on the Clyde, where timekeepers are kept inside special buildings that have been erected by the owners of the most extensive shipyards from approval of the char applications, self-acting seats similar in action to like appliances for water delivery are adopted. In factories of Dundee, worked, by women, the delivery is effected by a door-action. The closets there are single, and the entrances are under view.

In the company's extensive contract with the borough of Oldham, they were limited from the circumstance that that locality had already adopted what have received the name of "sanitary pans." In consequence, even a more elementary mode has necessarily been adopted. Restricted, at present, to the use of this imperfect adaptation, the company, in order to carry out its system, has supplied trays that are virtually "traps," and these are fixed slightly higher than halfway up the pans. These trays have the edge slightly bevelled downwards, and the central portion perforated. When the tray, or trap, is fixed, the outer rim is covered with fine char, and the joint is thereby hermetically sealed all round. The central part is covered with coarser char. The solid parts are retained, whilst the fluid pass through into the lower division. Charcoal vans traverse the town, and attendants sprinkle sufficient char over the central portion to maintain an impervious charcoal coating. Waggons and barrels, the latter hermetically closed, receive the contents respectively as the pans are filled. The pans, as they may require it, are taken to collecting stations, which have been provided by the borough, and they are there thoroughly cleansed by charcoal and by brushing. They are meanwhile replaced by others which have undergone this operation. The aggregate collection is taken to the factory, and it is there treated; the char, or dry compound, is prepared for re-use and distillation; the liquid is delivered into large collecting tanks, which are covered by traps similar in principle to those already described, only on a correspondingly enlarged scale, and covered, in like manner, with an impervious char coating. These tanks are connected one with another by means of the "Alver syphon," and a further separation of liquid from solid is effected by intermittent action. Finally, General Scott's patented lime process is applied for enrichment of the manurial product, and it is followed by charcoal filtration to attain any required standard of the effluent. By these means a manure, giving 7·72 ammonia and 18 phosphate, is attained, and a char workable by burning, so far as it has yet been carried, up to £7 18s. per ton value. When the company shall have had time to fully mature the practical applications of their principles by an improved system of collection, they confidently expect to very largely increase the ammoniacal value of the result.

The company have adopted an almost infinite variety of ingenious mechanical contrivances for the interception of excreta and urine in private dwellings. Many of these, however, have been

made necessary rather to overcome the resistance of habit and prejudice than as actually indispensable. The most ingenious of these consists of a revolving drum with three distinct chambers, so constructed that by a single action the pull-handle delivers a supply of char by a forward movement, and by a backward rotary movement throws the contents down the shaft of a storied building, and presents a freshly charged pan in the closet. In a less complicated arrangement a single pan only is presented, which receives the char delivery on the pull-handle being used whilst reversing the contents into any receptacle or shaft below.

An arrangement, which is possibly the best, and certainly the simplest, is the reception of charcoated material in portable receptacles, thoroughly screened by a seat. These may then be used with entire comfort and immunity in any bedroom, as well as in special closets. The contents of the used receptacles are wholly devoid of smell or offence. A single cylindrical shaft, 12 inches diameter, is then sufficient to convey the contents of a house of any number of rooms or storeys. The shaft conveys into a pit, which may be above or underground, at option, and may even consist wholly of Reeve's patent ventilator, which admits air without, but no water. Obviously there is in this case no possibility whatever of up-draught or infection. The contents may remain in the pit according to convenience, without limit of time. It is plain that this arrangement altogether obviates the difficulty often assumed to be so great of preventing urine and slops being poured down channels intended for dry carriage only, and in great measure dependent for their efficacy in being kept free from excess of fluid.

The simple mechanical contrivances of the "Alver trap and syphon," applied in various manner, meet all the requirements of every remaining description of household impurity. The slop-pail, the ordinary chamber utensil, the barrack pail, the standard urinal are all rendered inodorous by varied combinations of form, providing intermittent percolation through charcoal, and admitting of the addition of self-acting covers supplied with the char. Precisely the same principle is applied to the largest public urinals. In all this variety of condition the same principle is observed, and the collection is everywhere made to pass through a char receiving trap, to undergo intermittent action in the course of its passage, and after having been further treated for extract of ammoniacal value, where then practicable the effluent is again passed through a char exit.

Kitchen waters are received and dealt with in exactly like manner, by being passed through traps and by intermittent filtration, as are also the collections in stables. Ordinary scrubbing waters and other waters simply polluted, are treated with mere mechanical filtration, to which are added, in the case of street collections, intermediate precipitating tanks. Under the necessary pressure of time it is impossible to give a detailed description of these arrangements, which, however, will probably be better understood from the models and diagrams exhibited. It is perhaps only necessary to observe that the collecting and purifying tanks only require to be proportioned to the gallonage to be dealt with. By this arrangement, storage of re-purified water is available at any spot for protection against fire, for street watering, for g[ar]dening, or for fountains, in fact for any purp[ose] whatever.

The medical testimony to the company's ope[ra]tions has been —

That all germs of disease must be thereby [de]stroyed; and that it is inodorous and innocuou[s].

The report from the engineer to the Cl[yde] Navigation is as follows:—

"The trustees have had the carbon system [in] operation in all their public conveniences for nea[rly] a year with every satisfaction."

MILLINGTON SYNGE, R.E., Major-Gene[ral], F.S.A., F.R.G.S.

UNIVERSAL CHARCOAL AND SEWAGE CO[M]PANY FOR THE UTILISATION OF TOW[N] REFUSE.

The object of this paper is to show how the sa[ni]tary removal of the refuse of our cities, so as [to] prevent any one of its many constituents fr[om] ever becoming a nuisance, may be done effectua[lly] and economically. The refuse of our cities divi[des] itself into the following classes:—

(1.) The sweepings from our streets.

(2.) The house refuse, from ash-pits and du[st]bins.

(3.) The refuse from markets, abattoirs, &c.

(4.) The excrement of the population.

(1.) The sweepings of our streets have hith[erto] been, and at this time are, a most difficult nuisa[nce] to be got rid of, entailing a heavy expense on [the] householders. A few instances are appended, sho[w]ing the annual outlay of the respective parishes [and] townships on this head:—St. George, Hano[ver]-square, £1,740; St. Pancras, £4,000; Islingt[on], £6,000; Marylebone, £7,000; Lambeth, £7,0[00]; Paddington, £8,800; Sheffield, £8,000; Salf[ord], £10,000; Manchester, £28,000; Liverpool, £59,[000].

(2.) The house refuse is in precisely the sa[me] position, both as regards the trouble and the [ex]pense of its disposal. The items on this head [are] difficult to obtain, but the following may be ta[ken] as the cost in round numbers for this head only: Brighton spends £2,800; St. George's, Hano[ver]-square, £1,000; Norwich, £1,500; Lambeth, £3,3[00]; St. Pancras, £4,500; Bethnal-green, £4,900; P[ad]dington, £2,000; Newcastle-on-Tyne, £6,[000]. There is no town in this country which has [to] come to our knowledge where either the street [or] house refuse is disposed of at such a price as cov[ers] the expense of its collecting.

(3.) The refuse from our markets and abatto[irs], though valuable as a manure, is to a large ext[ent] wasted, owing to its obnoxious character.

(4.) The excrement of the population, though [the] most fertilising of manures, is almost entir[ely] wasted through the general adoption of wat[er]-closets. This latter practice is, perhaps, more th[an] any other, the cause of insalubrity in our cit[ies], and is a main cause of their polluting the riv[ers] which pass by them. It is self-evident that [the] first step towards purifying our rivers, is to ke[ep] out of them all organic and inorganic matt[er] which can either pollute or poison them. It [is] therefore the first sanitary duty of cities, carefu[lly] to prevent the excrement of their population fr[om] entering the rivers, and to see that the unavo[idable]

able sewage, arising from the rain, street, and surface waters, and house slops, is thoroughly cleansed and purified before it is allowed to be allowed to be admitted into the river, or even into the sea. This naturally points to a dry conservancy system, or a dry system of surface removal for all our nuisances. That there are difficulties in the way is unquestionable; that they are insurmountable the Universal Charcoal and Sewage Company does not admit. The readiest, the most economical, and the most sanitary method of getting rid of the town's refuse, whether such be from our streets, markets, houses, &c., is by its conversion into charcoal, which by this simple operation furnishes at once, without any chemical being required, a good deodorant for all the fæcal matter and garbage which can be collected in the town, which substances when mixed with the above-named charcoal, make a valuable and very fertile manure, which finds a ready market at from 25s. to 30s. per ton. If considered, it will be seen that our streets are being constantly covered with horse manure and other organic matters, which, by the friction of the traffic, are ground up and intimately mixed with the *debris* from the road metal into a dryish dust, or a pasty mass, according to the state of the weather. The organic matter present in this compound furnishes (by analysis), on an average, 20 per cent. of pure carbon in a finely comminuted state, which is more than sufficient for all purposes of deodorisation. Animal charcoal contains only from 5 per cent. to 15 per cent. of carbon.

The carbonising of the refuse, as practised by the Universal Charcoal and Sewage Company, Limited, is performed without causing any nuisance, in long cast-iron cylinders, which are subjected to a convenient temperature, and are self-feeding and self-delivering as they revolve over the furnace by which they are heated, so that the carbonisation is continuous. (A description of the operation and drawing of the apparatus will be found in the number of *Iron* newspaper dated June 20th, 1874.) This operation at once reduces the bulk of the refuse to be got rid of, 60 per cent., which, even supposing the charcoal obtained to be as worthless as the refuse was at first, is, of itself a material item for the consideration of such towns as, by Act of Parliament, are for the present compelled to use the fever-breeding water-closet, and so have no collection of fæces to mix with the charcoal to make it a more valuable manure than when used alone. The cost of converting the refuse into charcoal is less than ten shillings per ton of charcoal obtained, a considerable economy being found to result from withholding the gases, &c., given off during the carbonisation of the refuse. For such towns as are not yet subject to the water-closet arrangement, a dry conservancy system, such as is commonly known as "the pail system," affords in conjunction with the system of carbonisation of the refuse herein advocated, by far the most economical, and the most salubrious method of securing their thorough sanification. In fact, when properly arranged, typhoid fever, the product of the water-closet, would be almost, if not quite, unknown. In such towns, the facility and economy with which the existing arrangements can be adapted to an efficient pail charcoal system for the collection and removal of the excrement, are very great, and the expense of constructing immense sewers, &c., is avoided. The fæcal matter thus collected would be conveyed to the town's depot, where the refuse was taken for conversion into charcoal, and there would be emptied into trenches made in the charcoal, and mixed up with it; the resulting manure being of a highly fertilising character. Such manure has been applied to a large variety of crops during the past season with marked and beneficial results, although the unusually dry summer has been an unfavourable one for manures generally.

Thus it will be seen that every town holds in its own charge materials which must be got rid of somehow, from which it can produce, at a trifling outlay the most perfect of all deodorisers, charcoal, and thus out of its own refuse secure a ready and economic means of neutralising all the nuisances which may have rendered its precincts insalubrious.

It must also be mentioned that the same street refuse is easily converted into a filtering charcoal, suitable for the filtration of sewage effluent water, and even for potable waters, as it removes organic impurities as perfectly as animal charcoal.

It is most important to notice that, in addition to the many advantages of this system, there is a saving of at least one-third of the annual expense of the water supply on the water-carriage system, which, where the supply is in any degree short, as during the late long drought was felt extensively, is virtually an increase of the water supply by one-third.

By the adoption of this system all cesspools would be abolished, and, with their disappearance, the pollution of our subsoil, our wells, and our atmosphere would disappear also. Water-closets would also be prohibited, or only allowed under such arrangements as would intercept all that passed into them, and so prevent the pollution of the atmosphere by the foul gases evolved by fæcal and other matters in transit.

The advantages of a dry charcoal conservancy system are, among others:—

It is equally efficacious in the heat of summer, and in the frosts of winter.

It has no pipes to rust, corrode, or to burst by frost.

Its ready adaptation to ordinary privy arrangements.

Its economy as to original outlay.

Its economy as to working expenses, and wear and tear.

Its economising water where supply is short.

Its profitable utilisation of all kinds of refuse, and

Its thorough isolation of house in cases of infectious disease.

It prevents the pollution of our wells, our subsoil, and our atmosphere.

It creates no nuisance whatever.

No chemicals are required.

It pays its own expenses; and

Meets every requirement which sanitation demands.

It is impossible in so short a space as ten minutes to go into all the details and bearings of the system patented by the Universal Charcoal Company, Limited, of which the merest outline has been here given, but further information may be obtained

from the pamphlets issued by the company, which may be had on application to the Secretary, 71, Market-street, Manchester.—I am, &c.,

CHARLES ELCOCK, *Secretary.*

THE CLARIFYING AND UTILISATION OF SEWAGE COMPANY.

This is indeed a matter of the greatest importance, and deserves the most careful and serious consideration of all. Probably the ill effects of the present method of getting rid of sewage are nowhere more painfully or sensibly felt than in the manufacturing district of which Leeds may be considered the head centre. More particularly the streams to the south and west of this town, are little better than open sewers for carrying away the refuse from the mills, and the sewage of numberless manufacturing villages. Within the memory of the middle aged, streams formerly abounding in fish have been turned into receptacles for the foulest matter, emitting at all hours of the day the most vile and poisonous odours.

It becomes the duty of all, not merely to protest against such affairs, but in every possible way to seek to remedy them. The subject is vast, and increasing day by day, and for this reason the sooner it is fairly and honestly taken in hand the better.

Speaking from the experience of our company, an immense amount of good might be effected in a comparatively short space of time, and at an outlay far below what the results would warrant or lead one to expect, by first and decisive steps being taken against some of the worst offenders. In one district in this neighbourhood this has been done with the best effects. On an injunction being obtained against certain mill owners, restraining them from allowing them to send their foul water into the river, in each case our precipitating process was adopted, the foul water was intercepted and purified before leaving their premises, and not a single complaint has been made or heard of since.

The advantage gained by the principal offenders being required to purify their refuse water before leaving their premises would be immense; but here we have only the commencement of a good work, it must be followed up. Not a single foul water drain should be allowed to contaminate a river. Intercepting drains, if properly arranged and constructed, may be made to collect all the sewage, and where this is done no excuse should allow it to enter a river otherwise than in a pure state.

The Leeds Sewage Works at Knostrop are a practical proof and illustration of the possibility of this. In consequence of the quantity and variety of the dye water, the sewage of Leeds, amounting to not less than ten million gallons (10,000,000) a day, is probably some of the worst to deal with in the whole kingdom, but treated by our process the whole is made to pass into the river in a bright and pure state, the treatment also producing no nuisance or annoyance, even to those actually engaged in working it.

I am sorry that the short notice of your meeting prevents my getting any resolution on the subject from our directors; demonstration, however, is better than theory, and any member interested in the subject may satisfy himself of the efficiency of the treatment by a visit to the Leeds Works.

Up to the end of the year the process will be worked by our manager, but in order to prevent disappointment in case of his absence at any time, I should be glad if any deputation who may wish to visit the works, would kindly signify their intention to me beforehand. Thanking you for the oportunity offered of thus laying the matter before your meeting.—I am, &c.,

C. S. NELSON, *Secretary.*

I enclose an extract from the *Yorkshire Post*, on the Leeds Sewage Works, and an analysis of the process by the Leeds Borough Analyst.

EXTRACT FROM "YORKSHIRE POST."

The Clarifying and Utilisation of Sewage Company make use in their process of lime, charcoal, ashes, and a peculiar kind of iron liquid. The several ingredients having been duly prepared, by grinding where necessary, or in some other way, some of them will be shot down into the sewer, there to mix with the sewage, and to be lifted with it by the centrifugal pumps. An immense pipe, 3ft. in diameter inside, receives the sewage as it is lifted by the pumps, and conveying it out at the back of the engine-house through the compartment in which the iron cisterns are placed (in the passage through which the sewage receives the iron liquid), empties it into one of the two channels between the two rows of tanks at the back of the building. In its passage through the pipe care is taken to secure, by means of "agitators," a thorough mixing of the several ingredients with the sewage.

By an arrangement of sluice boards, the sewage from the large pipe, already mixed with the ingredients that are to effect the precipitation, may be conveyed to any one of the tanks direct, and by such arrangement any one of the twelve tanks may be taken at any moment, and, without at all interfering with the work going forward, may be emptied of the residuum or repaired as necessity may arise. For this purpose there is a double channel between two rows of six tanks, and the channel on the right hand into which the pipe empties itself direct has a fall towards the other end, it being a foot lower at the bottom end than at the top. Towards the lower end, or the end furthest from the pipe, the partition between the two channels ceases, and there being for a short space no partition, the sewage will flow at the lower end from the right channel over to the left, and the left channel having a fall in the opposite direction, the sewage will flow back again when the side sluices are closed the whole length of the second row of six tanks. But generally speaking the tanks will not be filled from the channel direct. Supposing all the tanks to be in working order the method pursued will be to raise the sluice board of the first of the six tanks on the right, and to let the sewage flow from the channel into it alone, each of the other tanks being filled by the overflow from the tank preceding it. This is secured by having the level of the lower end of each tank two inches beneath the level of the upper end, thus securing the circulation of the fluid by gravitation. By this simple but ingenious arrangement this important result will be obtained. The sewage in passing over the first tank will have parted with a portion of its solid matter, and hence will be partially purified when it has reached the second tank. Again, in passing over the second tank it will leave behind it a second instalment of solid matter; so with the third and each successive tank, until it has circulated through the whole twelve tanks, leaving a deposit at each, and at last flowing from the twelfth tank in a clear stream, known as the "effluent" water, and in a condition to pass into the river without polluting it.

When it becomes necessary to empty a tank of the residuum the first step towards this will be to reduce the effluent water to the lowest point. This will be accomplished by means of a floating wooden pipe, with a flexible joint, communicating with a sluice. When the water has become too thick to pass off with the effluent, but is too thin to go with the residuum, an arrangement is made whereby it may be taken back and treated over again. The water having been drawn off, the residuum will be forced through another sluice, which is placed at the bottom of each tank, into a subway underneath the two channels dividing the two rows of tanks. Having got the residuum into the subway, it will be forced into sumps, out of which it will be lifted by a pump, or some other means which may hereafter be devised.

Analysis of the Effluent Water at the Leeds Sewage Works, Knostrop, after Treatment by the Company's Process.

	Grains per Gallon.		Parts per 100,000.
Mineral matter, consisting of chlorides, salts of lime, magnesia, alkalies, &c.	39·02	..	55·74
Volatile and organic matters	8·68	..	12·37
Total dissolved solid matter............	47·70	..	68·11
Containing chlorine	7·45	..	10·64
equivalent to common salt	12·29	..	17·55
Containing ammonia....................	0·47	..	0·67
" albumenoid ammonia	0·15	..	0·21
Equivalent to nitrogenous organic matter, about	1·50	..	2·00

ANALYSIS OF MUD.

	Per Cent.		Pounds per Ton.
Moisture	68·95	..	1544·5
Organic matter	5·65	..	126·6
Phosphate of lime.....................	6·40	..	143·4
Sulphate of lime	2·38	..	53·1
Carbonate of lime	2·99	..	67·0
Carbonate of magnesia................	3·04	..	68·1
Oxide of iron	2·07	..	46·4
Alumina, &c.	0·12	..	2·7
Siliceous matter......................	8·40	..	188·2
	100·00	..	2240·0
Containing nitrogen	0·13	..	2·91
Equivalent to ammonia	0·156	..	3·49

THOMAS FAIRLEY,
Borough Analyst.

January, 1874.

DESCRIPTION OF THE PHOSPHATE SEWAGE PROCESS.

The "Phosphate Sewage Process," is based upon the use of specially prepared phosphates of alumina and lime with the sewage. The action of the prepared phosphates upon the sewage may be familiarly described as a curdling, or coagulation, of the fœcal matter in the sewage, giving it thereby a greater tendency to separate itself from the general bulk of water with which it has been intermixed. The next step is the use of lime, and this draws from the sewage the soluble phosphates which have been added in the process, forming therewith what is known as precipitated phosphate. The formation of this precipitated phosphate not only has the effect of recovering from the sewage water the soluble phosphate it contained, but it also carries down with it the curdled, or coagulated fœcal matter.

The sewage having been thus prepared, a separation of the solid matter is readily accomplished by means of "Precipitating Tanks," constructed so as not to interfere with that quiet condition of the water which is necessary for the deposit of a light and floculent precipitate. This has been successfully accomplished on this company's works at Barking and Hertford.

By these successive steps the deodorisation and defecation of the sewage is accomplished, so that whilst a flow of sewage enters at one end of the works, a stream of clear, bright effluent passes away at the other, leaving in the precipitating tanks a deposit of the solid matter, which has been separated from the sewage. This solid matter is discharged into shallow beds, where it is allowed to dry, and it is either moulded into bricks and dried in the air, or simply turned over, and the drying completed without further trouble, which is undoubtedly the cheapest course of procedure.

Such, in brief, is the "Phosphate Sewage Process," and the special advantages of this process are:—

1st. The production of a clean, bright effluent water.

2nd. The production of a really valuable manure, which goes far towards paying the cost of purification, and in some cases covers the cost.

In judging of the condition in which the effluent water from the sewage of a town can be safely discharged into a river, regard must be paid to the position of such a town, and whether the water is required for domestic purposes. There are some towns so situated that no purification of their sewage can be considered satisfactory without filtration, but at the same time there are many towns so situated that it is practically unnecessary for them to be required to filter their sewage waters. Under these and similar circumstances it is submitted that effluent water obtained by the posphate sewage process is of a character and quality which will meet the requirements of most towns without any filtration arrangements, but when filtration becomes imperative, then this process offers very decided advantages, by reducing the filtering area necessary for the purpose. It may be safely stated that this clean effluent water will not require one fifth of the area necessary for an equal quantity of raw sewage, and consequently for those towns where the highest purity is required, it very considerably reduces the area of land necessary, and the consequent outlay of capital. The adoption of the phosphate sewage process, by reason of the purity of the effluent water produced, is also a safeguard against the sewage farm becoming in itself a local nuisance by preventing accumulations of the solid matters of the sewage on the surface of the land and upon the vegitation.

The reports upon the phosphate sewage process originally issued by Dr. Letheby, the late Medical Officer of Health for the City of London, and Dr. Voelcker, the Consulting Chemist of the Royal Agricultural Society, have been confirmed by subsequent observations in the company's works under the use of sewage of higher strength and more offensive character than was originally experimented upon.

Dr. Letheby states:—

"The experiment affords conclusive proof of the opinion which I had previously formed, from observation and theory, of the great value of the phosphate process as a means of purifying sewage and of rendering the effluent water fit for irrigation, or for a discharge into a running stream without causing a nuisance."

And Dr. Voelcker reports:—

"I have no hesitation in saying that effluent sewage as thoroughly purified as I saw it done at the time of my visit, may be safely discharged into a watercourse without fear of causing a nuisance."

The manure obtained under the phosphate sewage process has many and great advantages over the ordinary sewage manures, which from their inferior quality are difficult of sale. As a matter of fact, it has been found more economical to purify the sewage by the use of a better and more expensive class of material, which, when it has accomplished the duty of purifying the sewage, adds to the utility and market value of the manure made. The manure produced under this process enables it to be compared favourably with other manures. The average composition of the manure now being made from London sewage is about 2½ per cent. ammoniacal matter and 22 per cent. precipitated phosphates, and consequently it is a really valuable manure. All such manures must be prepared to stand the test of the market upon the basis of their composition, and this alone is the true standard of value. The purchase of manure is now largely conducted upon the system of an agreed price for each unit of strength. It is a system which must increase, and any manure which cannot stand the test of such a standard cannot be looked upon as of an entirely satisfactory character. The manure produced by this company's process satisfactorily meets this test, and it can therefore be placed upon the market for sale on the basis of its own composition, and at the current market price shows a value ranging from £5 to £6 per ton.

W. Keith, *Secretary.*

THE DIAMOND SEWAGE PROCESS.

This process, as now applied to Llanelly, a town of 20,000 inhabitants, near Swansea, South Wales, is a double one, and has been specially arranged to meet the requirements not only of good residential towns, where all the houses are furnished with water-closets draining direct into sewers, but also of those towns in manufacturing districts where, from various causes, many of the houses can only be served by some form of closet other than the ordinary water-closet, and it has in this last respect proved so successful at Llanelly that the Local Board of that town have, on the recommendation of their medical officer of health, engineer, and inspector of nuisances, furnished the whole of an important district with the appliances for this part of the system, and after more than a year and a half experience of the working are proceeding as rapidly as possible to apply it to all the houses of the lower class.

The first part of the process refers to the sewage proper, viz., that which flows through the sewers, and includes all the ordinary liquid refuse of houses. This sewage is brought into the works by a diversion of the sewer, and the impurities separated by precipitation. The preparation of the precipitating mixture, its incorporation with the sewage, and the subsequent settlement in tanks, are effected by mechanical arrangements, of which the main features are in common, with more or less modification to precipitation processes in general. The effluent water being run off clear from the deposit, the latter is dried and prepared for market, and in this state forms a valuable manure.

The second part of the process is that in use for closets, from which the night-soil is removed by means of pails and vans specially suited for the purpose. The closets are fitted with a small door at the back of the seat, by which the pail can be introduced beneath the seat, and when full, removed without entering the closet, or in any way causing annoyance or disturbance to the householders.

The van man start from the works with a load of empty pails containing a small quantity of disinfectants, proceed to the houses to be served, remove the full pails. and replace them by empty pails as they go. The pails have proper covers, which prevent splashing or nuisance of any kind. The excreta thus brought to the works are mixed with dry disinfectants, of which the deposit produced by the first process forms a part. They are thus rendered completely inodorous, and, being dried, form the dry concentrated sewage manure of this process. The registered trade mark being D.C.S.M., in a diamond.

It is claimed that the effluent water from the first part of the system is at least equal to that produced by any known process. It has been kept in an open vessel for ten months, retaining its brilliancy and purity to the last without the smallest growth of sewage fungus or other deposit almost inseparable from such waters, and in all respects fit to be turned into any ordinary river in the kingdom.

The second part of the system has practically proved its efficiency to the entire satisfaction o the officers of the Board of Health, as evidenced b their reports to the Board, especially the medica officer, who, in reporting on the districts in whic the works are situated, and which had formerl never been free from fever, states that the healt of the district is now most satisfactory, and not single case of fever remained at the time of th report.

Under favourable arrangements with towns thi manure can be made at a profit, and its value, £ per ton, is proved by actual effects on the land a well as by analysis and sales made. The work are carried on by Mr. John S. Anderson, of th South Sea Home, and the Baltic, London, an were arranged and are under the general directio of Mr. Phillip Ovenden, C.E.

A B C PROCESS FOR TREATING SEWAGE OF THE NATIVE GUANO COMPANY.

This process derives its name from the initi letters of the ingredients made use of, viz., alun blood, clay, and charcoal, the three latter ma terials being specially intended to deodorise an purify the sewage waters, and the former to pre cipitate the impurities. An experience of ove five years has proved that the A B C mixtu removes from the sewage nearly the whole of it nitrogen except that which is found in sta sewage in the form of free ammonia, and it eve reduces this. In fresh sewage but little fre ammonia is detected. These nitrogenous matte are precipitated in the native guano produced b the process. The little ammonia left in the effluer

is in the form of sulphate of ammonia, and therefore as harmless as common salt. It also removes from the effluent, and adds to the manure, every trace of phosphoric acid, a most important circumstance as regards the immunity of the effluent from future putrefaction. The effect of the A B C mixture is so instantaneous and complete, that from the moment it mixes with the sewage it is deodorised, and throughout the remainder of the process, even through the hot cylinder drying, or through many months' exposure in the open air, the deposit is entirely free from all nuisance, and the effluent water has been kept for years without any change of appearance or the least taint of smell, and that too without any filter being used or required. By the addition of a small quantity of carbolic sulphite (for the sole use of which valuable agent the company have made satisfactory arrangements), all living organisms and disease germs are effectually destroyed, and by the paralysis of organic ferments, subsequent putrefaction both in the effluent and in the deposit is entirely prevented. It has also been incontestably proved by many months' trial at Leeds, that the mixture of dye water and the refuse of many kinds of manufactories do not interfere with the proper working of the A B C process. Notwithstanding the mass of such impurities coming down daily at Leeds, the effluent continued for months, night and day, to run off in a clear transparent cascade entirely free from smell or colour.

The process having been at work and under inspection for 5 years, the Native Guano Company are now in a position to prove, by the testimony of many independent authorities, that it fulfils the four great requirements of any sewage process—requirements that must be fulfilled before success can be claimed, and by which every process should be tested.

1st. That the effluent is sufficiently purified as to be innocuous and fit to go into a river.

2nd. That this can be effected without creating any nuisance.

3rd. That no material is used which injures or destroys the manurial qualities of the sewage.

4th. That it produces a manure capable of raising good crops of every kind, and that the value of such manure at least covers the expense of the process, even if it does not leave a satisfactory profit.

The proof that the A B C process fulfils all these requirements is given by the following independent testimony:—

1st. That the effluent is sufficiently purified as to be innocuous and fit to go into a river.

Mr. Keates, the chemical adviser of the Metropolitan Board of Works, after a careful supervision of the process during three months at Crossness, reports as follows:—

"That the effluent water was, on the whole, very good. The A B C treatment so far clarified and defecated the sewage that, looking solely to the physical condition and chemical composition of the water produced at Crossness, I am of opinion that such water was in fit state to be admitted into any ordinary river without producing a dangerous degree of pollution."

The use of the process at Leeds enabled the authorities to get their injunction suspended, and the Chairman of the Streets and Sewerage Committee, Mr. Alderman Tatham, on the 22nd September, 1873, officially testifies:—

"That the effluent water produced by the process is sufficiently pure to be allowed to flow into the river with the assent of the authorities."

The fact of fish living and continuing healthy in the effluent has been repeatedly proved.

The following is an official testimony by Mr. Alderman Tatham:—

"I, George Tatham, an alderman of the borough of Leeds, in England, and chairman of the committee of the Council, having charge of the works hereinafter referred to, do hereby certify that the Native Guano Company of London, in England, have superintended the construction of works at Leeds for the Corporation of this borough, such works being for the purpose of carrying out the purification of the Leeds sewage matter by the process patented by the said company, and known as the 'A B C process.'

"The said works are now in operation, and are daily purifying from one and a half to two millions of gallons per day of the sewage of Leeds, the effluent water from which runs from the tanks into the River Aire.

"On the 17th February, in this present year, a quantity of the effluent water was placed in a vase, and on the same day a fish (a carp) was placed in the water, where it remained alive and well and increased in size, until the 29th of July in this year, on which day it died, thus living and thriving in the effluent water between four and five months, no other water having been used.

"That between these dates the weather was very hot, and the water was changed every six or seven days, the fish being taken and put into the water by hand.

"On the 17th February, three fish were also placed in the water supplied by the Corporation for domestic purposes, where they remained until the 25th of July, when one of them died.

"Dated this 17th day of October, 1872.

"(Signed)

"George Tatham,

"Chairman of the Streets and Sewerage Committee of the "Borough of Leeds."

In the tanks in Paris fish of many kinds, including hundreds of the delicate gudgeon, lived and thrived.

No better proof of the purifying of the water can however be given than the following testimony in Mr. Keates' official report:—

"For some time after the experiment was begun, the outlet channel was cleaned every morning. On the 10th of September I desired that it should be left untouched, in order that the effect of the effluent water might be noted, and from that date to the end of November the half of the channel most distant from the outfall of the tank was never cleaned. After ten weeks there was no appearance of sewer fungus or other organic growth on the sides and bottom of the channel."

2nd. The entire absence of nuisance throughout the process.

Again I quote Mr. Keates' report to the Metropolitan Board of Works:—

"That during the preparation of the manure, including the storing of the moist cakes of mud from the presses, and the final drying in the drying cylinder, no offensive effluvia were emitted, and that, taking the experience of Crossness as a guide, the 'A B C process' may be carried up to the completion of the manure for the market without producing any nuisance."

And Mr. Alderman Tatham states:—

"3. That the whole process, including the preparation of the native guano, is performed without offensive odour or nuisance."

Consequent on this entire absence of nuisance, the works for the A B C process may be safely erected in the most convenient part of a town, and save the cost of a long continuation of expensive main sewers.

3rd. That no material is used which injures or destroys the manurial qualities of the sewage.

No testimony is required for proof of this, as the blood, clay, and charcoal are in themselves useful and are used as manures, whilst the alumina in the alum is similar in its action to clay, and the sulphuric acid fixes the ammonia and forms sulphate of ammonia.

4th. That the manure produced is valuable and grows good crops, repaying the expense of the treatment.

Numerous testimonials from independent farmers, gardeners, &c., as to the satisfactory results obtained from the native guano produced by the A B C process have been received and published. Copies of these accompany this paper, but are too voluminous to be introduced. The testimony of the company's agents is that farmers who began with a trial of one or five tons increased their orders to 50, 100, and even 200 tons. The demand for the guano produced from the sewers of residential towns such as Leamington, Hastings, &c., has each season exceeded the supply. Upwards of 4,260 tons have been sold, and £14,398 have been received in cash for it. It has been tried with great success especially on the coffee plantations of Ceylon. It has been proved also that its effects are continuous, and—unlike Peruvian guano—not confined to a single season, showing that its use greatly benefits the soil.

The authorities of Leeds, anxious themselves to test the value of the native guano made there, conducted a trial of two years, for the purof comparing it with other manures. The results are officially published. They prove that even the native guano produced from the weak and dye-mixed sewage of Leeds, and calculated at the price which the guano from rich residential towns is sold (£3 10s. per ton) beat Peruvian guano both seasons, and was but little behind stable manure, though the latter was at an exceptionally low cost, whilst the superior quality of the hay was admitted by an expert, though the difference in the value was not allowed for in the results.

As a proof of the native guano covering the expense of treating the sewage, it may be mentioned that the price asked and readily obtained is £3 10s. per ton, delivered at the railway station nearest the works. Almost the whole of the 4,260 tons mentioned above was sold at this price, and, though the chemical analysis may not bear out such a value, the farmers find, from actual experience, that it produces excellent crops, and are well satisfied to repeat their orders at £3 10s. per ton. The result of five years' experience proves that the cost of producing the native guano should not exceed from 35s. to 40s. per ton, according to the size and locality of the works. Great economies have of late been introduced into the process. Cheap substitutes have been found for the expensive alum and animal charcoal first used. Labour-saving machines have been introduced, and continuously flowing tanks have been substituted for the intermittent settling system of early days. After many disappointments, a cheap and effective drying process has been secured in the heated revolving cylinders, and the engineering, as well as the chemical treatment, has been simplified and economised. The following short summary of the process may serve to give a general idea of its action:—

The sewage is first mixed with the blood, clay, and charcoal, and, just before entering the tanks, the sulphate of alumina is added. The mixed sewage flows into the first of a series of six tanks, and thence through each to the outfall, where the effluent falls in a cascade into the river. The flow can be cut off from any particular tank to enable the mud deposit to be removed. This mud passes through drying cylinders which deliver automatically the dry native guano ready for the use of the farmers, quite free from smell, and so continuing for any length of time.

The A B C process was worked in temporary works at Leamington during the time that works for carrying out the previous arrangement with Lord Warwick were being built. During that period the town was relieved from the injunction that had been enforced against it. The completion of Lord Warwick's works, of course, put an end to the company's connection with Leamington.

The process was tried for over a year at Leeds under the close supervision of the authorities, relieving them also from the injunctions hanging over them, and so satisfied were they with its success that they officially state—

"That the town of Leeds has disinfected a part of the sewage of the town, and are about completing the works to disinfect the whole of the sewage by means of the A B C process."

A trial was made at Crossness under the supervision of the Metropolitan Board of Works, and the official report of their chemist, Mr. Keates, was entirely satisfactory as regards its sanitary success. The Board, however, reported that "there was no proof that it could be adopted with any hope of benefit to the ratepayers," ignoring the fact that the trial was only on a retail scale, and could therefore be no proof of the real expense to a town under ordinary circumstances.

Any further information will be gladly given at the office of the Native Guano Company (Limited), 9, Victoria-chambers, Westminster, S.W., and the effect of the A B C mixture will be gladly shown.—I am, &c.,

C. Rawson,
Managing Director, Native Guano Company.

THE RIVERS PROTECTION AND MANURE COMPANY.

There are three principal modes of dealing with sewage: Irrigation, Precipitation, and Filtration. By the first the manurial ingredients of sewage are passed into the land directly; by the second they are extracted with the view of applying them subsequently as dry manure. Both of them aim at a utilisation of the sewage for the purposes of agriculture and at a return to be derived from the improved condition of the land, or the sale of a chemical manure. Filtration, which is the third system, on the other hand merely changes the condition of the sewage, and is purely destined to render it innocuous when discharged into water courses.

It is intended to apply irrigation, where local circumstances recommend it, in combination with

Whitthread's precipitation process. Irrigation and precipitation have, quite unnecessarily, been placed in hostile juxtaposition, whilst on the contrary they should, where possible, be made to act together. No precipitation process is able to extract the fixed ammonia from solution, irrigation alone can completely utilise this valuable body; on the other hand, there is no doubt that in order to irrigate successfully, the suspended and putrescible matters ought to be removed by chemical precipitation before the sewage is applied to land. Moreover, it would be an immense boon to the irrigationist were he able in wet weather to dispense with the necessity of over-drenching his fields, merely in order to purify his sewage. This is especially the case in England, where the clouds usually are merciful enough. When precipitation and irrigation can be combined, they should be so, in order to recover the greatest possible amount of value, but it is evident that in many cases, where large quantities of sewage have to be dealt with, irrigation is impossible from want of land, while in others the land is not suitable for the purpose. A precipitation process which throws off a pure effluent and yields a deposit of value is therefore a necessity in the utilisation of sewage.

The Whitthread precipitation process has for a year been working successfully on a large scale at Enfield, and is now to be employed at Tottenham, effectually purifying the sewage so as to render the effluent water perfectly harmless, and turning out a good useful manure at a cheap cost. The merits of this process have been attested to by leading scientific authorities, such as Professor Corfield, and Professor Valentin (of the Royal College of Chemistry), and by Professor Sell, of the Royal College of Chemistry at Berlin, and their judgment must be deemed the more conclusive as these gentlemen speak under grave responsibility, and as no other precipitation process has ever before elicited from them anything in the shape of approbation.

The Whitthread process may be briefly described as follows:—Dicalcic phosphate dissolved in an aqueous solution of monocalcic phosphate is added to the sewage as it flows from the sewers, when the whole is well mixed; milk of lime is added in sufficient quantity to precipitate all the phosphates, while an excess of lime is carefully guarded against. The quantity of phosphates to be added depends on the quantity of nitrogenous organic matter in solution in the sewage.

Dicalcic phosphate has the power, when used as above described, to carry down with it organic matter, and especially nitrogenous organic matter; thus it removes those bodies most prone to decomposition, which are, at the same time, the most valuable manurial ingredients in the sewage. The resulting deposit consists of a nitrogenous calcic phosphate. The working of the process is simple in the extreme, and requires no special knowledge; it can be regulated by rule of thumb. The tanks and mixing apparatus used are similar to those employed in other precipitation processes, only as the precipitation is very rapid, tank room may be economised.

The precipitate is of a most valuable nature. The agent used, in itself a valuable manure, is always entirely recovered in the mud, the phosphoric acid existing in the sewage is likewise secured, and as the dicalcic phosphate efficaciously precipitates the putrescible organic matters, the quantity of nitrogen existing in the precipitate is very large. The manure contains no water of chemical combination, it is thrown down in a flocculent state, being perfectly inodorous, and can be easily dried. Numerous experiments have been made in this direction and the drying difficulty has been solved in various ways.

The rich and stronger the sewage, the more valuable will be the result, but it will everywhere give farmers a good useful manure at a cheap cost in large quantities.

When sewage is too poor in manurial matters to render it worth treating for the sake of its deposit, it is proposed to purify it by another very inexpensive process which has been patented, the rationale of which is easily understood. All know what a powerful disinfectant bleaching powder is. Bleaching powder owes its power to chlorine; when chlorine is brought into contact with bodies containing hydrogen as one of their elements, such as ammonia, the chloride seizes hold of the hydrogen to form hydrochloric acid, while the nitrogen is set free. When, however, the chlorine is brought into contact with oxidisable bodies in the presence of water, no matter whether these bodies are organic or inorganic, they are oxidised. A fluid like sewage is oxidised by chlorine by a process which is identical with burning all the organic matters present, except the ammonia, which is decomposed, while the sulphur compounds which produce the most offensive odours are converted into sulphuric acid.

The compounds used to effect these changes are some of them little known, but the body which will be employed most frequently is the tetrachloride of manganese, which evolves in the presence of organic matters a large amount of chlorine in its nascent, and thus its most energetic condition. This compound is much cheaper than bleaching powder, much more powerful in its action (an excessively small quantity effecting the desired purpose), while it does not load the water with lime salts as bleaching powder does, and it leaves no objectionable by-products in the effluent.

The simple object of this process is rapidly to effect a complete change in the condition of the putrescible bodies, to do the same thing in a few minutes which requires weeks in the ordinary course of nature, and days by filtration through land, with the advantage of doing this in every kind of weather, and at all seasons of the year.

The company has also acquired a supply of seaweed charcoal as a desiccating and filtering medium of high value.

FOURTH ORDINARY MEETING.

Wednesday, December 9th, 1874; James Fitz-James Stephen, Esq., Q.C., in the chair.

The following candidates were proposed for election as members of the Society:—

Blinkhorn, William, Sutton-grange, St. Helen's, Lancashire.

Booth, Lawrence, Essex-chambers, Essex-street, Manchester.

Brandon, David, F.S.A., 24, Berkeley-square, W.
Crossley, John, British Plate Glass Works, Ravenhead, St. Helen's, Lancashire.
Mann, Robert James, 5, Kingsdown-villa, Bolingbroke-road, Wandsworth-common, S.W.
Morgan, William, Ph.D., 28, Orange-street, Swansea.
Muntz, George Henri Marc, Church-hill-house, Handsworth, near Birmingham.
Richardson, John, Lincoln.
Robinson, Henry, 7, Westminster-chambers, S.W.
Scott, Walter, 57, Lansdowne-road, W.
Whitley, Joseph, Railway Works, Hunslet-road, Leeds.

The following candidates were balloted for and duly elected members of the Society:—

Campbell, Charles Halliburton, 10, Eaton-place, S.W
Gill, Lieut., W. J., R.E., Aldershot.
Grosvenor, Henry, 1, Bridgewater-square, Barbican, E.C.
Moberly, Charles Henry, 1, Park-crescent, Erith, Kent.
Moser, Richard, C.E., Upper Lawn, Tulse-hill, S.W.
Pease, H. Fell (Mayor of Darlington), Brinkburn, Darlington.
Wagstaffe, Thomas Rogers, 10, Lancaster-place, Strand, W.C.
Waite, William, Park-road, Halifax.
Wright, Dr. C. R. Alder, Chemical Laboratory, St. Mary's Hospital, Paddington, W.

And as Honorary Corresponding Member.

Lassala y Palomares, His Excellency Don Vicente, G.C.Ch.III., Valencia, Spain.

The discussion on Mr. F. Bramwell's paper on "The Expediency of Protection for Inventions," adjourned from the 2nd inst., was resumed by

Capt. Selwyn, R.N., as the mover of the adjournment, opened the discussion, and remarked that his justification in moving the adjournment had been sufficiently evident to all who had read the leading articles in the *Standard* of Saturday and the *Times* of to-day on the subject, which showed that not only was the paper itself replete in interest to the general public as well as to inventors, but that the subject had come to be considered in its proper aspect as that of a great national question. The compliments that had been paid—if indeed truth could be called a compliment—to the lecturer he most heartily joined in. No more exhaustive paper, no more clearly written paper had ever appeared on that much-disputed question of the Patent-laws, than the one they had had the pleasure of listening to. The *Times*, however, remarked, and he thought with great force, that there was a point on which Mr. Bramwell only touched slightly. Having won a victory all along the line which he particularly adopted as his own, he left the question of the reform of the Patent-laws to be treated by other speakers. He was sorry that the President of the Inventors' Institute (Sir Antonio Brady) was not there to-night, but he knew exactly what his views were, and to a certain extent he represented the council of the institute. They wished to put forward very strongly the necessity for a wise reform of the Patent-laws. Having long fought the question successfully that the Patent-laws were not an injury to the community, but calculated to do the community the greatest good, they now came very properly to the question of a reform, and in doing so they had come to the conclusion that they could not do better than point out the existence in a nation kindred to our own in everything but its governmental institutions, the principle adopted there, which had not only given the community an enormous benefit for the development of inventive genius, but had also thoroughly satisfied the inventor. It was a system which proceeded on exactly the opposite plan to ours, which, instead of leading the inventor by the hand towards success, as the American Patent-laws indisputably did, takes him by the throat practically and robs him. The contrast of the way in which this was done in America and in England was so strong that he could not avoid bringing it to their notice. They gave to any two men, who chose to go together to the Patent-office, holding the same views, describing the same invention in the very same work,—they gave them both a patent. That was really nothing but a permission to go to law, and the lamentable result of a patent so given was, first that an enormous number of worthless inventions were patented; and secondly, that large sums of money were spent without the slightest prospect of a return. The American Patent-law proceeded in exactly the opposite direction. It investigated fully and fairly the merit, the validity, and the originality of his invention. As Major Hotchkiss had told them, there were 70 examiners altogether, divided into three classes of about 22 each, and so much care was taken that, in a recent case, three days were spent in examining the merits of an invention. What was the result? Very few patents were contested, and a great many were brought to a successful issue. An inventor could never benefit in the smallest degree, unless the community benefitted in a much larger degree, and so, whatever could benefit the inventor is felt as a benefit by the community at large. It had been urged that they should give to the toiling masses technical education, and that they should raise them in every direction; but they had also heard, over and over again, from the chiefs of labour, that this would be only a snare and a delusion, unless they gave them some prize to contend for. If for their brain-work they got protection, then we might rely upon it that however fierce the struggle, or however few the prizes to be won, those prizes would not fail to stimulate a large amount of intelligence. The whole basis of society was very well known to be the protection of property. But whereas property in land, money, houses, was not nearly so susceptible—and in this country was hardly at all susceptible—of extension, there was no limit to the development of the wealth created by intelligence, and in proportion as intelligence was encouraged to produce valuable products out of waste materials, so would great fortunes be founded and wealth increase. He did not pretend to lay down a straight path from which there should be no deviation, but simply to put before them in what respect the laws should be modified or allowed. He did not presume to say that the laws of the country should be the same, or that the intelligence and industries were so similar that they required exactly the same legislation; but he did venture to say that there was a model which had produced good effects, and his warmest desire was that it might be copied successfully. The less costs that were paid by the inventor the greater would be the benefit to the community at large, for whatever costs were paid out of pocket by an inventor, or by those who contested an invention, must eventually fall upon the consumer.

Mr. F. W. Campin said he would not go into the question of how the Patent-law might be improved, but he would say a word or two with regard to the main subject, namely, the expediency of patents. Mr. Bramwell had alluded to the fact that inventions were often produced by men who were not connected with the trade or profession dealing with the subject of their inventions. That was perfectly true, and it seemed to him to be the strongest possible ground for maintaining the system of a limited property in an invention as the reward to an inventor, rather than any scheme of national rewards. Inventors were not usually rich men, and generally speaking they were quite incapable of doing anything for the practical development of the invention they had made. They therefore had to go to manufacturers or capitalists, and when they did so, was it to be expected that the manufacturer or the capitalist would take them in hand unless it was to make some property in the invention or get some

advantage by it? As a matter of practice he had always found that when a capitalist was brought to aid an inventor, the very first thing he went into was the question of whether the patent was a valid legal property. That showed that he looked very much to having a legal guarantee that the money he was going to spend would be secured to him.

Mr. Horatio Lloyd had entertained great objections to the general principle of a Patent-law, but those objections had been much modified and overcome by the consideration which had been given to the subject. He had been unable to devise any other system of rewards to inventors, and therefore he had been compelled to modify the conclusion he had originally come to, and to express a reluctant acquiescence though not a settled conviction as to the expediency of protection for patents. He would add his humble voice to the general chorus of applause with which Mr. Bramwell's paper was greeted. To him, he confessed, it seemed a most wonderful production; the composition was admirable; the order was clear; the language lucid and precise. It was in fact a marvellously wonderful production of the human brain. But there was one thing in that essay—for essay it was—which he admired more than anything else, and that was the marvellous dexterity and skill and artistic talent which had been brought to bear on one side of the question. He should designate it as the written speech of a most able and skilful advocate. He showed perfectly the one side of the question; in fact, Mr. Bramwell had taken up the part of an advocate, and if he were not so eminent in the profession in which he laboured, he should have said that no man could have distinguished himself so much had he chosen the profession of an advocate. But he could not help thinking that if there should be found an advocate equally dexterous and equally skilful, there might be adduced arguments as weighty and as powerful on the other side of the question. He did not wish to play the part of the *advocatus diaboli*, for he knew there was a general concurrence of opinion on the subject, and he saw from the tone of the meeting that there was a general consent, in that Society at all events, to the principle of the Patent-laws. Perhaps it was difficult, it might be even impossible, to suggest a good substitute—but, nevertheless, there were great evils in the existing system, and if he did not believe that they were generally admitted, and that there was an earnest intention and desire to remedy them, he should adhere to his former conclusion, that notwithstanding there might be meritorious inventors who might suffer by the abolition of the Patent-laws, it would be better that those laws should not exist. But, as he said before, he had modified his conclusions. Of course, it was impossible for any man having a right heart and mind to say that you should avail yourself of the gains, and the labour, and the talent of the inventor, without giving him some remuneration. But he thought, nevertheless, that Mr. Bramwell had put the case too high, and he could not agree with him that the stimulus of mere gain which he had put forward as the incentive was the most material one. It certainly was not the only one which entered the mind of great men in the great discoveries and the great inventions which had been made. The men who had been the great benefactors of mankind had not been stimulated by the mere love of gain, but by a much higher feeling. He could not believe in the man who would come forward and say he had a great invention, but if they did not pay him his price he would hold it back. There were many men who had given their time, and labour, and talent without for a moment entertaining any idea of receiving any reward except that which Mr. Bramwell had so merrily disposed of, the reward of honour—the reward of thinking they had done some good for the benefit of their fellow men. He could not go along with Mr. Bramwell in many of his propositions. He could admit his conclusion, and yet dispute many of his premises, and he could not for one moment admit that that low feeling had actuated many to whom the world was indebted for its greatest discoveries and inventions. He did not find that the greatest inventors had been so actuated, nor did he find the Patent-laws brought out those inventions. Take for instance the electric telegraph, or the method of propelling steam vessels. He would challenge Mr. Bramwell to say who was the inventor of the electric telegraph, or to whom could be attributed the merit of the invention of steam propulsion. It was impossible. Ronalds, if anybody, was really the originator of the telegraph. The application, the mere mechanical contrivance, might be claimed by Cooke and Wheatstone, but the idea, the thought, that which had developed itself into this mechanical result or appliance, belonged to another. He did not seek for gain. That was not his motive. Take again the instance of the locomotive. He would defy any man to say who was the inventor of that. That invention was a growth. It was not a sudden creation. It developed itself from time to time, and out of one thing sprang another, till at last the idea came to be matured into something practical. It was not a stimulus of that low kind which created such inventions, although, he admitted, it might act upon others. There was a class to whom the love of gain was the stimulus, and who did not mind stealing the work of other men's brains, and who got the reward; but these were not the men whom the laws of the country ought to encourage and protect. In the present state of the law, unless it were improved, he should still doubt whether it were desirable to protect the inventions of such men. Mr. Bramwell had asked inventors were they satisfied? and what was the answer? A loud scream of discontent, and so, he said, every one should get up and complain of the law. But it was his duty to show both sides of the question, and not one only. It was his duty to show the evils that arise from such a law as well as its benefits, and so he did, for he gave seven objections which were urged against it, but all of which he disposed of in the most perfunctory manner. It was his duty, in stating the case, to show whether the advantages of such a law counterbalance the evils. But he did not. He merely gave seven heads of objections which had been raised in a discussion which took place last year, and a great many of the observations on which were really futile. The first was interference with freedom of trade. Now free trade was a term which was often used, but it must have its limitations. Then another objection was that British manufacturers were put to a disadvantage compared with the subjects of countries where there were no Patent-laws. That Mr. Bramwell disposed of at once as being worthless; but he must say that he thought he might have shown a a little more justice to Switzerland than he did; and he remembered that in Switzerland there was one of the finest establishments of mechanical inventions that existed anywhere that he knew. So he easily disposed of two of the seven objections which he put forward, and of two others, namely, that patents were given for useless things, and for things which were not new, he disposed in about two or three lines; when the great objection of all was that there was a class of patents which had no object and no use. Mr. Bramwell had touched very lightly indeed upon his adversary's case. He did not discuss it, but left that to others. What he did say was not complimentary to the many other persons who had thought otherwise, and to whom he mght have given a little credit of having thought on the subject. Then he spoke most slightingly of the feeling of honour, quoting a passage from Shakspeare. Either he meant to imply that Shakspeare was of that opinion, or that he (Mr. Bramwell) adopted that sentiment of Shakspeare. He was unwilling to think the latter, and he was sure it was not true of the former. It was about the most ignoble thing that ever was uttered, and it proceeded from the mouth of the most ignoble character that ever Shakspeare created. And who was it? Sir John Falstaff. And on what

occasion did he utter it? When he was meditating whether he would not fly from danger. But did Mr. Bramwell mean to say that men were influenced by such a consideration as that? Did he mean to say that there was no desire for posthumous fame in the minds of men, or that they never think that their fame will be perpetuated, and their name handed to posterity? Mr. Bramwell had instanced a fanciful country parson, who having made an invention, might be unable to protect it without the aid of the Patent-law, and had also spoken of the necessity of protecting the manufacturer, who must keep his invention secret. He thought secrecy was most demoralising, and the man who did not convey his secret, but exposed his workmen to temptation, deserved no reward. Mr. Bramwell had instanced the case of Crompton, and said that burglars had broken into his premises to steal his secret. He wanted to know why he did not get a patent; and he could not help thinking that Crompton at that time had a very serious misgiving as to its value. Another instance of the futility of hoping for reward. Another case cited was that of Dr. Potts. He did make a very good invention, but it was said he never would have a reward. But did Dr. Potts try his invention by experiment? If he had not done so his description would have misled, because it was only by the experiments afterwards that it was discovered what did cause the cylinder to sink, namely, the displacement of the loose material. He did not think Dr. Potts deserved any reward. He would conclude his remarks by saying that he was a *quasi* convert, and had tried in vain to find some other reward. He certainly desired some modification of the Patent-law, but in justification to himself he was bound to say that at the time he gave his evidence, in 1851, the law was in a very bad state, and there were great evils, and such as seemed to him to say that unless a remedy were found he would rather not have a Patent-law at all. Since then a great deal had been done. In 1852, the law was changed, and an Act was passed; but the most material part of that Act, namely, the appointment of a Commission which was to take the initiative in ascertaining whether the invention was new and so forth was a nullity. In 1871 there was a committee again appointed, and they recommended that that commission should be formed. That, however, had not been done, and it showed how necessary it was to exercise vigilance. What he would venture to suggest would be that this Society should appoint a standing committee to look after the matter, to see that it was done, for it was really a necessary thing. One recommendation was that there should be an obligation to grant licenses, and if the terms were at all in controversy or dispute the body so appointed should adjust them.

Mr. J. Hinde Palmer, Q.C., having been a member of the Committee of the House of Commons in 1871 and 1872, to inquire into the Patent-laws, said he had necessarily taken great interest in the subject. But when he saw the heading of Mr. Bramwell's paper he began to think they had gone back, in point of time, for three or four years, because he had considered that what took place before those committees had put an end to the idea which had previously prevailed in favour of the total abolition of protection for invention. There was a general feeling, he thought, throughout the country, exemplified by the evidence given before the committee, that it was desirable that there should be protection of inventions. And not only had that committee reported in favour of the protection, but there had been an International Congress of all countries at Vienna, which Congress, after very mature deliberation and considerable discussion—several taking up the view of abolition which prevailed among some in this country—after all that full discussion, they came to a division upon the simple principle of whether there should be protection or not, and 74 voted for it and only 6 against it. The pre-eminent position which this country holds as a commercial cou
try was to be traced to the manufacturing industries
the land, and that which has tended more than an
thing else to elevate that industry to the height whi
it had attained, he felt was the protection of the Pate
law. Lord Selborne, when Sir Roundell Palmer, mad
most powerful speech in the House of Commons agai
protection; still he considered he was justified in sayi
that at the present time the conviction of everyone w
had had experience in the matter was that protect
for inventions was a matter of justice, a mat
of policy, and, as Mr. Bramwell had said,
matter of expediency. But if any doubt did really e
at all upon the question, it was dispelled by the a
paper of Mr. Bramwell; and he could only express
earnest wish that it had been produced in the way
evidence before the Committee, because if it had b
produced there, he felt sure it would have brought c
viction to the mind of every one. Mr. Lloyd said
had been converted. Generally speaking, conv
became rather too enthusiastic on the other side;
there was also another saying, that he that was convin
against his will was of the same opinion still; and
feared there was lingering in the mind of Mr. Lloy
strong idea that patents for invention had better
abolished altogether. Shortly after Lord Selborne
made a speech in the House of Commons, he took
chair at a large meeting of skilled artisans at Clerk
well, held upon the avowed principle of total abolitio
patents for inventions. The several artisans discu
the question in favour of the protection of inventi
and the gentleman who was intended to move
resolution in favour of the total abolition was so
vinced by the arguments he heard on the other s
that, to the great surprise of Sir Roundell Palmer,
actually himself altered the resolution, to one in fav
of the laws, and carried it with only two hands
up against it. The committee which inquired into
matter was composed of twenty-one members, pres
over by Mr. Samuelson, and a great number of
of experience in patent matters, Mr. Siemens,
Nasmyth, and many others of the best witne
that could be obtained gave evidence, and the conclu
come to, after most matured deliberation, was
"Letters patent promoted the progress of manufactu
and led to the introduction and publication of nume
improvements, and contributed greatly to the prog
of industry." From that it might fairly be concl
that protection of inventions was a matter of policy
a matter of justice. As regards pecuniary rewards
inventions, everybody in the House of Commons thou
they were perfectly impracticable. You could never
you were rewarding the right man, and it was felt
would be a source of great evil and corruption. The
other alternative therefore was to give a right of prop
in the production of a man's inventive genius.
all seem agreed that the laws ought to
amended, and there were two points upon w
amendment was required. First, that there sh
be a preliminary inquiry before the patent
granted; 2nd, this was already granted in the Act, b
had became a practical nullity, for the clerk of
Attorney-General was examined before the Commi
and it was found to be a mere matter of routine,
that so far as any preliminary investigation was
cerned it was a mere myth. One great objection u
against the Patent-laws was that a great numbe
frivolous and almost useless patents were grante
people, and that patents were granted to others
really were not entitled to them. If the prelimin
investigation were conducted by experienced and
men, who were not law officers of the Crown,
great objection would be removed, and the investiga
would be such that only those patents which appe
to be of substantial beneficial public advantage w
be granted. That preliminary investigation would
of great utility, and the object of the Act of 1852

to appoint a Commission who should be able to carry it out. But the Commission was a mere myth, composed as it was of the Lord Chancellor, the Master of the Rolls, the Attorney-General and the Solicitor-General. The Master of the Rolls was examined before the Committee of the House of Commons, and he said that the Commission was worse than nothing; that the whole thing was in fact delegated to one officer, Mr. B. Woodcroft, F.R.S., a very efficient gentleman, but all the labour devolved on him. It had been suggested that this Commission should be reinforced by the appointment of additional Commissioners, who should be persons of experience in manufactures and chemistry, and in the branches of trade to which patent inventions were most likely to relate. That was the first step to be taken to constitute a really efficient Commission to conduct the preliminary inquiries, and that would lead to a great many amendments. An application was made to the late Lord Chancellor Hatherley on the subject, but nothing was done, and he looked therefore with great satisfaction to the agitation now being carried on, as it must lead to some result, for in this country it was well known nothing could be obtained without constantly agitating, and constantly pressing on the attention of the Government of the day the necessity for their action. He did not think it was necessary to go to the same extent in this country that was done in America, because, on looking at the number of patents granted in England in 1872, he found they were not quite [illegible], whereas in America there were applications for [illegible] in that year, 12,000 of which were granted. Probably one inducement by which the number of applications were so greatly increased in America was that the cost was considerably less than here, for while there it was only £7, here a patent could not be obtained for less than £175. There was an idea prevalent in some quarters that it was not desirable to make the cost of patents too low, but it should not be so high as in England, where it was much greater than in any other country. One of the great objections made by abolitionists, as he might call them, would be completely cured if a proper system of preliminary examinations were adopted. It had been urged that patents operated to stop the way and prevent future improvements, and this had been illustrated by Mr. Nasmyth with reference to the steam hammer, and by others also, and it was said that if a patent were applied for for an improvement in a pre-existing invention, there was great difficulty in obtaining the consent of the first patentee. This view had been urged by Sir R. Palmer in the House of Commons, and by Mr. Justice Grove before the Committee, but it would be avoided by another recommendation of the same Committee, viz., it should be made compulsory to grant licenses on equitable terms and conditions. This suggestion had also been very fully discussed at the Vienna Congress, and adopted. It was said that inventors would not work together, as they had been reported as doing in [illegible], and no doubt there might be difficulties on that score. Some persons might be inclined to be litigious, to listen to no terms, and to refuse permission to anyone else to make use of their inventions for the purpose of an improvement. But then would come in the provision for compulsory licenses, and if it appeared to be for the public advantage that the second inventor should carry out his improvement, there might be a tribunal to determine, in case of difference, what was a fair and just royalty to pay to the first patentee. The question then arose as to who should be entrusted with this power, and it was finally determined that the Patent Commissioners should be the ultimate authority on such questions. Thus they again come back to the necessity for an efficient Patent Commission, and in having such a body, making satisfactory preliminary examinations of inventions and compulsory license clauses in patents, would go very far to meet all possible objections. He would add, that at the very time when Mr. Samuelson moved for the Select Committee, he introduced a short Bill, which also bore the name of Mr. Mundella, for the amendment of the Patent-law, and though no doubt it was far from perfect, if it had got into committee, it might have been made satisfactory. He did not think much legislation was required, and this short Bill provided for the two main improvements he had already spoken of, with one other which had been frequently mooted, and which seemed in many ways desirable, viz., the possibility of granting, under certain conditions, indefeasible patents, in order to prevent the enormous legislation which was complained of, although this had been much exaggerated. Of course such a patent would only be granted after full notice and opportunity had been given to any person to object, and, with due precautions, he saw no reason why the idea should not be adopted. He trusted the Society of Arts would not now leave this great national question unsettled, but would press upon the Lord Chancellor and the Government the absolute necessity, in a great manufacturing and commercial country like England, that the Patent-laws should be made in some way efficient, and to tend more than they now did to promote and stimulate genius.

The Chairman having announced, in order to meet the wishes of many gentlemen who desired to speak, that the discussion would be adjourned at 10 o'clock to that day week,

Mr. B. Samuelson, M.P., said he was very glad that Mr. Bramwell had taken up this subject, not because his views required demonstration, but because it brought the whole subject forward and attracted public notice to it. If he had any fault to find with Mr. Bramwell's paper it would be somewhat of the same character as the exception taken by Mr. Lloyd, that matters had been represented rather too much *couleur de rose*. It was doubtless a good plan to put the best face on matters, but it might be carried to an extreme, and the danger in the present case was that you thereby furnished arguments to your opponents. It could not be denied that there were differences of opinion about any Patent-law, nor that there were grave defects in the English system. It would not do to insist that without a Patent-law invention would not proceed, nor that under the English law inventors got all that was due to them, whilst manufacturing progress was promoted. With regard to the non-existence of Patent-laws in other countries, Mr. Bramwell had made light of the example of Holland and Switzerland, but Mr. Lloyd had referred to the large establishments in the latter country for the manufacture of spinning machinery, and it was the undoubted fact that this spinning machinery, manufactured without a Patent-law, was driving English machinery out of the South of Germany and the North of Italy. It might be said that that was simply a question for the manufacturer, but it was depriving England of so much labour. Then, as to the nature of the present law, under its provisions it was impossible for the manufacturer to obtain a license except on such terms as the inventor chose to impose; and though it was quite right that the manufacturer should pay just terms, it was not right that the industry of the country should be crippled through the obstinacy of the inventor. In Switzerland a dozen different inventions might be combined in one machine, while here every master had to go "on his own hook," as it was termed, the result being, as he had already stated, that better and more complete spinning machinery could be obtained in Switzerland than in England, owing to the obstruction of patentees. Holland was a small country, with only two million of inhabitants, but he would ask the sugar refiners of London, Liverpool, and Bristol how they felt under the circumstances of the Amsterdam refiners being free from any patent dues, whilst they in England were at the mercy of patentees. No doubt other instances of a similar kind might be mentioned;

but one thing Mr. Bramwell had omitted altogether to state, viz., that in Germany, though there was nominally a Patent-law, virtually there was none whatever; and if it had not been for the unfortunate war with France, he believed the consequences would have been ere now perceptible in this country. Therefore, while not abolishing the Patent-laws altogether, on account of the many difficulties, every effort should be used to make them as efficient and as little obstructive as possible. The last speaker had referred to the Committee of the House of Commons which sat for two sessions, but for all the good which had resulted—unless the present discussion were to be reckoned as one—it might as well never have sat at all. Ever since the report was issued, in which he believed not a single fault had ever been found by anybody, one deputation after another had been to the law officers of the Crown, and had urged upon them to take the matter into consideration, but nothing whatever had been done. He did not believe any fresh legislation was required, or, if so, it would be so slight in character that there would be no difficulty in carrying it. The Act of 1852 gave power to the Lord Chancellor to appoint Technical Commissioners; and if such a body were judiciously chosen, he ventured to think they would find in the law as it stood all the materials for building up a system of patent administration which should do all that it was possible for any Patent-law to do in favour of both patentees and manufacturers. There was already power to appoint examiners; the Commissioners might either act as such themselves, or appoint qualified persons for the purpose, and there was also power at present to insist on the granting of licenses. Within the last few weeks there had been an instance of the renewal of a patent to the Martini-Henry rifle, the condition being imposed that every manufacturer of small arms for military purposes should be at liberty to use the invention on paying a license duty not to exceed 2s. In fact, every patent granted contained the words that it was on such conditions as the Crown saw fit to impose, which would, of course, include requiring the patentee to grant licenses on reasonable terms. With regard to litigation, it had been said that in all matters involving valuable property important litigation would be sure to arise; but he could not but be reminded of the fable of the boys and the frogs, since what was only sport to a certain class of gentlemen was death to the inventor; and he did not really think that so much litigation was at all necessary. It would, however, inevitably take place so long as a patent for the same thing was granted by the Attorney-General in one office, and by the Solicitor-General in another; nay, while two patents for the same thing were granted by the Attorney-General in his own office at the same time. These learned gentlemen did not know what they were dealing with, and if the same thing were called A in one specification and B in another it was of course considered to be quite different. It should be insisted upon that all inventions should be described intelligibly, though there was not much use in describing them for the Attorney or Solicitor-General, who had not time to read the specification. Only a short time ago, he had a patent refused, and of course thought there was some error in the specification; but on inquiry it appeared that the great difficulty lay in the attestation clause, which did not properly express that the person before whom the declaration was made took it from the intending patentees jointly and severally. If he described a thing as an oval, and some one else described the same thing under the name of an ellipse, a patent would inevitably be granted for each. The appointment of efficient Commissioners lay at the root of the whole thing, and no good would come of all their discussions until this was done—due care being taken to avoid jobbery. In spite of all that had been said about honour not going far, he believed there were many men who would count it an honour to be entrusted with the adjudication of such important interests, and who would desire but a nominal salary, if any. But even if good salaries were paid, they would be saved fifty times over in the course of a year. As had been said by Capt. Selwyn, the Patent-law ought to be so administered that instead of taking the inventor by the throat, it should take him by the hand, and in many cases, especially if he were a poor man, show him that he had better not waste his money, and what was of more importance, his time and energy, over a thing which some one else had invented forty years before, and abandoned as impracticable. Difficult questions arose about imported inventions, but he considered it a scandal to the State to allow a patent to be enforced simply as an obstruction. Not long ago he was shown a watch, with a particular arrangement for winding, which was patented in England, and on asking whether they were made in Birmingham or Coventry, he was told they were not made in England at all, neither were any licenses granted, because it answered the patentees' purpose better to have them made in Geneva. That was not doing justice to English artisans; it was not allowed in France, or any other country, he believed, except in England; and he doubted whether it was not almost worse than the course adopted by certain schemers between whom there was a race who should be first to steal an American invention, bring it over here, and patent it. These, however, were minor points; the main thing was to get proper persons appointed to administer the Patent-law, and everything else would soon follow. In fact, he did not believe there would be any difference of opinion between the Commissioners as to the small legal changes which would be required. He had purposely avoided discussing the question of property in inventions, because it would be only throwing doubts upon a thing which was already settled in the minds of most people. In conclusion, he hoped the Society would follow up this question, urge it upon Parliament, and not allow it again to go to sleep; for ministries changed and work accumulated, and unless a strong pressure of public opinion was brought to bear very little was ever done.

The discussion was then adjourned to Wednesday next.

MISCELLANEOUS.

THE LAW OF PATENTS.

The *Pall Mall Gazette* of Friday, the 4th instant, had the following article on Mr. Bramwell's paper. Though it is in great measure a summary of what has already been before the readers of the *Journal*, yet it appears worth while to republish it in its entirety, as a useful contribution to the arguments on Mr. Bramwell's side of the question.

A paper was read on Wednesday evening at the Society of Arts, by Mr. Bramwell, on the subject of the law of patents, which, as it appears to us, ought to put an end once for all to one at least of the many fallacies which are raised upon this subject—the question, namely, whether there ought to be any Patent-law at all. It is well known that a considerable number of persons have for some time answered this question in the negative, and have contended that the law as it stands is open to so many abuses that it does more harm than good. Mr. Bramwell's paper, the interest of which can only be guessed at by those who have seen the abridged account of it which appeared in the newspapers, dealt with the subject in a manner which really leaves nothing more to be said about it.

Fully admitting that, in many respects, the existing law stands in need of reforms, he established the necessity for the existence of such a law by a series of arguments tending to show the general expediency of protecting inventions. The leading arguments were as follows:—In the first place, under our present system of li

...ly the whole of our comfort and prosperity depends ...mechanical invention. Food, clothing, loco-...on, military power—all depend upon the encourage-...t of inventions, and to give the inventor, under cer-...conditions and for a certain time, a monopoly of his ...ntion, is the most direct and obvious means of ...ing this end. This case in favour of a Patent-... is as simple as it is strong, but its whole strength ...not become apparent till the objections which may ...made to it are considered.

The inventor, it is said for one thing, will invent ...the pleasure of exercising his ingenuity. The ...er is that this pleasure carries him a very little ... The real difficulty of invention lies not in the ...ery of the original general idea. That is, no doubt, ... which to those who are capable of performing it at ...delightful, and may perhaps be its own reward. The ...pinch comes when the general idea has to be worked ...in practical detail, and this is so difficult a matter ...no one will do it unless he is highly paid for it.

Again, it is said that the inventor may work his own ...ntion, and will have special facilities for doing so. ...answer is that to work an invention requires capital, ...wledge of business, and other gifts of a very different ...from those which cause inventions to be made. A ...her answer is that many of the very most important ...tions are inventions of processes which can be ap-...to innumerable purposes, but are not confined to ...ne. A man, for instance, invents a furnace which ...ly economises heat. It is useful to all manufac-...rs, but not to one more than another. Therefore, if ...inventor sought to profit by his invention in the ...way suggested, he would have, in the first place, to ...on a trade with which perhaps he had no connec-...whatever, and when he had done so he would have ...motive to keep as secret as he could a process which ...would be an enormous benefit to all trades if it was made ...and he had a royalty on it. Mr. Bram-...gave some illustrations of this which were as ...ing as any part of his lecture. The follow-...very simple one is, perhaps, more suitable ...our columns. Suppose that the rudder was a new ...ntion, and that ships were usually steered by some ...and unsatisfactory machine, would it not be ...to say to the inventor (who very probably ...be, say, a country clergyman), Your reward ...be this: Buy a coasting brig, fit her with a rudder, ...her yourself, or by some agent who will keep ...secret, and you will find that you will be able to ...goods between Newcastle and London more cheaply ...people who steer their colliers by the intricate ...which you will supersede. The case of the ...is very instructive. It is an invention of enor-...value, of the widest possible application, and so ...that any one can understand it when it is ...to him, and that any carpenter can make it. ...no reward could be given to the inventor except ...reward of a royalty, for he could neither make ...profit by using the invention himself, nor would ...any advantage over other people in manu-...and selling it. Simplicity and general utility ...the highest merits which an invention can possess. ...Patent-law gives a proportional reward to the ...; nothing else possibly can reward him at all.

...argument bears upon the character of inventors, ...of great general interest. Mr. Bramwell pointed ...that nearly all inventions not only are, but must ...the nature of the case be, made by persons who are ...greater or less extent outsiders with respect to the ...to which their invention relates. A man whose ...is established, and who has thoroughly acquainted ...with a mechanical process and overcome its diffi-...is not only unfitted in a very large proportion of ...for striking out new ideas, but his interests are ...as a rule, opposed to the adoption of improvements. ...invested his capital in machinery which a new ...will reduce very probably to old iron. Unless, therefore, he is put under compulsion, he will continue to make his fortune in the old way and at the old rate. The manner in which compulsion is applied to him is by the inventor, whom the Patent-law enables to say, "If you do not adopt my invention and improve your manufacture, I shall take it to your rival in business, whom it will enable to undersell you." The Patent-law in this manner gives inventors a power practically to compel the adoption of their inventions if they are useful, which overrules the obstructiveness of persons interested in maintaining the existing state of things.

Finally, Mr. Bramwell exposed with great vigour and humour the absurdity of the notion that the public could ever give national rewards to inventors. The suggestion of a standing Commission or Committee which should pay people prizes for inventing this or that is indeed a proposal worthy of Laputa, and the practical difficulties, if we ought not rather to say the practical impossibilities, of the proposal suggest themselves in multitudes as soon as the subject is seriously considered.

We hope this summary of part of Mr. Bramwell's prper may lead those who are interested in the subject to study it. The only question which it does not appear to us to solve is the question how anyone can have maintained the absurd proposition against which it is directed. We believe the truth to be that those who do so confound together two very different things—the anxieties and uncertainties connected with discoveries and property in patents, which, no doubt, make themselves felt through the medium of the Patent-law, and the Patent-law itself. They wish to abolish the law because the subject matter to which it applies is uncertain, full of difficulty and anxiety, and apt to produce all sorts of capricious and unexpected results. They think that they will cure themselves of the disease by turning off the doctor. It is unquestionably true that the career of an inventor, like the career of all other reformers, is full of troubles and anxieties. In the first place, he is probably a more or less unsettled person to begin with; a man who for some reason has got out of the common ruts and has to make his way as well as he can across country; a man with more ingenuity than fitness for practical business. Such people always exaggerate their own merits, and are in a state of continual indignation against the injustice (as they consider it) of nature, which gives much greater rewards in the way of solid wealth and comfort to the possessors of more commonplace qualities. Such people would be more uncomfortable without a Patent-law than they are with one, though their discomfort would be of a rather different kind. They would have to complain, not of discovering that their patents were void, but of finding that their inventions were useless. The reforming temperament, ingenuity, and originality have their advantages, but they very seldom make a man thoroughly comfortable and easy in his circumstances.

Apart, however, from this it must be observed that in the very nature of things patent property, however valuable it may be—and in many cases it is of enormous value—must always be uncertain and attended with peculiar disadvantages. The question whether an invention is really original or not, and whether or not a particular process or contrivance differs substantially from another process of the same kind and for the same purpose, must under almost all circumstances be a very difficult one. In almost every other kind of dispute which can come into a court of law the subject matter in dispute is at all events definite. Does this land or this money belong to A or B? Shall A pay B damages for this act or not? In the case of a patent right the question is as to the the nature of processes which very often run into each other. Is the process by which one set of photographs are made, really or only apparently different from the process by which another set are made? In the early

history of the art of photographing did such an inventor reach such a point, or did he stop short of it, and attain only to something which depends on a different principle? These questions and others like them always excite great heart-burning and jealousy, and are, and always must be, specially difficult to decide, and whatever manner of deciding them is adopted, the loser will invariably declare that it is ridiculously incompetent and absurd. We believe, however, that it will be found first, that the matters really complained of are the fault of the intricacy of the subject rather than of the law which deals with it; and next, that the expense and vehemence of the litigations which take place about patents prove in reality the importance of the subject matter litigated upon. Throw the oyster into the sea, and there will, no doubt, be an end of the story about the shells and the fish; but oyster-beds are a valuable property for all that.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A meeting in furtherance of the establishment of the school was held at Liverpool, on Thursday, the 4th instant. The chair was occupied by **Mr. Clarke Aspinall**, who in opening the proceedings explained the character of the school, and gave a short account of the events which had led to its formation. He was followed by **Mr. Lionel Benson**, who gave further information of the same character.

Mr. P. H. Rathbone moved the first resolution, "That this meeting fully concurs in the proposed scheme of the Society of Arts for the formation of a National Training School for Music, and desires that Liverpool should assist in promoting the scholarships in connection therewith in the manner explained by Mr. Benson."

Mr. E. Samuelson seconded the motion, which was carried unanimously.

Mr. J. L. Bowes moved the second resolution, "That the following gentlemen, with power to add to their number, be appointed a local committee in connection with the Society of Arts to assist in carrying out the objects stated in the foregoing resolution:—Mr. Clarke Aspinall, Mr. Thomas Baring, Mr. A. G. Kurtz, Mr. Philip Rathbone, Mr. James L. Bowes, Mr. J. E. Dudley Ryder, Mr. H. E. Rensburg, Mr. W. Winter Raffles, Mr. Edward Samuelson, Mr. Robertson Gladstone, Mr. Hugh Perkins, Mr. Benson Rathbone, Mr. William Langton, and Mr. J. M. Wood, jun. That Mr. J. L. Bowes be requested to act as hon. sec. to the local committee."

Mr. H. E. Rensburg seconded the motion, which was carried unanimously.

540,000 tons of coal were used last year for the production of gas in Paris, and from this quantity 140,000,000 cubic metres of gas (4,944,321,200 cubic feet) was produced, which gives an average yield of 9,156 cubic feet of gas per ton. The city is supplied through 287 leagues of main. The total number of lights is estimated to be 902,000, of which 35,000 are for the lighting of the public streets. The receipts of the Parisian Gas Company amounted to 31,500,000 francs, 1,500,000 francs of which are derived from the public lighting.

Good progress has been made of late years in iron ship building in Italy; a fine iron steam-vessel, the *Etna*, of 3,000 tons, has been recently completed by Messrs. Orlando, of Leghorn, for the Simaria Steam Navigation Company, and is the largest iron vessel that has yet been built in Italy.

In accordance with statistics recently published by the Minister of Finance, at the Hague, the total number of vessels that entered the Dutch ports during the year 1873 was 8,762, the total burden being 2,968,401 tons. Out of this amount France appears for 9,266 tons, divided among 48 vessels.

CHANNEL PASSAGE.

The report of the English Channel Steamship pany, read at the annual meeting the other day, that the *Castalia* was most successfully launched on 2nd of June last. Messrs. Blyth and Co., who contr for the engines and boilers, put the machine board, and on the 20th of August the vessel was for an experimental trial. On the voyage from docks it was found that priming of the boilers to a extent occurred, so that the power of the engine not be developed, and the number of revolution much less than required to drive the ship at t quisite speed. Mr. Blyth seemed to consider t little importance, and stated that he could rem The alterations were made, and after running times to the Nore and back she proceeded from Gra to Dover, occupying nine hours in the passag maximum speed being ten knots per hour. The still primed very much, and it was considered tha ther alterations should be made. Mr. Blyth to make further alterations. On the 14th of O after the further alterations had been completed, found they had not cured the priming, which sti vailed as much as ever. Mr. Penn, the eminent en happened to be at Dover, and, with the consent Blyth, Mr. Penn's chief manager undertook to intend some further alterations. But it was cons unsafe to work the engines at greater speed; the could not produce sufficient steam, and therefore be replaced by new ones. The steamer was then b back to the Thames. The construction of th of the steamer by the Thames Ironwork and building Company was very satisfactory. vessel was of sufficient strength, and had great steadiness in sailing and steering. The di expected that the *Castalia* would have made at thirteen or fourteen knots per hour. The cha said he had nothing to add to the report of the dir but they all felt very much disappointed that the of the enterprise should have been so unfortu interrupted. He hoped that the negotiations p would be brought to a conclusion, but the less th at present the better. In reply to questions, stated that the utmost speed they got out of the e was ten knots per hour, and that only for a few m the priming being considerable. The ship was in the water than was intended, and that arose the unexpected weight of the engines. Had the e been lighter it would not have been necessary to the floats. The report was then received and ad Mr. Mackenzie said he had no doubt that Mr. J would make the vessel a complete success. C Saunders said that, as an old sailor, he went to D the vessel, and thought she was an excellent fo steaming across the Channel. It was impossible sufficient speed out of the machinery, and he felt that the vessel, with suitable engines and boil board, would go better and more steadily than an ship he had ever seen.

The discovery of petroleum springs on the berg Heaths in Northern Germany is expected to ha siderable effect on the locality. Borings were m Oberg by Hanoverian and French surveyors as e 1863, but then the measures taken failed to confi opinion which had been previously advanced of th sence of oil. Since 1852 petroleum has been obtaine out intermission, although the process adopted f extraction has consisted in little more than a mere w of the sand, through which the oil was suffered to r vessels.

It is stated that upwards of 1,200 applic for space in the Centennial Exhibition have already be by intending American exhibitors. Rapid progress i made with the buildings. The contractor has 5,00 employed.

CORRESPONDENCE.

INTERNATIONAL PATENT-LAW.

Sir,—In the discussion on Mr. Bramwell's admirable paper, Major Hotchkiss is reported to have "hoped the day would soon come when there would be not only international copy-right, but international patent-right." As these two phrases have been frequently used in conjunction of late, perhaps you will permit me to point out that "international copy-right," as at present understood, means no more than this—that foreign and native authors are placed on precisely the same footing, not that a literary work registered in one country becomes immediately protected in all the others with which copy-right treaties exist. In this limited sense the Patent-law may be said to be already "international;" for, as a rule, foreigners in any country applying for patents are not subject to any disabilities, as they were until recently in Canada. Beyond this it would, I think, be difficult to go, at present at all events.—I am, &c.,

Lex.

STREET PAVEMENT.

Sir,—In the interesting controversy as to the relative advantages of the asphalte and of the wooden pavements, which have both of them the great recommendation to us in London of being comparatively noiseless, the former is also cleanly, and the latter, no doubt, also the more noiseless of the two, I do not observe that any one has noticed two circumstances, which, in judging of their comparative merits, seem to me to tell in favour of the asphalte. In the first place it is not fair, with little experimental patches here and there in our streets, as in Holborn and in Threadneedle-street, if it is found that there the horses fall more frequently, to conclude that they would fall more frequently on the asphalte, if, as I hope soon, it will become our usual street pavement. If one walks on ice it is with a different step to that adapted to walking on a Macadamised road, but it is soon learnt, and so would the horses learn to traverse the asphalte, safely I believe, but not of course when unexpectedly they come upon it. I do not mean that asphalte is as slippery as ice. If, in foreign countries, an Englishman steps on a waxed or polished floor incautiously, he very likely has a fall, but the natives do not, and they seem to exercise no particular caution. In the next place, it is pretty clear to me, though I cannot prove it, that when horses do fall on the asphalte pavement they do not hurt themselves as they do on any other less smooth or elastic pavement. So that, for two reasons, I believe it is not fair, in judging of the advantages, comparatively, of the asphalte, to count merely the number of times horses fall on it. I should like to know the comparative number of broken knees to the number of falls on the different pavements, and if they do not fall comparatively seldom at the end of a long stretch of the asphalte pavements. I have no kind of interest in any asphalte paving, or any other, but I believe it will be found much the best for men and for horses.—I am, &c.,

J. F. Streatfield.

15, Upper Brook-street, W.,
Dec. 5, 1874.

Jaffa contains about 240 groves, or orchards, producing about 33,300,000 oranges, of the value of 3,330,000 piastres, or, at 144 piastres to the pound, £23,125 sterling. About one-sixth part of the total number of oranges is consumed in Palestine; the remainder is exported to Turkish ports and Egypt, for the most part, in small Greek sailing vessels, which come purposely to Jaffa in the season, which is the month of November.

GENERAL NOTES.

Saltpetre.—It would appear that a new source of this substance has just been discovered in some parts of the catacombs of Paris, and that the French Government will henceforward take such measures as may be found necessary for organising the systematic working of this salt for use in the powder mills of the State.

United States International Exhibition of 1876.—It was stated by the daily papers of Thursday last that Lord Derby had intimated to the United States Minister in London, and through him to the Washington Cabinet, that a Commission will be appointed to represent this country at the exhibition to be held in Philadelphia, in 1876, in celebration of the hundredth year of American independence. It is also stated that twenty-one Governments have accepted the invitation to participate in the Centennial Exhibition—namely, Norway, Sweden, Germany, Belgium, the Netherlands, France, Mexico, Guatemala, San Salvador, Venezuela, Peru, Ecuador, Chili, Brazil, the United States of Columbia, the Argentine Confederation, Liberia, Hayti, the Sandwich Islands, and Japan. According to a statement in *Nature*, private letters from America announce that the proprietors of the *Great Eastern* are engaged in discussing a somewhat extraordinary proposal. The great ship, it is said, is to be anchored in Philadelphia Harbour during the Centennial Exhibition, and to be made a great floating hotel, where 5,000 persons can be comfortably accommodated.

French Industrial Establishments.—According to statistics issued by the French Minister of Commerce there exist in France 123,000 industrial establishments, which employ engines to the amount of 502,000-horse power, and give work to about 1,800,000 men. The department of the Seine stands foremost in the list, with a production, in round numbers, of 1,690,000,000 fr., and enters for one-fifth of the total production. Le Nord, which comes next, shows a manufacturing production of about 700,000,000 fr.; Le Rhone, 600,000,000 fr.; La Seine-Inférieure, 440,000,000 fr.; Les Bouches-du-Rhone, 271,000,000 fr.; and La Loire, 224,000,000 fr. La Corrèze and Le Cantal are the last departments on the list, the former, with a production of 5,500,000 fr., and the latter, with 3,500,000 fr. The average production per department is 109,500,000 fr., but this is divided, as appears above, in a very unequal manner.

Census of India.—The Indian Census of 1871-72, says the *Athenæum*, seems to be likely to prove of greater comparative importance than was expected. Ethnologists and geographers will be especially concerned to learn that one of the pet theories of most of their number is likely to be upset. To state the matter roughly,—what if India, and not China, be found to be the most populous country in the globe? The authorities of the India Office have ascertained, from a careful examination of the whole of the results of the late Indian census, that the population of India is not less than 283,000,000. But they are of opinion that if it were possible to obtain a perfectly accurate census of the inhabitants of the whole of the Protected States, of the hill and forest tribes, and of the tribes of the eastern frontier and the Sub-Himalayas, the total population of our Indian Empire would actually amount to not less than 300,000,000! It will be remembered that, a few years ago, the "one hundred and eighty millions of our Indian subjects" used to be spoken of, and latterly this has given place to the more liberal estimate of "two hundred millions." And now, it appears that we must talk of two hundred and eighty millions at least, when we speak of the population of India, if we wish to be even approximately accurate. But this is not all. A few years ago it used to be stated that the population of China amounted to 500,000,000. At the present time it is generally reckoned at 400,000,000. But there has been no census of China, as there has been of the greater part of India. Indeed there are many reasons for the growing opinions of some that after all, the population of China may be found not to amount to more than 300,000,000. And if so, what then? May we not possibly find that India is as thickly populated as the Celestial Empire itself? In view of such a question being examined, it is a patent fact that the recent census of India is of unique comparative interest.

Blackening Sheet Zinc.—The following is a new process lately discovered for obtaining zinc sheets of a solid black colour. The sheet of zinc is cleansed by hydrochloric acid and sand, and then plunged into a solution of equal parts of chlorate of potash and sulphuric acid. A slight velvety-black deposit is immediately formed. The plate is carefully washed with water, allowed to dry, and then plunged into a solution of asphalte in benzine, left to drain, and rubbed with a piece of cotton rag.

Hydraulic Engines for Sewing Machines.—Some little engines for this purpose, made by M. A. Schmid, of Zurich, were shown at the Vienna Exhibition. They are now much used in Switzerland, where water is abundant, and supplied at a high pressure. The engine consists of a water and air tight chest, in which works a small oscillating cylinder, the pistol-rod of which turns a three-speed cone pulley. An air-vessel serves as a regulator, and a plate of plain glass in the chest permits of the working of the engine being seen. The speed of the shaft varies between 120 and 500 revolutions per minute, and the consumption of water depends on the work done. Thus, for 1 kilogrammetre, with water at 20 metres pressure, it is 360 litres (79 gallons) per hour, which corresponds to fifty per cent. of useful work. For tailors' sewing machines, which require as much power as 4 kilogrammetres per second, this engine would be much too weak, but it is stated to be adapted for sewing linen, and for family purposes. Its price at Zurich is 100 francs (£4).

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for the Wednesday evening before Christmas have been made:—

December 16.—Adjourned Discussion on Mr. F. J. Bramwell's paper on "The Expediency of Protection for Inventions."

N.B.—The reading of the papers announced for December 9th and 16th, on "The Protection of Buildings from Lightning," by Dr. R. J. Mann, and on "The Sandblast and its Application to Industrial Purposes," by W. E. Newton, have been postponed till after Christmas.

Cantor Lectures.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows:—

1st Course.—"Alcohol: Its Action and its Use." by Dr. B. W. Richardson, F.R.S.

2nd Course.—"On the Material, Construction, Form, and Principles of Tools used in Handicraft," by the Rev. Arthur Rigg, M.A.

3rd Course.—"On some of the Forms of the Modern Steam Engine," by F. J. Bramwell, F.R.S., President of the Institution of Mechanical Engineers.

The following are the remaining lectures of the first course:—

Lecture II.—Monday, December 14th.

The Alcohol group of organic bodies.—Respective action of different Alcohols.

Lecture III.—Monday, December 21st.

The influence of Common or Ethylic Alcohol animal life.—The primary physiological action Alcohol.

Lecture IV.—Monday, January 18th.

The position of Alcohol as a food.—Its effects on animal temperature.—Hygienic considerations.

Lecture V.—Monday, January 25th.

The secondary action of Alcohol on vital function Physical deteriorations of structure—general and sp —incident to its excessive use.

Lecture VI.—Monday, February 1st.

Influence ot Alcohol on the nervous organis with special reterence to the mental phenomena ind by its use.—Summary.

Members are privileged to introduce *two* fri to each of the Ordinary and Sectional Meetin the Society, and *one* friend to each Cantor Lec

SCIENTIFIC MEETINGS FOR THE ENSUING W

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C. (Cantor Lectures.) By Dr. B. W. Rich "Alcohol; its Action and its Use." (Lecture II.
Royal Geographical, 1, Savile-row, W., 8½ p.m. W. T. Grandy, "Report of the Livingstone Con pedition."
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Social Science Association, 1, Adam-street, Adelphi, 8 p.m. Mr. J. Bailey Denton, "The Stor Water."

Tues. ...Civil Engineers, 25, Great George-street, Westm S.W., 8 p.m. 1. Mr. W. D. Cay, "The New Breakwater at Aberdeen." 2. Mr. Geo. L "The Extension of the South Jetty at Kustend
Statistical, Somerset House-terrace, W.C. 7¾ p.m N. A. Humphreys, "The value of Death Rat Test of Sanitary Condition."
Pathological, 53, Berners-street, Oxford-street, W.

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C. Adjourned Discussion on Mr. Bramwell's Pa "The Expediency of Protection for Inventions."
Meteorological, 52, Great George-street, S.W., 7
Geological, Burlington House, W., 8 p.m. 1. John Hopkinson and Charles Lapworth, "Desc of the Graptolites of the Arenig and Llandeilo R St. David's." 2. Mr. H. F. Blandford, "On t and Correlations of the plant-bearing series of and the former existence of an Indo-Oceanic nent." 3. Rev. J. F. Blake, "On the Kimm Clay of England."
Royal Society of Literature, 4, St. Martin's-place, 8 p.m.

Thur. ...Royal, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Si Lubbock, "Observations on Bees and Wasp Prof. Allman, "Diagnoses of New Genera and of Hydroida."
Chemical, Burlington House, W., 8 p.m. 1. Schorlemmer, "On Grove's method of prepar Chlorides." 2. Mr. J. Davies, "On the Precip of Metals by Zinc." 3. Mr. T. Morgan, "Res on the Paraffins existing in Pennsylvanian Petro 4. Mr. C. Schorlemmer, "Some Remarks on t ceding Paper."
Inventors' Institute, 4, St. Martin's-place, W.C., 8
Zoological, 11, Hanover-square, W., 4 p.m.
Numismatic, 13, Gate-street, W.C., 7 p.m.
Philosophical Club, Willis's Rooms, St. James's 6 p.m.

Fri. ......Architectural Association (at the House of the S of Arts), 7½ p.m.
Civil and Mechanical Engineers, 7, Westminster bers, S.W., 7½ p.m. Mr. R. H. Tweddell, latest application of Hydraulic Power."
Philological, University College, W.C., 8 p.m. Mr Ellis, "English Dialects."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,152. Vol. XXIII.

FRIDAY, DECEMBER 18, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

STOVE COMPETITION.

In a communication from the late Sir William Bodkin, dated July 19th, 1872, and addressed to the Secretary of the Society of Arts, it was stated that a gentlemen, who does not wish to have his name disclosed, volunteered to give the sum of five hundred pounds with a view to encourage the development of improved means for the economic use of fuel in private dwellings. On referring the proposal to the Council of the Society of Arts it was resolved:—

"That the Council thankfully accept the offer, and refer it to a Committee to confer with Sir William Bodkin, and concert with him the proper action to be taken."

In consequence of this the following committee was formed, to whom was entrusted the decision of the means most likely to accomplish the wishes of the donor.

Major-General F. Eardley-Wilmot, R.A., F.R.S. (Chairman), F. A. Abel, F.R.S., F. J. Bramwell, F.R.S.; E. Chadwick, C.B.; Major Du Cane, C.B.; Major-General Eliot, Captain Douglas Galton, C.B., F.R.S.; W. Hawes, F.G.S.; C. Mann, Dr. David S. Price, F.C.S.; R. Rawlinson, C.B.; Rev. Arthur Rigg, M.A.; Captain E. Scott, R.N.; Major Webber, R.E.; P. Le Neve Foster, M.A. (Sec.); S. W. Davies, A.R.S.M. (in charge of the testing).

After numerous meetings and inquiries, the Committee authorised the issue in the *Journal* of the Society of Arts of a public notice, of which the following is a reprint:—

Economic Use of Coal for Domestic Purposes.

With reference to the sum of £500 placed at the disposal of the Council through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—

1. For a new and improved system of grate suitable for existing chimneys as generally constructed, which shall with the least amount of coal, answer best for warming and ventilating a room.—*The Society's Gold Medal and Fifty Pounds.*

2. For a new and improved system of grate, suitable for existing chimneys as generally constructed, which shall with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—*The Society's Gold Medal and Fifty Pounds.*

4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—*The Society's Gold Medal and Fifty Pounds.*

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

The competing articles must be delivered not later than the 1st of December, 1873, with a view to their being tested, and subsequently shown in the London International Exhibition of 1874.

Further particulars as to place of delivery and other arrangements will be published as soon as they are finally settled.

December, 1872.

There were two hundred and four articles sent in for competition, and after careful consideration and some correspondence with the exhibitors, one hundred and seven were retained for the purpose of being tested.

The duty of personally conducting the experimental testing, under the superintendence of the Committee, was placed in the hand of Mr. Davies, a gentlemen who had been a student, exhibitioner, and prizeman at the Royal School of Mines, and who received the Murchison Medal and prize in 1872, and the diploma of "Associate" in 1873.

The operation of testing extended over many months, and the results had then to be arranged in a convenient form, to enable the Committee to institute a proper comparison, and to arrive at a judgment. This has necessarily occupied considerable additional time, and has unavoidably delayed the final decision of the Council.

Whilst the Council recognise the labour and expense which the various competitors have incurred in bringing the contrivances under trial, they consider it their duty to point out that the Society has been involved in very considerable outlay in providing special rooms and appliances for the purpose of these trials, and in the actual carrying out of the tests.

A careful consideration of the returns and facts in the hands of the Committee, and their Report, has forced upon the Council the conclusion, which they have arrived at with very considerable regret, that while giving full credit to the invention and efforts of the competitors for the care and labour which they have bestowed upon their contrivances, the Council nevertheless are unable to award any prize.

By order,

P. Le Neve Foster, *Secretary.*

15th December, 1874.

TECHNOLOGICAL EXAMINATIONS.

The date fixed for the Examinations in 1875 is Saturday, the 8th May, from 7 to 10 p.m. Programmes may be had gratis upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

JUVENILE LECTURES.

The Council have arranged with Prof. McLeod, of the Indian Engineering College, Cooper's-hill, to deliver two lectures on Wednesday, January 6, and Wednesday, January 13, at 3 p.m. The subject will be "The Work and Food of the Iron Horse."

POLLUTION OF RIVERS.

A Conference was held on Thursday, December 10th), at 3 p.m. "On the steps to be taken to ensure prompt and efficient measures for preventing the Pollution of Rivers." The Right Hon. LYON PLAYFAIR, C.B., M.P., F.R.S., LL.D., was in the chair.

The Chairman, in opening the proceedings, mentioned the names of several noblemen and gentlemen who regretted their inability to be present, amongst them were Lord Wharncliffe, Lord Northwick, Mr. J. Walter, M.P., Mr. Ralph Assheton, Mr. H. Allsopp, M.P., Mr. W. T. Charley, M.P., the Duke of Buccleugh, Professor Tanner, and Dr. Hardwicke. He then said that the papers which had been circulated in the room describing the various methods proposed for dealing with the difficulty [these appeared in last week's *Journal*] would be taken as read, and he therefore proposed to take the discussion in the following order:—1. Existing evils and necessity of remedy. 2. Separation of fæcal matters, manufacturing refuse, and house drainage from the rainfall. 3. Methods of treating water-carried sewage so as to purify it before discharge into rivers. To each of these points an hour would be allotted.

Mr. J. Chalmers Morton (one of the Rivers Pollution Commissioners) submitted that processes having been already pointed out, and being well known by which filthy water can be cleansed, and by which therefore river pollution, in almost all its forms, can be prevented, it was no longer a solution of the once inscrutable problem that was required; it was a plain and workable law which shall forbid it that was needed. Law no doubt already existed for the abatement of river nuisances, so that if any one be aggrieved he has his remedy at present, and if he has a nature tough enough, and purse and patience long enough, he may even now obtain the injunction he desires. But the practical value of the existing law may be safely gathered from the existing condition of our rivers. The existing law was virtually inoperative, and it was to the enactment of an efficient law that all our attention should be now given. The existing failure of the law against river pollution was owing partly to the costliness of its processes, but mainly to the indefiniteness of the offence which it is desired to prevent. He had always understood that a plain and unmistakable definition of a nuisance or offence was the very first step to be taken in any attempt to forbid it or abate it, and therefore he heartily hoped that this Conference might see its way to the urgent and confident recommendation of the enactment of unmistakable standards of impurity, below which all liquid discharges into water courses shall be forbidden, as an essential part of any serviceable legislation on this subject. Without t[...] it might not be always impossible to obtain a convicti[...] but he said that without them it was impossible [...] justice should invariably be done, for these stand[...] were as necessary for the protection of the innocen[...] for the easy conviction of the guilty. At present, if [...] go before a Court with your complaint in general t[...] of the nuisance by which you are aggrieved, you [...] certain to be met by evidence, also in general terms, [...] the thing is not so bad as you declared it, or that t[...] is really no nuisance at all, or that if there be any [...] comfort it is as nothing compared with the tenfold [...] jury which would be inflicted on one hundredfold [...] number of sufferers if any injunction should be iss[...] and what was a distracted jury, or even a clear-sig[...] judge, to do for either complainant or defenda[...] the face of contradictory evidence, both lay and scien[...] so long as both are allowed all the resources o[...] English language with which to attack or de[...] What was wanted was a set of standards to which th[...] could be at once referred with no possibility of ambi[...] or uncertainty as the result of the reference. Of c[...] it was necessary that these standards be most car[...] fixed, so that, in the words of the Royal Commi[...] "there be no serious injury to the processes and m[...] factures concerned." As regards the standards w[...] have been recommended in the reports of the Rivers [...] mission, he, though not professionally a chemist, [...] felt at liberty to sign the recommendation that [...] standards be enacted, because, having compared [...] them the analyses of the effluent waters from various [...] dial processes, he was able to say that these stan[...] were extremely lenient. It might surprise any gentl[...] who looks on this subject from the manufacturer's [...] of view to hear that the filthy Irwell water itself [...] not offend the standards of pollution of which we [...] the enactment. It does not contain 2 of organi[...] bon nor ·3 of organic nitrogen in solution in 1[...] parts. Of course it has been polluted by the acc[...] drainage much filthier than itself, so that if these [...] dards were enacted they would act beneficially o[...] Irwell; but the fact that this filthy river does not [...] offend them is proof of their leniency. It mig[...] thought a whimsical, or even fantastical, thing to [...] in an Act of Parliament, ·0003 per cent. of o[...] nitrogen the definition of an offence; but we had [...] cedent for that kind of definition with the Alkali Ac[...] he presumed that Dr. Lyon Playfair could ascerta[...] declare the presence of ·3 of organic nitrogen in 1[...] parts of water, if not with as much facility, at lea[...] as much confidence and certainty as that which he [...] feel, after counting hands, in declaring the minor[...] any, which is prepared to defend legislation a[...] offence without any definition of the offence it is in[...] to forbid. Lastly, no one had ever thought of p[...] these standards in the hands of the common inf[...] They must of course be administered by competen[...] appointed for the purpose. But to this, having a[...] exhausted his allotted time, he would only adver[...] earnestly desired that as one result of this Con[...] some confident and urgent declaration might b[...] before the proper Government Department th[...] enactment of standards of forbidden pollution was es[...] to efficient legislation on this subject.

Major-General Scott, C.B., quite concurred in th[...] of the last speaker, that a standard of purity was [...] tially necessary before legislation could be atte[...] But the principal question to be discussed wo[...] what that standard should be. He believed tha[...] mately they would come to the only mode by [...] water when once foul could be purified, and th[...] either by using it in irrigation or by earth filt[...] But whilst believing this, he also thought it wo[...] very impolitic at the present moment for Gover[...] to legislate in such a way as to oblige every to[...] take up one of those two systems. In the first [...] land was in many places difficult to acquire, and

and people objected to having a large amount of sodden soil in the neighbourhood of their dwellings. Above all, you could not get any body of Englishmen to [illegible] upon landowners the necessity of having such saturated ground in their immediate neighbourhood. This had been proved in the case of Birmingham. In that case almost every man who had a knowledge of the sewage question was invited to give his opinion, all the leading chemists, engineers, and agriculturists stated their views on the subject, and ultimately it was resolved to bring forward a scheme by which the separation of the solids from the liquid sewage was to be supplemented by irrigation and filtration. There was no doubt in the mind of any reasonable man that no better system than this could be proposed, but what was the result? After the Bill had been approved by a select committee of the House it was thrown out, simply on the representations of two land owners principally affected by it, that it would be an injustice to them. At the present time therefore you could not carry out complete legislation if it were attempted, and the question arose to what extent should it go. To his mind, the matter was very clear, and he would beg to read a few words written by the Sewage of Towns Commissioners, 15 or 16 years ago. They said "that by far the greater part of the solid matter held in suspension in water was readily deposited in rivers, covering the banks with mud and permanently raising the beds, gradually destroying the scouring power of the water, partially silting them up; and in some instances these deposits had accumulated to such an extent as to impede the navigation, and render the surrounding country subject to floods, entailing a vast expenditure in periodical cleansing. And however the appearance of the water might be improved after these deposits had taken place, yet the deposited matters lay in the bed of the current under conditions favourable to putrefaction, so that when the foul mud was disturbed during the prevalence of rain or floods it sent forth effluvia very offensive to the surrounding district." Here, then, it was plain that the chief evil arising from the flow of sewage into rivers was attributed to the solid matter, and the Commissioners went on to state that this "might be obviated by simply arresting the solid matter in suspension in the liquid." Inasmuch as the Legislature itself had been instrumental in bringing about the present state of things, he thought it would be very hard [illegible] oblige them all, and at once, to carry their sewage water to that degree of perfection which would be required by insisting on irrigation or careful filtration. So far, however, as the solids were concerned the remedy was easy enough. It would not press hard on municipalities to compel them to keep these offensive matters out of rivers. Fifteen years ago the Sewage of Towns Commissioners reported that "the more the subject had been investigated the more convincing was the evidence that there was no town which might not, with suitable care, and at a moderate cost, greatly mitigate the existing evils, if not wholly remove them," and their conclusion was, "that in the absence of means for applying sewage to land, the modes of precipitation at present did offer remedial measures of a very satisfactory character." If that were the case, why were we at the present day still in the same condition as before, with almost every town in the kingdom casting its foul sewage matters into the rivers? It had arisen because we had in the first instance aimed too high. He thought the last degree of perfection ought ultimately to be insisted upon, but at the present moment there were so many corporate towns on the banks of rivers, contributing to their pollution, that until they could all be brought to one point it would be very unfair that one town should be picked out and made to purify its sewage wholly, whilst others were still polluting these rivers. During the last three years he had had a great deal to do with town councils and had seen many of their difficulties, and this much he thought might be insisted upon, that they should remove the solids from the liquids before the latter flowed into the river, and a graduated scale might easily be devised, insisting that the amount of solid thrown into rivers should not bear more than a certain proportion to the volume of water. If that much were done, more would be sure to follow, because they could not arrest the solids without creating some degree of nuisance which would necessitate the application of deodorisation. Immediately that was attempted it would be necessary to use some precipitate, and then the solids might be much more perfectly removed. One half of dissolved organic nitrogen would also be removed by precipitation, and the whole operation conducted in an inoffensive manner. The first step to be taken therefore, in his opinion, was to insist that only a certain amount of solid per gallon of sewage be allowed to pass into a stream, and the next stage would be that deodorisation should be employed. When they got to that point, it might be a question in what cases further purification should be effected by earth filtration or irrigation, and, inasmuch as precipitation, or at least subsidence, was a necessary preliminary to these operations, manifestly the steps he recommended were in the right direction, and would make further legislation easier.

Mr. John Thom, speaking as a polluter of water, did not believe that any class of the community would be more benefited by legislation on this subject than polluters of water themselves. He did not speak from any theoretical notions, but from his own experience. There had been plenty of law, but there was as yet so little certainty as to how it might be applied in any given case, that the great majority of manufacturers all stood in danger both from those below and those above them on the stream. They might be prosecuted by anyone below them for a nuisance, whilst anyone above them might set up a manufactory which would do them positive harm. If they went to the most eminent lawyers for advice they would get different opinions as to what would be the result of the proceedings. About twenty-two years ago the firm with which he was connected had a lawsuit with regard to a pollution they sent down, and which was said to be doing great damage. They lost the case, but they gained much more than it cost them from having no more pollution of the same kind from those above, in fact, it was stopped in a day, showing that any legislation preventing pollution might very readily be carried out. About eighteen years ago he commenced keeping his own pollution out of the stream, but he was immediately served with a notice from the legal adviser of his landlord to refrain from any such attempts, as it was endangering his water rights and privileges. The landlord claimed to foul the stream, and in his lease there was a clause of surrender if those rights were endangered. This showed the necessity for legislation before means could be used for keeping pollutions out of the rivers. Again, the water generally came down to his works quite black to the amount of between two and three millions of gallons daily; and from careful experiments he had ascertained that one part of this black dye water would make 10,000 parts unfit for his use, so that one part being put in by a person above him compelled him to purify 10,000 parts of water; yet from a letter which he held in his hand it appeared that the manufacturer above could keep that black dye out of the water with the greatest ease, and at a merely nominal cost, in fact, he believed it could be done with a profit. Legislation, therefore, in such a case would only give fair play to all manufacturers or polluters of water. Again, on the stream above him there were large works in course of erection, which must of necessity foul the water, and from the absence of any law upon the subject those who were erecting those works did not know what to do. They put them up at hap-hazard, subject to prosecution if they fouled the water, and he had no hesitation in saying that it would take from 3 to 7 per cent. on the outlay on that plant to settle their legal rights, but he was equally satisfied that with proper legislation on the sub-

ject only a half per cent. would be required to enable them to keep all foul matters out of the stream, and thus avoid doing any mischief to every one between themselves and the sea.

Sir Robert Torrens, who represented the Conservators of the River Dart, said the special grievance in the district from which he came arose from the constant starting of small mines, nine-tenths of which were got up simply for stock-jobbing purposes, not really for mining. The speculators in these schemes set up works merely to sell the mines, and the earth washed out from the crushed ores was allowed to flow into the rivers in all directions. The law enabled the Conservators to interfere and stop that process if they could show that this earthy matter actually poisoned the fish, but they were utterly powerless to check it, if, as was generally the case, it did not poison the fish, but simply deterred the salmon from coming up the rivers, and spoiled the spawning beds by depositing mud where nature had placed sand and gravel, on which alone salmon would deposit their ova. The question then arose, what means could be suggested for remedying this grievance. It appeared to him very simple, and they had practical proof of their efficiency. In the Black Forest of Germany, where mining of various kinds was carried on, before the water used in washing ores was allowed to return into the stream, it had to be passed through settling tanks, in which all the mud was deposited. The water flowed through furze bushes and things of that kind, very inexpensive, and the deposit was cleared out periodically when the tanks got too full. In almost all the cases he had in his mind in Devonshire, such tanks might be put up at a very trifling cost indeed. The managing engineer of a mine above Ashburton, on the River Dart, stated that for £150 he could put up a tank of that kind, but he demanded that the Conservators should pay the cost. Inasmuch, however, as they would have no guarantee that it would be erected, or that the speculators might not cease to use it if they paid the money, of course it could not be done. He might mention another case of a mine which had been tried once or twice, and had been shut up, having scarcely any minerals in it, but it had lately been opened again in another name in order to delude the public; the water which had lodged in it for years was pumped out, and the consequence was that it killed all the fish in the stream that flowed through Ashburton. Another mine had been started close to his own place, when the stream, which had been beautifully clear, assumed the appearance of red ink. Unfortunately the law was so doubtful, and the machinery so costly, as practically to prohibit the Conservators taking any steps to remedy this grievance. He concurred in what had fallen from a preceding speaker, that it would not be well to attempt a very large measure of relief until public opinion was sufficiently aroused upon the subject, but if a moderate measure were proposed it might perhaps be carried, such for instance, as one which would compel any parties starting a mine to deposit £500 or £1,000 as a guarantee that before turning the water into the stream they would cause it to be filtered and purified. This was a most vital question affecting the whole population, though unhappily a very small portion indeed of that population was at all alive to its importance. On the other hand there was a very compact and powerful body interested, or imagining themselves interested in opposing any such effort as they were assembled to discuss, and he should like to see subscriptions got up for the purpose of circulating information on the subject, and so instructing the public mind, for until that was done he believed it would be utterly hopeless for any private member, and almost for any Government, to attempt to carry a mprehensive measure in the face of the manufacturing and mining interests in the House of Commons. He had stood three contested elections, and had never been questioned on the subject, nor did he remember any case in which a candidate had been required to state what he would do on this most important question. He, therefore, thought the first necessity was to create such a pressure of public opinion as would lead to something being done at the next election to promote efficient legislation.

Sir John Murray desired to make a few remarks on some of the rivers in which he was deeply interested. He would first call attention to a small stream called the Sherborne, not far from Coventry, known in years past as one of the dirtiest and foulest streams in the kingdom. The sewage of Coventry ran into it, but since this had been treated in tanks, which had been built for the defecation of the sewage, it had a very different appearance. Formerly for two miles down it was almost impossible to inhale the atmosphere in its neighbourhood without feeling the bad effects, and as for fish they existed but a very short time in it. How they got into the stream nobody knew, but probably they were brought in from other quarters at times of flood. Matters were very different now, for he had letters in his possession from gentlemen residing on the banks, stating that the water was exceedingly pure, and that the fish were rapidly increasing in numbers. Now, if a simple process such as that adopted at Coventry—the use of sulphate of alumina in conjunction with lime—was so successful in treating the sewage of a town of 40,000 inhabitants, the daily sewage being two millions of gallons, he thought every town and village might be required to adopt similar means, and he understood that this method yielded an effluent whose purity was above the required standard. This question was one of vital consequence to the inhabitants of the whole of Great Britain. The first consideration was certainly sanitary, the object being to obtain pure air and water; the second was agricultural for why should they throw away a valuable manure estimated to be worth two millions per annum? and the third, which came home more to himself living near th banks of some rivers in the south of Scotland, ha reference to the question of fishing. The Tweed Fisher Laws had lately been the subject of investigation, and i appeared that heavy penalties, and even imprisonmer had been inflicted for years past on poor fishermen wh killed a smolt or small salmon, yet at the same time co porations on the banks of those streams were allowed t destroy the fish with impunity. This certainly was n a state of things which ought be allowed.

Lieut.-Colonel Alfred Jones said the matter whi had struck him as most important was the separation manufacturing refuse, and its purification by each ind vidual manufacturer before it was allowed to ent streams. Each man paid rates, according to the val of his property, and one man ought not to pass a great amount of impurity into the stream than his neighbo The addition of this refuse complicated the question utilising and purifying sewage, whereas it would be simple matter for each manufacturer, knowing what had to look forward for in waste water, to purify it, a he ought to be obliged to do so. As in the case of t alkali works, he believed it would be found to the ma facturer's own advantage.

The Chairman said these observations would co more properly when discussing the second part of subject.

Major-General Synge said that since he came into room the question had occurred to his mind why a body objected to the pollution of rivers, and why such a practice come into such universal existence deserved to meet with the unmitigated reprobatio every intelligent being living near a stream. But re they had met to try and put a stop to what migh any moment prove the most desolating plague that afflicted the globe. Then what position did they i vidually occupy so long as they contributed to the pagation of the evil? The reply suggested itself t

said that the prelude to the abuse of anything was the ignorance of its proper use, and if the objects for which water was given to mankind were properly appreciated, he thought it would be impossible for two persons to state, as he had heard in an assembly of a similar kind to the present, that water was a thing which, under no circumstances, ought to be drunk, and that the proper thing to do with every stream was to turn your back upon it and make it a vehicle for the gravest abuses. If the value and proper use of water was appreciated, it would not be necessary to devise any elaborate or scientific process. The first thing to be borne in mind was the individual duty of every man to himself and to his neighbour; but secondly, this duty must always be taken in connection with the possibility of carrying it out, and they must therefore consider whether it was really impossible to maintain the purity of water. There was much to be said in palliation of the existing system, seeing the elaborate, ingenious, and complicated machinery which had been devised for dealing with it. He believed, however, the only sound advice with reference to turning sewage into rivers was that given some years ago in *Punch*, though on a very different subject, namely, "Don't." He disliked compulsory action, for he thought no man had a right to take his neighbour by the throat and compel him to do anything, but it would be quite possible, and perhaps a popular novelty to go back to the Decalogue and say—You shall not murder by inflicting on your neighbour the poisonous outcome of your own person, you shall not make it a difficulty to know whether your linen has been washed in pure water, or whether every shirt you wear shall not be a source of fresh danger, and every opening you make in your room an additional means of poisoning your neighbour. He should simply take this ground. If a man chose to do anything on his own premises it should not injure his neighbour. The details of how this might be carried out were embodied in some of the proposals which had been printed. But if they went on this simple basis of the duty of using water, and not corrupting it, and then went on to utilise all putrescible matters, they would soon arrive at a practical result.

Sir Joseph Heron said that, representing the Town Council of Manchester, he came to see if he could obtain any light on a very dark subject about which he was more perplexed than he could easily describe. He suggested that they had now spent sufficient time in discussing a matter about which there was no difference of opinion, and they might as well pass to the second head of the subject. They had discussed the existing evils *ad nauseam*, and it would be much better if they could obtain some practical information as to the nature of the remedy to be applied.

Mr. John Evans, F.R.S., suggested that it would have been better if a fourth subject had been added with regard to the legislation to be proposed. There could be no doubt that some remedy was necessary for existing evils, but his difficulty was how that remedy should be applied so as not to act unfairly on existing classes, more especially upon manufacturers, considering that the Society, under whose auspices they were gathered, was established for the promotion of Arts, Manufactures, and Commerce. The subject divided itself into two heads, namely, the pollutions caused by fæcal matters, and those resulting from mineral matters, the produce of ordinary manufactures. If rivers were purified to that extent, that fæcal matters were excluded from them, it would be a much more simple matter to deal with the matters arising from the manufactories, but it was evident to him that though it might be desirable to have some fixed tests established, those tests should not be of precisely the same nature in all cases, but that some modification should be allowed in respect of certain classes of manufactories, and that provision should be made for those with whom it was a matter of almost absolute impossibility to carry out the remedies which might be suggested. It was all very well to say that men should be compelled to send water into a river in a state of purity, which should comply with certain tests; but in many cases where the works were situated on a limited portion of ground, or on particular levels, it became almost impossible to carry on any purifying process on a large scale. Suggestions had been made for a series of ponds, or catch pits, but how on earth was a man, limited in his ground, to adopt that system? therefore, any measures of a compulsory nature ought to be accompanied by special provisions enabling a man to obtain the necessary means of carrying them out. If a manufacturer were driven into adopting a large system of irrigation, a man below him might bring an action against him for diverting the stream, while if he adopted a system of evaporation, he was liable to be prosecuted for a nuisance. It was by no means so simple a process that any one given plan would be applicable to all circumstances, and though he agreed that there should be some fixed standards, they should be in the first instance of the mildest character. There ought to be variations allowed in the case of particular trades and manufactures, with liberty to the public authorities to abstain from calling on any particular manufacturer to comply with them, if there were no sign of danger resulting to the stream from his works being upon it. It was not every river which was intended to be potable, and there were always considerable differences arising from the proportion between the volume of the stream and of that which flowed into it; thus a drain carrying 10 gallons a minute into a large river did not effect any material mischief, whilst if it discharged into a small stream it would seriously injure the purity of the water. Tidal rivers again stood on quite a different footing to others.

The Chairman having suggested that a resolution stating that the evils of river pollution were recognised, and that some legislation on the subject was required, should be brought forward,

Sir Joseph Heron said he would propose a resolution, as he had no objection to throw upon the Government the responsibility of finding out what legislation was practicable, and he thought they could not err in bringing it under their notice. It was no use abusing local authorities for the state of their rivers so long as they were utterly powerless to act in the matter. In Manchester, however, he believed the Irwell was in a better state when it passed out of Manchester than when it came in. They had an enormous supply of water, and such an immense quantity went into the sewers that it diluted the sewage to such a large extent, as compared with the state in which sewage passed into the river above, as to considerably improve the state of the river. He protested against the abominable system of introducing water-closets into every town and village, and turning all the refuse from these closets into the sewers. He considered this was beginning at the wrong end, though unfortunately the Government had, under certain influences, coerced local bodies into the introduction of this system. The resolution he had to propose was: "That this meeting, being satisfied that it is necessary to improve the foul state of the rivers in this country, and that legislation on the subject is required, requests the Council of the Society of Arts to urge this necessity on the attention of her Majesty's Government by deputation or otherwise." He did not think it would be of much use, as suggested, to circulate pamphlets, which would only be thrown into the waste paper basket, but the moment the Government dealt with the subject, and proposed legislation, the attention of the country would be drawn to it, and some good might be done.

Sir John Murray seconded the resolution, which was at once carried unanimously

The Chairman said they must now consider the second branch of the subject, namely, "Separation of fæcal matters, manufacturing refuse, and house drainage from the rainfall," and he would first call upon Capt. Liernur, who had made some important experiments at Amsterdam and other towns in Holland, to address the meeting.

Capt. Liernur said the method of using sewers so as to carry off the rainfall, and also to remove the fæcal and other putrescible matter, was without doubt attended with many serious drawbacks. That matter was very often, if not always, the carrier of organisms having infectious properties, which were not kept in the sewer, but were apt to pollute both the air and soil of the town. The air was polluted from ventilating the sewer itself, and escaped at every rise of the sewage as affected by the rainfall. Whenever it rained after several days of dry weather, the polluting elements were passed through the pores of the brickwork by simple hydraulic pressure, and when this subsoil water rose, a stratum of air equal to the rise of water was pushed upwards, carrying these infectious elements with it. Hence, so long as infectious matter was conveyed by means of water, and carried through porous conduits which were in contact with the atmosphere, there could be no other result, but that both the air and soil became contaminated with the seeds of disease. Many sewage engineers thought it was not unhealthy to live in towns the soil of which was polluted with excrement, and hence they advocated the use of rain-water sewers ventilated as much as possible. He did not know upon what hypothesis they based their theory, and he could not but think that the great increase of several kinds of zymotic diseases in towns served on this principle tended very little to support it. At any rate, Continental authorities on sanitary matters were of a different opinion; they insisted on the conveyance of any matter which might carry infection through conduits from which the escape of any fluid or any gas was absolutely impossible, and also on absolute cessation of all fluctuation in the level of the subsoil water. Hence rain-water sewers should not act as drains for waste water, and fæcal matters and household refuse should be removed separately by air-tight iron pipes, or some similar contrivance. This was also demanded by the danger created outside towns, namely, the pollution produced where sewage was discharged. The cleansing of sewage by precipitation and filtration was known to be practically impossible; nor had irrigation upon the whole been much more successful, but had shown itself only a serious additional expense, besides being a danger to the public health; hence most engineers had preferred recently to discharge sewage into the sea wherever there was a chance of so doing, and did not hesitate to construct miles of culverts for that purpose, rather than involve towns in the troubles and lawsuits which often arose in connection with sewage farming. On the other hand there was no technical or financial difficulty in the separate removal of putrescible matter, or any danger of polluting the air or soil with it. This had been proved by the works constructed by himself. They consisted of a net-work of hermetically closed iron pipes in connection with a stationary pumping engine. This collected the contents of both privy-closets and kitchen sinks, the motive power being air instead of water. This system did not prevent the use of water-closets, provided they only used water enough to keep the basin clean, for which, experience showed, one quart was sufficient when the closet was properly constructed. Water-closets, however, were not necessary on sanitary or æsthetic grounds. Privy-closets had been constructed for the poorer classes, in which no water was employed at all, and they appeared to give every satisfaction, and it was certain that the offensive matter could be removed without the enormous dilution, which, by the method of water carriage, made its utilisation for farming purposes almost impossible. The matter in question could be transported for use in the wet form as collected, or be converted into a dry substance by evaporation in vacuum pans. In the first case its value to the farmer was 3s. 6d., and in the latter from 8s. to 12s. 6d. per head per annum. There was no other method by which the utilisation of sewage could become profitable, for generally speaking the disposal of the matter was as much an expense as its removal, and hence the sewage of towns involved a considerable increase of taxation, which led to an increase of house-rent, and resulted in a crowding together of the working classes in still smaller rooms, and in raising the price of all necessaries of life. These resultants, however, were the very reverse of sanitary, and it appeared very questionable if the sewage works, at the cost of the comfort of the poor, were really sanitary improvements at all. The separate method avoided this sort of danger; it made the collection and disposal of putrescible matters a source of profit, both possible and practicable, the result being that a town could be sewered without polluting either the soil, the air, or the stream, and without increasing taxation. This could never be effected by the pail system.

The Rev. Henry Moule said the evils of pollution and waste were the necessary results of the daily accumulation of putrefying and putrefied matter in drains, sewers, and cesspools; and to deal with such intractable substances *en masse* was impossible. This serious evil must be traced and dealt with in detail, which by the water system was impracticable. A general system, however, of earth-closets was perfectly feasible, and to such an extent that the cleansing of towns and villages would in many cases be not a matter of expense, but of positive gain. By this system that substance was removed from the drains and sewers which was most offensive, and which presented the greatest difficulty to deal with; and thus the necessity of flushing was avoided, which reduced the quantity of water required by five-sixths. The remaining sixth could be dealt with quite easily, especially if slops were removed from the sink-water, which could be carried off by small drains. The contents of the vaults need not be carried away oftener than once in three months, and if the product were only worth 10s. per ton, it would, from a town of 25,000 inhabitants, produce a revenue of £10,000 per annum. The rev. gentleman further proceeded to narrate the financial results which might be obtained by the application of sewage to garden ground, and the general effects produced by the use of the earth-closet system, the details of which may be found in his printed communication.

Prof. Wanklyn wished to say a word with reference to the question of standards. The first speaker had stated that ·003 of a part per cent. of organic nitrogen was sufficient to condemn an effluent, and moreover that chemists were perfectly able to determine that amount. Now he wished to state that there was no process known to chemists by which the organic nitrogen could be determined. There was one process which he believed was only employed by one chemist of eminence, and it yielded an error of 1,000 per cent. on the substance on which it was applied, which was perfectly absurd. Thus if the water yielded an impurity of 5·, the experimental error was 50 or 1,000 per cent. There were, however indirect means of ascertaining what would be implied by three parts of organic nitrogen per 100,000 parts of water, or ·003 per cent., and it would no doubt surprise some gentlemen to be informed that such a standard would admit the foulest sewage in the country into any river, and thus any legislation which would enact such a standard would license the passage of the filthiest impurities into our streams. He was not in favour of what were called chemical standards to be applied to effluents, and the only one he would be inclined to adopt would be transparency. He agreed with General

Scott that the only practical enactment would be to ensure that a perfectly clear liquid should flow into the rivers.

Mr. Morton said he was very sorry that Dr. Frankland, his colleague on the Rivers Commission, was not present, but with reference to the attack made upon his mode of water analysis, he would only say that Mr. Wanklyn's observations would have been more serviceable if addressed to the Chemical Society than to such a meeting as the present.

Mr. Wanklyn said his observations were addressed to the Chemical Society six years ago, in the presence of Dr. Frankland, who had never yet replied to them.

Mr. Baldwin Latham, speaking as an engineer, thought it very desirable to separate sewage matters from ordinary rainfall, but it was sometimes a question of very great difficulty when you came to apply it. For instance, he might take as a typical town one of those in the Potteries which had been sewered on the separate plan. If the rainfall were excluded, what with the nature of the materials used in macadamising the roads, the amount of filth that accumulated upon them with the constant practice of the lower classes of the population of going to the street door and throwing out the whole of their slops on to the highway, all tended very materially with the small rainfall to produce a liquid quite equal in polluting effect to the strongest sewage you could deal with. On that ground, although this arrangement had been adopted in two such towns by the Duke of Sutherland—who had come forward as the largest landed proprietor of the neighbourhood to assist them in getting out of their difficulties with regard to this question, thus setting a good example to other landowners—it had been found absolutely necessary to make a connection between the rainfall sewers and the sewers proper, so that when there was a small amount of rainfall passing through the sewers a connection might be made between one series and the other, and the small amount of rainfall might pass into the sewage proper, whereas when the flow increased and the volume of water was large, the whole of that water would pass away to the natural streams of the district. There were, however, many districts more happily situated, such as those governed by rural sanitary boards, who had nothing to do with the drainage of the roads or the making of gullys, and who could therefore carry out their works much more cheaply than had been done by authorities acting under the jurisdiction of local boards. This question of the separation of fæcal matters from rainfall to a certain extent opened out the question, what was the best system to be adopted for the collection of fæcal matters, whether they were to be passed into the sewers or dealt with in any other way. As a general rule, he thought, in large towns, where there was an abundance of water, the water-closet system would always commend itself for adoption, because, from long experience on this question, it had been shown by the Rivers Pollution Commissioners that from the inquiries they had made the amount of polluting matter contributed by water-closets was not materially in excess of that where the ordinary middenstead or dry system was in use. They also knew that in some towns which had been put under the system of collecting fæcal matter directly from houses, the amount collected did not amount to more than one-tenth of the whole produced, so that nine-tenths must find its way ultimately into the sewers. There was also this advantage, that where you had water brought into towns for various purposes, it could be made use of for carrying away this matter immediately from the premises, for that was the important point in a sanitary point of view; and where any system whatever had been introduced which did not render it necessary for it to be kept for some time. He was not going to say there was no value in the earth-closet system, for he had himself recommended sanitary authorities to adopt it, and thought it a very valuable appliance in some positions. Capt. Liernur's system also had much to commend it, and it was certainly far preferable to that horrid system of pails which was now adopted in many manufacturing towns in Lancashire; to carry such disgusting matter through the habitations of the people was an abomination; the very sight of the process was disgusting to anyone, more especially if the removal was neglected for a short time. The positive abomination of the apparatus was such, and the interval for collection was so great, that an accidental visitor to an establishment quite put out the ordinary calculation, and rendered what might be otherwise a little unpleasant, an intolerable nuisance. Capt. Liernur's system had this advantage, that it collected the whole of the fæcal matter, but did not depend on manual labour. It did not invade the privacy of the dwelling, being effected by special pumping machinery, and consequently the work could be performed much more cheaply. With regard to the sewage of Manchester, he believed the analysis of it, taking it with all its fæcal matter kept out of it, was more foul than that of many water-closet towns. He knew that towns had many deficiencies to contend with, but he believed the separation of fæcal matter from rainfall was of great importance, and should be insisted upon in almost every instance.

Mr. Charles James Wahab, referring to the North Esk, a small river in Midlothian, said there were nine paper mills, containing sixteen paper machines, situated upon it, and consequently a very large amount of polluted water was discharged into the river. The stream was small, only containing below the paper mills 3,500 cubic feet a minute in the summer, or 31½ million gallons in a day. The impurity was equal to 14·5 grains per gallon, or total equal to 29 tons 2 cwt. daily. Above the mills this stream contained an impurity of 7·6 per gallon, which, upon the same quantity of water, would amount to 15 tons 5 cwt., so that the added impurity in passing the mills amounted to 13 tons 13 cwt. It had been found, however, by numerous carefully-conducted experiments, that only 6·4 grains per gallon were added from all the paper mills, so that there remained a quantity of 7 tons 13 cwt. from other causes. He had only to add that this stream had upon its banks, besides these paper mills, a number of little villages and gentlemen's houses, and it was his opinion that a great quantity of this impurity, which was unaccounted for, arose from the sewage of these houses and villages. This showed the great importance of treating sewage in a different way to manufacturing refuse. It had always appeared to him extremely hard on manufacturers that they should be obliged to purify their discharges and brought into Court as contaminators of rivers, while riparian proprietors and the agricultural labour of the country were evidently to blame to almost the same extent.

Mr. Charles Elcock thought the object of the meeting should be practical, and that it would do well to take into consideration the question of the propriety of separating all fæcal matter and manufacturing refuse from the rainfall, and, if possible, to decide whether it was desirable or not. It appeared to him it was essential it should be done, if the rivers were to be maintained in that degree of purity which they ought to possess. It was said that the amount of impurity added to rivers from water-closets was very small, and this was brought forward as an argument why excreta of this kind should be allowed to go into them. But if it added anything to the already existing impurities in the sewage proper of a town, it appeared certain such a discharge ought not to be allowed. The next question was as to the most suitable means by which the fæcal matter could be kept out of sewers. There was no doubt that so long as towns existed, sewers must exist, but that fæcal matters should be allowed to

go into them no sane man would admit. No one need go further than Over Darwen to see the effect of a little fæcal matter getting into a sewer, for any gentleman who during the last month had walked through the streets and happened inadvertently to get over one of the gratings would have perceived such a stench, as, to use a common expression, must be experienced to be appreciated. What then could be done to get rid of the night-soil instead of passing it into the sewers? They had heard a very elegant term used for the receptacles, as they were called in Manchester, in which they were collected, but wherever the system of collecting the night soil in pails, whether wooden or galvanised, had been introduced, it invariably tended to a decrease in the death rate and in the prevalence of typhoid fever, which was a most important item to take into consideration. He contended under proper arrangements these receptacles were not objectionable, and he had had considerable experience in dealing with them. In fact, there might be a pile of them in the room reaching up to the ceiling, and no one would be aware of it if his eyes were shut. It had not, however, been sufficiently considered that night-soil was not the only thing to be got rid of. There were other nuisances in towns quite as great, though engineers years ago, not having their attention sufficiently directed to the matter, took it into their heads that getting rid of the night-soil was the one thing for them to do, and consequently the water-closet system was invented, than which a more ingenious machinery could not be suggested for the introduction of poison into houses, and Acts of Parliament were brought into force to compel their adoption. Happily in Manchester there was a different state of things, and now no house was allowed to be built which had not in connection with it at least one open dry closet outside the house. It would be found on inquiry that the refuse from houses, streets, abattoirs, and many other places, was quite as injurious as the night-soil nuisance, although it did not make itself so immediately apparent, and this refuse of streets and houses had been found, when properly treated, to furnish the most effectual means of preventing these receptacles becoming in any way objectionable. This was done by simply converting this street and house refuse into the most powerful deodorant known, viz., charcoal, and a means was thus provided for deodorising the foulest collection from any cesspool, and converting it into a sweet and wholesome mass.

Mr. Alderman Taylor (Rochdale) having heard one or two depreciatory remarks of the pail system, wished to add his testimony to its efficiency, being quite satisfied that in many Yorkshire and Lancashire towns it would be impossible to remove the refuse matter without some such system. Many gentlemen spoke of it, and even wrote about it, who had never seen it in operation, or tested it in any way, and whose statements therefore were obviously of no value. The manufacture of night soil into manure had been spoken of as desirable; it had been adopted at Rochdale some years, and they would shortly be able to prove, not only that it was desirable, but also profitable. When that was the case he thought it was a very serious matter for all towns to consider, because many of them were short of a good water supply; and it would therefore be very desirable to avoid using water, if not absolutely necessary, for carrying away the refuse fæcal matter, as it was supposed, in the cheapest way. He however believed that that so called cheapest way was the dearest that could be devised, for you not only spent a large sum in water but diminished the value of the manure amazingly. He might say also that he was a strong advocate for irrigation, but the difficulty they had in the North was in getting land at anything like a reasonable price. Unfortunately the landowners tried to put upon them a kind of black mail, and they were obliged to give three or four times its natural value for any land to be used for such purposes.

Mr. Adam Scott desired to correct a
conception arising from what Mr. Latham
regard to Captain Liernur's system.
think that that system only effected th
fæcal matter, but it also removed the h
other matter which was quite as impor
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were practically of the same nature, the
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various organic matters in solution whi
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allow any of that mud to collect, as, if tim
he could easily have shown.

The Chairman said the question of se
matter and manufacturing refuse from th
a most important one, but as there v
opinions upon it, and so many method
the meeting would probably agree with h
not desirable to pass any resolution upon it
therefore pass to the consideration of the
the subject, "Methods of treating water-
so as to purify it before discharging into

Mr. C. Rawson said he was naturally
in one process of treating sewage, viz
being the managing director of the comp
advocating the advantages of his own sys
be sorry to say a word against any ot
tended that in any system of preci
were four points which should be careful
one, that the effluent water should be fit
river; second, that in the treatment
proper no nuisance whatever should be
that there should be no chemical used w
any way deteriorate or injure the manu
the sewage, for when they considered th
with which farmers collected all the m
for use upon their fields, it was rather a
the science of England that at the p
they were pouring into the rivers and
the most valuable manurial material w
used. Fourth, and this was perhaps the
in the eyes of many corporations, that
produce should be valuable and should
expense of treating the sewage. He believe
process in every way fulfilled these four
He would not stay to explain the process
he had brought forward the evidence
officials bearing testimony to its succe
points he had mentioned. His experien
to believe that there was not a single
manufacture or dye works which might n
sewer and be treated by the A B C proc
the sewage itself, and, in fact, someti
stituents actually assisted the precipitati
the sewage came down charged with mos
dyes, yet after being treated by the A B
effluent water formed a beautifully clear
from the end of the works, which astoni
who saw it.

Mr. Charles Jones said he had inter
remark or two on the separate system of
would only add, with reference to that p
to what had been said by Mr. Latham,
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would suggest that the Local Governmen
when schemes are suggested to them, c
visability of recommending the separate
would thereby strengthen the hands o
dealing with local boards. It must b
however, that they had to do, to a great
water carriage at present in existence.
were already established to the number

ends, and they must be dealt with, and the principle on which they had to work was to get rid of the nuisance at the least possible cost. Therefore, while they had every respect for the A B C, and many other systems, he thought those who had to deal with the question practically must look first to the question of expense. Now, experience showed that lime was the simplest, best, and most efficient means of dealing with this question. He had tried the lime system at Ealing for many years, and it had proved thoroughly successful. This might be gathered from the fact that they were next door to the Conservators of the Thames, who had never attempted to interfere with them. He therefore suggested that this system should be tried by municipalities and other authorities before putting their constituents to the enormous expense required by many systems which were laid before the public. He firmly believed in irrigation, but also advocated the use of lime in conjunction with it, because in thus treating the sewage you got rid of that which was obnoxious, and obtained the compound which was most valuable to the agriculturist. You could then do with a minimum of land for turning the effluent water upon, and the land so used occasioned no nuisance whatever, though it would produce most excellent crops. He thought if they waited until earth-closets or any similar system were adopted throughout the country they would have to wait a long time, and he did not believe that any Government would urge the adoption of any such scheme. As to the disposal of the sludge produced by the precipitation of sewage by means of lime, various methods had been suggested for disposing of it which he had not time to describe, but would only say it was to be dealt with, and without difficulty. He was now dealing with it at Ealing and in other towns in various ways, and in every town the treatment would depend upon the circumstances of the town and the nature of the soil, whether it were clay or light land.

Mr. W. Hope, V.C., said General Scott had fallen into a slight error, which he thought would increase the fear entertained by municipalities with regard to the application of sewage to land. He had stated that every scientific man who had examined the question said that sewage could not be entirely purified except by passing it through land, either in a concentrated manner or by irrigation and utilisation. He had been employed by the Corporation of Birmingham, jointly with Mr. Rawlinson, to prepare a scheme, the Bill for which was thrown out, and therefore he not only knew the whole of the circumstances, but what he was now stating had been stated publicly by the chairman of the Parliamentary Committee of the Corporation, and had been published in all Birmingham newspapers. Parliament did not throw out the Bill because it was a bad scheme, or because they refused to sanction the principle. The Bill was before the Select Committee for fifteen days at a cost of four guineas per minute; it was opposed by eight counsel, and he was afraid to say how many engineers, doctors, chemists, and so forth were examined. The opening statement of the opposing counsel was terrible to listen to, but unfortunately it turned out that they had not understood what the scheme was, so that after fifteen days' fighting they could not produce one witness in their favour and against the Bill. Consequently the preamble was passed, and Lord Henley, the chairman, stated that the Committee passed the Bill unanimously. The principal opponents were Sir Charles Adderley and Sir Robert Peel, their opposition being solely on financial grounds. Sir Charles Adderley asked £70,000 for the piece of land to be taken from him, which was several miles from his house, and consisted of outlying fields in no way connected with his residential property. The Corporation were on the point of settling with him, but he (Mr. Hope) heard of it, begged them not to do anything of the kind, and undertook to pass the Bill through Committee and to get the price reduced by £20,000. Accordingly, after the Bill had passed through Committee, Sir Charles Adderley offered to take £50,000, but the Corporation being perhaps a little elated would only give £46,500, the price their valuer had put upon it, and therefore Sir Charles Adderley opposed it in an unconstitutional manner, and the Bill was ultimately thrown out.

The Chairman suggested that these details hardly bore upon the subject of discussion.

Mr. Hope said he wished to prevent towns being frightened out of applying to Parliament for land for the purpose of entirely purifying their sewage. The case of Rochdale had already been mentioned by Mr. Alderman Taylor. He was a witness in that case, though the scheme was not prepared by himself, and it was thrown out because the plans were defective, not as regards the application of sewage to land, but as to the conveyance of the sewage from the town, the engineer having omitted to ascertain the nature of the subsoil through which he proposed to take his sewage. With regard to London, he (Mr. Hope) applied for an Act of Parliament in 1865 for dealing with the sewage of London, and he held in his hand a report of the Select Committee appointed to examine the Bill. That committee had before them an immense body of evidence, and they concluded by saying upon this evidence, "Your committee are of opinion that the scheme which has been submitted to them is a useful and profitable mode of applying the sewage of the northern portion of the metropolis, and they have no reason to suppose that any more useful or profitable scheme could be devised." The Bill was fiercely opposed by the Corporation, but, notwithstanding that, the committee reported as he had already stated, and he ventured to say that so strong a report had never before been made by a Parliamentary Committee. He ventured to submit that ought to be taken as a proof that the application of sewage to land was the most useful and profitable means of disposing of it. As he saw Mr. Smee present, he desired to say one word as to the wholesomeness of sewage milk. If he would come down to his farm at Romford he would see an animal only eight months old fed exclusively on sewage milk, which had for the first six months twenty gallons a day, quite enough to poison anything, if it were injurious, and it was now the size of an animal twelve or fifteen months old. That very day he had had a bullock slaughtered which had been fed for a long on sewage grown produce, and fattened in three months exclusively on similar food. The result was that he weighed 192 stone of 14 lbs. each.

Mr. A. M. Fowler (Salford), said it seemed to him that the arguments had been all on one side, for not one word had been said in favour of the manufacturers, though it would be a very serious question indeed for them if their interests were not carefully watched. In the case of the River Aire, at Leeds, there were very many large manufactories upon it above the town, and he remembered very well when the question was agitated there, the great mill owners got up a meeting at once, and formed themselves into a deputation to wait upon the Home Secretary. If any stringent or arbitrary measures were put in force to purify this river, no doubt the same course would be pursued, and opposition would be encountered. The question was not whether purification could be accomplished—for there were several methods of doing it—it was simply a question of expense, and therefore, if the A B C process could be worked so economically as had been stated, in a town like Leeds or Manchester, he thought it might be very usefully introduced in towns where they were so situated that land could not be obtained. He had had fish living in this effluent water several weeks by the side of a globe containing water supplied by the town, and strange to say the fish in this latter globe died two days before they did in the effluent water from the sewage. He had not the slightest interest in this

process, either directly or indirectly. It so happened that in the neighbourhood of Leeds and Manchester, there were two wealthy navigation companies, the Aire and Calder Navigation, and the Bridgewater Canal. The Aire and Calder Navigation Company were the custodians of the river throughout its whole water shed, and would not allow a manufactory or anything else to abstract one drop of water from the river without returning it again. Therefore if a manufacturer took a quantity of water, he could not turn it into the sewers, where it would pass down to the sewage works and be deodorised, but must turn it back into the river, so that the river by such an operation became fouler than before. As Sir Joseph Heron had said with regard to the Irwell, it was worse above the town than it was below it, because the manufacturers turned their refuse into the stream.

Mr. W. C. Sillar feared that the unanimity with which the meeting had received the first proposition as to the evils existing, and the necessity for a remedy, would not be found when they discussed the processes which ought to be adopted, nor did he think a room of that kind was the place where the owners of any particular process should advocate their ideas. The real judges of this matter were the town council, or sanitary authorities, in whose hands was vested the solution of this problem. In days gone by it was said that the problem was very difficult, because there was no known process by which you could get out of the difficulty. Now, on the other hand, they were told that so far from there being no process, there were so many that positively they could not make up their minds which to choose. He was much interested in one process, but at the same time, if a better one could be shown, he should be the last to lament it. His object was to see the rivers clear, and the wealth utilised which now was wasted. One of the great difficulties they had had to contend against was the apathy of town councils. A great deal was said about the expense of this process and of that, but they never calculated the expense of not doing it. It was as in the case of railway accidents, they never could get directors to avoid them until the damages given by juries brought them to reason; and if a calculation were made of the sickness and death which arose from polluted water, the responsibility would be so heavy that public opinion would be brought to bear, and municipalities would be compelled to adopt some process or other to prevent pollution. A good deal had been said as to the advisability of separating refuse and fæcal matter from sewage, but as he viewed it the problem was given—sewage containing this matter, how was it to be treated? There were plenty of processes, and he trusted some legislation would soon be initiated by which the matter would no longer be allowed to rest in abeyance. Some of his friends had been willing to bear the whole expense, if towns would only allow their sewage to be treated so as to demonstrate the practicability of the process. This was not a question in which personal interest should be allowed to come into play; there ought to be some impartial tribunal appointed to say what ought to be done.

Mr. Alfred Smee, F.R.S., said he came to the meeting to learn and not to teach, but in consequence of some amount of misunderstanding which appeared to exist as to his views, and from what Mr. Hope had said, he felt bound to say a few words. He agreed with him that sewage must ultimately be cleansed in the earth and that they never could get water, which once had been sewage, fit to again go into a stream without filtration through the ground. Many experimenters stated that they so purified the water that they could recommend it to be drank, but there was no town in England where the inhabitants pumped back their sewage after they had purified it into their own water tanks. Only the other day, when at the Wallington Station, he asked what the state of the water was, when he was informed it was quite unfit to drink, that it had filtered through from the sewage irrigation ground. Although that was badly

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the peculiarity of the Parisian system as regarded house refuse, he attributed the comparatively low state of mortality there. He had made a careful comparison of the mortality of Paris and London, a matter by no means easy, because the census returns in France were made only once in five years, and he found that the mortality of Paris was very slightly above that of London, a proverbially healthy metropolis. The Paris system was to deposit the house refuse in the streets, and an admirable system of street cleansing being also adopted, he contended that it would be far better for London to follow the same system, and to remove it by an improved system of street cleansing, rather than to hoard it as was practically done in and about our houses, for by such a method not only would the rate of mortality be diminished, but the solution of the sewage question would be rendered much more easy. One great difficulty was to keep out of the sewers that mass of filth which was deposited in the streets, not ordinarily called house refuse. But if there were a proper system of street cleansing, a great deal of what now passed into the sewers would be removed by horse and cart.

Mr. Henry Morgan (Lodge Farm, Barking) said he was glad to hear Mr. Smee take exception to the evils which occurred on some sewage farms, though he was sorry he did not go on to say that he found none such on the large farm at Barking, where for eight years they had dealt with the North London sewage. They had there carried out experiments for the purpose of throwing down solid matter held in suspension by the Phosphate Sewage Company's process, and pouring the effluent water on to the farm, the result being that they grew such crops as attracted Mr. Smee's attention and approbation, and he might remind Mr. Smee that they had had the pleasure of supplying him on two separate occasions with mangold-wurzel grown by sewage for the use of his own cows. Of course if such practices as he had referred to were general there would be an end of irrigation, but he hoped the meeting would remember that when they spoke of "purity" being obtained by passing sewage over dry land, or through it, or both, that the exact meaning of the word was rather debateable. He doubted very much whether the word "potable" was applicable even to the water which had passed through the land and been applied to growing crops; that was a point, however, which chemists alone could decide. With regard to the scheme which had been referred to by Mr. Hope, as laid before the Select Committee for the purpose of dealing with the North London sewage, as he represented the company which took that concession from Mr. Hope, he was bound to say that whatever the Select Committee might have thought of the scheme from the evidence then before it, he would undertake to bring evidence now which would show that it could not have been carried out successfully by private enterprise.

Mr. Bailey Denton wished to point out a little inconsistency in the remarks of Mr. Alfred Smee. He commenced by speaking of the great advantage of filtering sewage through soil, and in fact admitted that the difficulty could be overcome by that process, and then he spoke of the roots being so covered with sewage matter that they were repulsive in character. What Mr. Smee stated was an utter impossibility, because, if the sewage passed through the soil as well as over the surface, it was clearly impossible that the sewage matter could cling to the roots of the grass.

The Chairman thought the meeting would agree with him that the Council of the Society of Arts were perfectly justified in calling together this Conference, as they had heard persons from all parts of Great Britain, though they had not heard any gentleman from Ireland who could speak as to the state of the river Liffey. Possibly the case of Ireland did not present the same urgency as other parts of Great Britain, because there were not so many manufactories there. He was glad to notice that several suggestions had been made; one, no doubt from a very good motive, from General Scott, to the effect that if they legislated too rapidly they might injure their cause, and that they should first ask the Government to insist on the solid matter being taken out of sewage and the liquid only allowed to run into the streams. He did not think his friend General Scott had had so much experience of Lancashire and Yorkshire streams as Sir Joseph Heron and himself had long had, because if some of the colouring matters now turned into these streams were allowed to remain, their condition would be perfectly insufferable. They had all seen or heard of Gainsborough's "Blue Boy," but if they went to some of these streams in which indigo and Prussian blue was running down, they might see fifty blue boys come out; and if they went to a stream in the neighbourhood of which black dye was used they might see fifty boys go in, and fifty "men and brothers" come out in a state far worse than that in which they went in to the stream for the purposes of ablution. It was therefore quite as necessary to get rid of the soluble matters as of the solids, especially in fishing streams, for one of the most poisonous substances, and one of the most common which destroyed trout and salmon more than any other, was oil of vitriol. This could be removed as easily as possible by simply filtering it through lime-stone, and why should that be allowed to go into a stream simply because it was soluble? No doubt it would much improve the system of sewage if all soluble matter were taken out, but that was not sufficient. The meeting seemed to agree that the rivers were intended for the use of the whole community who inhabited the drainage area through which the rivers flowed, for the various purposes for which rivers were useful to mankind, and that no one town in that area had a right to appropriate that river and destroy its usefulness to other communities; similarly that no one manufacturer had a right to say, I add to the production of the country, and therefore I will take that river which is intended for the benefit of the whole district, and destroy its usefulness before it comes down to others. Each river therefore ought to be preserved in such a state of purity—absolute purity they could not obtain—that it might be of use and benefit to the whole drainage area which it watered. What then was the stage at which they had arrived? They would remember *Punch's* cartoon of last week, referring to a picture of Millais, where Mr. Disraeli said, with reference to the Arctic expedition, "It is possible, therefore it shall be done." By the first resolution it had been asserted that the purification of rivers was possible, and therefore it should be done. It was not for them, out of so many competing schemes, many of which were excellent, to select one and say it should be applied, but as a chemist he might be allowed to say that he had looked at all the different kinds of impurities which passed into the rivers, he had seen the different methods which had been used for removing them, and there was no one class of impurities which could not be removed, generally with great profit to the manufacturer. They must not attempt to do this in an arbitrary way, but must allow manufacturers to understand that the country intended to have its rivers pure. They would not say to any man, you shall do this or that, without full time for consideration to apply the remedies, but that it was the intention of the public and of the Legislature to purify the foul rivers of the country, and, as Mr. Thom had showed, he believed the manufacturers would then come to the Legislature and ask for futher restrictions. This had been their experience with the alkali works. A few years ago they used to foul the air most abominably with muriatic acid gas, and cried out very much against being forbidden to do so, but they had now found that they could not only prevent this easily, but that they could do so with profit, and they actually came to Parliament and said—"be more severe." So he believed

it would be with manufacturers generally with regard to the fouling of streams, it would be for their benefit as well as for that of the community at large. He believed, therefore, the practical result of the Conference would be that they ought to tell Mr. Disraeli that the thing was possible and that it should be done. If that were done, he believed a solution of the question was not very far from accomplishment, and that they would soon see their beautiful rivers restored to that bright and clear colour which they ought to be, instead of being, as they now were, a disgrace to the country through which they passed.

A vote of thanks to the Chairman for presiding having been passed, the proceedings terminated.

FIFTH ORDINARY MEETING.

Wednesday, December 16th, 1874; William Newmarch, F.R.S. in the chair.

The following candidates were proposed for election as members of the Society:—

Haliday, Maj.-Gen. Andrew, United Service Club, S.W.
Hands, Richard Medwin, Coventry.
Higgin, James, F.C.S., 22, Little Peter-street, Gaythorne, Manchester.
Hirst, J. H., 8, Small-street, Bristol.
Lewis, William Henry, Charnleigh, Roath, Cardiff.
Twite, Charles, F.R.G.S., Uuruguay, and 5, Victoria-street, S.W.
Whittem, Thomas Sibley, Wyken Colliery Company, Coventry.

The following candidates were balloted, for and and duly elected members of the Society:—

Arbuthnot, Sir Alexander, 62, Redcliffe-gardens, S.W.
Boyd, Richard Wade, 105, New Bond-street, W.
Davies, Robert E., Mayor of Portsmouth.
Lloyd, John Horatio, 100, Lancaster-gate, W.
Rawson, C., Native Guano Company (Limited), 9, Victoria-chambers, Westminster, S.W.
Toms, G. Bailey, 7a, Laurence Pountney-hill, E.C.
Turner, Frederick, St. Peter's Iron Works, Ipswich.
Ward, Reginald, 36, Lincoln's-inn-fields, W.C.
Woolbert, Frederick Thomas, 12, Lincoln's-inn-fields, W.C.

The Discussion on Mr. F. J. Bramwell's paper on "The Expediency of Protection for Inventions," adjourned from the 9th inst., was resumed by

Lieut.-Col. Strange, F.R.S., who congratulated Mr. Bramwell on the great interest he had elicited by his paper. It was true he had confined himself to a form of the question on which there existed really very little difference of opinion, but in doing so he had added greatly to our knowledge on the subject. He wished, however, that Mr. Bramwell had devoted a little more of his paper to the subject of the present evils of the patent system, and he would venture to suggest that he should on some future occasion give another paper on that branch of the subject. The party which maintained that the Patent-laws should be abolished placed themselves in a most extraordinary position. They said, abolish the laws entirely, and then, admitting their necessity, began to think about providing some remuneration or reward for invention, only to find however, as Mr. Lloyd admitted, that this could not be done, for there was really no method of doing it satisfactorily. Mr. Macfie (a great authority on the subject), in his letter to the *Times*, distinctly admitted that rewards were impracticable, so that abolitionists placed themselves in the position of abolishing the present system without providing any substitute for it. Last week the discussion had turned not so much upon the abolition of the upon the improvement of them; and t great authority, Mr. Hinde Palmer and had spoken to that point, and told ther Committee of the House of Comm the question had been referred, and were members, had made a specific which they said, and which every write also said, lay at the very foundation of tion, namely, that before patents we should undergo preliminary investigatio to be a complete unanimity of opinio absolutely necessary. But those gen said that no legislation was necessa into effect. The law which at pre powered the Patent Commissioners tribunal for that purpose, to be co petent persons, to carry on this prel gation. It only required to be admini But why was it not administered? them. The money required to carry grudged. Six years ago he had the on the Council of the Royal Society, body received a letter from one of the tionaries who act as the Commission they considered it necessary to have scientific men to make the prelimina They intended to have an eminent applied to the Chemical Society to nom required a skilful mechanician, and ha Institute of Mechanics with a view to of one. They wanted a gentleman v philosophy, and therefore applied to th to name a gentleman qualified for th the letter went on to say that gentlem in science would no doubt be ready to g to the country with the object of adva ledge of and benefiting the communi that they would not require any remun services—in fact, that they would receiv Council of the Royal Society received t derision, and a resolution was unanim quiring the president to call upon the tionary who had sent the letter, and the Royal Society declined to ask an give up his time and services for not advance that which had for its object money by individuals, and the conferrin on the community at large. The Pre delivered the message, and at the next the reply, which was to the effect tha functionary knew nothing about the letter had been written by some subordi was altogether a mistake. These high le were paid enormous salaries for doing do not perform, and their presence rather retards than advances the refor laws, and yet they wished for the ser scientific men without remuneration. over a fund which had a surplus of £95,000, and yet they begrudged to p salary necessary to get eminent men to importance to the country. He was ex by the observation of Mr. Samuelso this subject, when he said:—"In sp had been said about honour not going there were many men who would honour to be entrusted with the adju important interests, and who would nominal salary, if any." He had heard pain, for no gentleman in the country formed as to the value of the services and of the impulse which they gave to t the country than he was, and yet he sa ought to be given to the country for no tested against the nonsense that had bee subject, especially by one of the spea

money. There was no dishonour in labouring for money. Every profession did it. He did it himself, and Mr. Horatio Lloyd, who had made honour the great question, had himself most honourably worked all his life, and probably for money. He himself was a patentee, but he confessed his object in taking out a patent was not to benefit the community but to make money. And if he did not make money the community would not be benefitted.

Mr. H. T. Wood wished to bring forward a few facts in relation to the American system which might, he thought, throw a different light upon it to that in which it had been represented by some of the previous speakers. With all deference to the judgment and authority of those gentlemen who advocated such a change, he ventured to think that the adoption of this plan would be pernicious in the extreme, and a most unhappy departure from the admirable lines upon which our own system was founded. Imperfect in its details as this system might be, it was, he urged, absolutely correct in principle, and a reform in a few comparatively minor administrative details was all that was required to make it as admirable in practice as it already was in theory. That our Patent-law, as now administered, possessed many and grievous defects, was not to be denied, but the defects were easy of remedy, and such as—were the reformers less insistant, each on his own scheme—might very easily be repaired. The best available example of the plan of previous examination was offered by America. The advantages of the system of that country had been already sufficiently dwelt upon. In the face of such extreme laudation, it was difficult to believe that this system was condemned by a large part of the American press, both popular and scientific; that its action had, in numerous instances, been condemned by the American courts; and that it was itself condemned by implication in the last official report of the American Patent-office. In that document Commissioner Leggett stated that each Examiner in charge of a class now works entirely without supervision, and that "the result is that very many applications are hastily and carelessly examined; very many patents are issued for what is subject-matter not patentable; and applications are rejected upon which patents should be granted." He adds that from the bad drawing of the specifications many patents are "exceedingly annoying and damaging to the public" from being "permitted to cover not only the applicant's invention, but very much that is well known and open to free use by the public." How well merited these remarks are might be seen from an inspection of the American Official Gazette, and the published specifications of the office. It would of course be impossible to lay before the meeting any great amount of evidence on the subject, but he (Mr. Wood) had brought in a few specimens, a dozen in all, which he would lay on the table and ask gentleman to examine for themselves. Most of these were utterly trivial and useless. In one case a patent had been granted for a method of opening an envelope by a thread affixed thereto, and a second patent had been granted for a similar thread, but with a knot upon it. In another case a patent had been granted for a method of fixing a small looking-glass to a toilet glass to enable a lady to see her back hair. This had previously been patented three times in England. It had been advertised and illustrated in the catalogue of a well-known furniture dealer (Mr. Heal), and it had been exhibited before the Society of Arts, and figured in the *Journal*. If this was not prior publication, what was? Even in their own office patents were duplicated. On May 21, 1872, S. Boyd patented a method of cutting leather in a particular way, so as to economise leather. On June 25, in the same year, J. Woodley patented absolutely and identically the same invention. These were not rare and unusual instances; they were taken from a great mass of similar examples. When the patent question came before the Court, it was not unusual to find the judge animadverting most severely on the action of the Examiners. In 1871 a patent was granted to Seeger and Boyd for packing ground hops in air-tight cases. This, coming incidentally before the Court, the judge remarked on it in the very severest terms—"Why such a patent should have been allowed is beyond my comprehension. A mere child can put ground hops into a bottle and cover the cork with sealing-wax..... Unfortunately the patent is beyond the control of the Commissioner." In 1872 a patent was granted to Leggett for making shovels of cast-iron. On this the Commissioner said:—"It is a matter of astonishment to me that the patent was ever granted, and of greater astonishment that the extension has been reported on favourably by the Examiner." It would be easy, but useless, to multiply examples which could be readily gathered by anybody for himself from the official records of the office. These might serve to show the real action of that system which was so over-praised in England, and would prove how far justified was the principal technical journal of the States, the *Scientific American*, in persistently advocating a change to the English plan. But had the advocates of this system ever considered what such an alteration really implied? It was all very well to talk of three Examiners; in America they had seventy, and were crying out about the work being scamped. Nor was it correct to suppose that the work of the English Patent-office was much less than that of the States. On an average each English patent represented three or four American. It was not an uncommon thing for fifteen or sixteen American patents to be required to cover the same ground as a single English patent. There was therefore no reasonable expectation that the number and consequent cost of the staff would be less than in America, and it might be expected that a yearly charge of about £30,000 would have to be met. How the Treasury would regard the proposal thus to cut off a third of the patent revenue might perhaps be imagined. And for what good object would this costly staff be collected? Simply to dispose of a lot of useless patents which would die of themselves in a few years. There was a great outcry about these useless and frivolous patents, but what harm did they do? They certainly increased the labour of a search, but that would easily be remedied by good indexes. If a man liked to waste his time and his money in insane inventions, it was no part of the duty of the Government to interfere. Surely the work of ascertaining the novelty of an invention belonged to the inventor. It certainly might be well to require an affidavit from the intending patentee or his agents that a search had been made and that the thing appeared new. Perhaps it might even be possible to make all patent agents officers of the court, as it were, and compel them to take out a license. Then every inventor would have to employ an agent, who would be obliged to assert that he believed the invention to be new, and would be liable to fine for a false declaration. When an invention showed signs of vitality, when litigation or opposition was threatened, then if some Board could examine and report officially on that invention, good would be done, and for this purpose either a permanent board might be appointed, or a special committee of qualified persons nominated in each case. But it was not enough to say that previous examination would be useless, it would not seldom be actively mischievous. How many patents on which fortunes have been made, and rightly made, might have been refused on the ground of some wretched prior invention, never carried to any fulfilment? Supposing an Examiner had refused Mr. Bessemer a patent for his great invention on the ground of want of novelty, as he certainly would have done if he had before him the specifications of Martin and others for the same process. What greater injury could have been inflicted on what more important manufacture? Was not the mere possibility of such a case arising enough to explode the whole scheme? No, this might be depended on, that free-trade in invention, as in all else, was the wisest and safest policy; the pro-

gress of science and the good of the State would be far better served by giving the utmost facilities to individual genius, so that each man might prosecute his own ideas in his own way. This was the sound and secure basis on which our present laws were founded, and any attempt to pull down the old structure and replace it by a new, could not fail to be most injurious in its issue.

Mr. John Coryton said he was greatly surprised at what had taken place at the deputation which waited on the Lord Chancellor on the subject of the Patent-laws. He had expected that Sir Antonio Brady would tell the Chancellor that he had been placed at the head of the Commissioners by an Act of Parliament for the purpose of protecting inventors from having their patents filched from them on the one hand, and to protect the public against fraudulent inventions on the other; that that was the duty placed upon the Commissioners, but that not one of them had taken the slightest trouble in the matter; that he would have referred to the report which had been made by the Committee of the House of Commons, who had investigated the subject in 1872, and which said that the Lord Chancellor, the Master of the Rolls, and the English law officers of the Crown were now the only Commissioners, and that by reason of their other engagements it was very difficult to get a meeting; that, practically, an officer in the Patent-office did the duty of the Commissioners. He thought that the foreman of the deputation would have told the Lord Chancellor of his duty, and how the whole subject had been neglected since the Act of 1852 was passed. But nothing of the sort occurred. The deputation was exceedingly polite, and the meeting seemed to have resulted in a sort of mutual admiration society, the deputation congratulating and praising the Chancellor, and the Chancellor in his turn praising the deputation. The Act was an uncommonly good Act, if it were properly carried into effect. But it never had been. And if they wanted to give it a fair trial, they must get the right men as Commissioners, and put them in the right place, and give them a liberal remuneration for their services; and he did not see how the surplus could be better applied than in this way. But he was not altogether favourable to the granting of patents. Suppose A. B. C., and all the rest of the letters of the alphabet were inventors. If A. got his patent what became of the rest? They were shut out, and a grievous injury was thereby done in many cases. The great fault was that there was no supervision, and that very little attention was paid to the public interest. As to the rights of the patentee, what were they? They were founded upon an Act passed 250 years ago, which originated with the necessity of terminating the grants of exclusive privileges to courtiers, but it was never intended that such patents as were granted at the present day should be the subject of the patent-right. The real object of the Patent-law was to add a new manufacture, and to increase the industry of the country by the protection of useful inventions. But how far that was carried out he need not stop to inquire. And it often happened now that protection was granted not to the real inventor, but to someone else. The line which separated the man who made a failure from the man who made the lucky hit was very narrow. There was a great deal of chance between the man who just hit the mark and the man who just failed. He strongly advocated the employment of eminent scientific men, the establishment of a museum for the reception of models, and the delivery of lectures on these models.

Mr. Wm. Smith strongly objected to changing a system, however defective it might be, for one he knew to be utterly worthless as the American system was. It was a delusion, a mockery, and a snare to compare that with the English system. He would rather go to the French system of granting patents to every person who applied for them. The appointment of a Board of Examiners, like that of the American system, was too absurd to merit discussion. They were complaining of the great cost that inventors were put to, and yet they were going to charge the country with the administration of a bad system at an enormous cost. Nothing could be worse than the American system. Mention had been made of the American Patent Museum, but it was worthless from beginning to end. Every inventor was called upon to supply a model of his invention, which should not exceed 12 inches square. But how many inventions of any merit could be properly illustrated within the dimensions of a cubic foot? Then as to the deposit of the models. They were to be deposited at the time of the application, and every one knew that inventors were not then in the best position to give the country the fullest details of the working of their inventions, and to guard future inventors against shoals and quicksands. With regard to the obligation to grant licenses, that had some merits no doubt, but it also had disadvantages. But every inventor who enjoyed protection from the State ought to be compelled to put his invention in practice within a limited period, as they were obliged to do in France. As to the question of cost, it had been stated that the English system was the most costly, being £25 in the first instance and £175 altogether. But when matters were taken into consideration, such as provisional protection, cost of searches and such like, which were often necessary, the amount was nearer £100 than £25 in the first instance. As to the examination, he thought the advocacy of that by the Inventors' Institute would do a great deal of harm. The substitution of the American system would be most objectionable. If there was a better staff of well paid men at the Patent-office under Mr. Woodcroft, who was a very able man, to exercise a strict supervision, and use a little more care in the matter, there would be a far better administration of the Patent-law. He did not at all agree to the proposal to substitute a Board of Examiners for the present system. The ordinary mode of proceeding in connection with the application by an English inventor for a patent in the United States involved frequently the necessity of taking out 4, 5, or 6 patents, for that which in England had been done under one; and in the case of the application by Saxby and Farmer for a patent for their interlocking gear, it was suggested that no less than 14 applications should be made for that which in England had been patented under one specification. Where then was the boasted cheapness of the American system, if you had to multiply the £7, which an American patent was said to cost, by 14? But that was not all. The amount of expense consequent upon the reference backwards and forwards to the examiners, and the necessity of the inventor being represented by counsel, greatly enhanced the cost, and he protested against the American system altogether.

Mr. Theodore Aston, Q.C., said his experience would lead him to say that under the existing system, in a great many instances, a deserving patentee was unable to enforce his rights in a court of law. Mr. Samuelson in his remarks had said that Mr. Bramwell had omitted to give sufficient weight to the fact that neither in Holland nor in Switzerland were patents granted, and that no great difficulties arose in consequence. He also said that patentees in England were in consequence of the absence of patents in Holland and in Switzerland enabled to place certain trades at a disadvantage, and he especially referred to the sugar refining trade. Mr. Samuelson also referred to Mr. Macfie, who had distinguished himself by his opposition to patents, and who had addressed a letter to the *Times* on the subject. But in that letter he very carefully abstained from giving any single case in which the sugar manufacture was interfered with by the existence of English patents. He neither stated the existence nor the manner in which the interference took place. And why did he not do so? Because he was unable to; and this he would prove by the evidence that gentleman gave before the Patent-law Commissioners, which would show how very important it was to sift statements

which were thrown broadcast, and see how far they were borne out by the facts. Mr. Macfie was examined by Lord Overstone, who put this question—"There being 400 patents now in existence affecting your trade, some of which are made use of by you, do you find that the existence of these patent rights creates impediment, and interruption, and inconvenience in the prosecution of your business?" Now observe the answer. "Not in the smallest degree, but if patentees were as troublesome as they might become under a change of the law and with a broader organisation, we should find our business so uncomfortable that it would be almost necessary to retire from it. Every one of those parties might come and allege that we were infringing some patent and might bring us before a court, as that person to whom I have referred." The state of matters with reference to interference with trade, as far as he was aware, had not altered since the time he gave that evidence, and he was quite sure that the amelioration of the system, which they all looked for, had not yet come. With regard to Switzerland how did it act? It was quite true that, being as it were at the door of the market, the Swiss manufacturer was able, not having transport to pay, and not having high wages and the difficulties of strikes to contend with, to manufacture machinery at a considerably lower cost than an English manufacturer could supply it to a South German customer. But how did this act in fact? An eminent Lancashire firm who had been accustomed for many years to supply South Germany with machinery, supplied looms to two manufacturers in a very well-known town in Saxon Switzerland, supplying them under cover of a South German patent. This patent was on the eve of expiring, and the Lancashire firm knowing that under these circumstances there would be competition by the Swiss manufacturers, who were very desirous of entering into that market, they were on their part desirous in some way or other of holding their own. It happened that they were able to make very great improvements in looms that year, and the consequence was that the productive power of the looms they had already supplied to the German manufacturer might be improved by these alterations to the extent of 25 per cent. They took out letters patent in the South German States for these further improvements, but when they went to supply them to the manufacturers they found that one of them had been making very extensive alterations in his establishment, and had got a large building prepared with new looms which he had obtained from Switzerland. The representative of the Lancashire firm looked at them, and then spoke to the proprietor of the mill, saying, he saw that they had got part of their castings from Lancashire, and that the looms were copies of theirs. Oh, yes, he said, he did give a loom to the Swiss maker, and he took a copy of it. To this the traveller replied that it was a very ungentlemanly proceeding, but that if possible they must get over that difficulty. He then told him that they had further improvements which increased the producing power of the looms 25 per cent. more; but that those improvements he would not allow to be put to his old looms, nor would he allow any one else to add them, but that he would supply all other competing manufacturers with them, and that they would be enabled thereby to increase their production 25 per cent. The manufacturer replied that he had a contract with the Zurich manufacturer, who was bound to give him looms of equal producing power to the best looms of X Y Z, and that in case they did not do so the looms were to be sent back again. The Lancashire representative replied that he was going to Dresden to supply his competitor with them, that they would be added in a fortnight; and that he would then return and see him. When he did return and saw this German manufacturer he at once ordered the improved looms. But what was that owing to? Simply to the fact that having these improvements at hand, and having a patent which would enable the English manufacturer to compete with the Swiss rival upon broad fair terms, he was able to hold his own. Without a power such as that an English manufacturer would not be able, considering the difficulties under which he laboured, to compete with his rivals who came in at an advantage, having had the benefit of his experience, and not having to pay transport. But they would not be able to do so when the English competitor had not the advantage of having a patent here, and was not able to claim any return for that, or under a species of reciprocity—because if the English law were annulled the foreign laws would follow suit—and there would be a great difficulty in the English manufacturer competing with the foreign manufacturer. It was worth while to consider to what extent patents from abroad bear any ratio to those taken out in the United Kingdom. Taking an average of three years, the number of patents granted for English inventions were about 3,300. Of those 683 were for communications from abroad, so that the proportion of foreign inventions introduced to home inventions bears the proportion of about one-fourth to one-fifth. As to those, at least, it must be said the country was richer by the addition, owing to the existence of the Patent-laws. Of the total number considerably the larger proportion were for inventions of no practical utility. This was easily tested by considering the number of patents kept alive at the end of three years and at the end of seven. At the end of three years 753 were alive; therefore it might be said these were reasonably good inventions. At the end of seven years 201 were alive. Therefore, out of 3,300 only 200 stood the test of seven years' trial, or stood the payment of the extra £100, and they might fairly be called good substantial inventions. As to the surplus of £95,000, it must be remembered that £28,000 really consisted of stamp duty, which was a revenue tax which the Government had as much right to put upon the parchment conveying the patent right as upon any other parchment or deed. Government always meant that there should be two distinct species of payments; one for fees, and the other for a revenue tax, which was £5 upon the warrant, £10 upon the three years' payment, and £20 upon the seven years' payment. Those taxes amounted in round numbers for all the years that have passed since the beginning of the law, to £184,700. That was a large sum for the Government to take for stamp duty. But the aggregate surplus from which that deduction was made was no less than £1,100,203. Therefore, deducting what the Government might legally claim, namely, £184,700, there still was left the large surplus for disposal of £913,500 for the requirements of the Patent-office, as was intended by the Patent-law. If that were so, once grant that it was feasible that expenditure should be incurred for the object of improving the system, there was the means. He did not agree with the speaker who said the Commissioners were paid for doing something they did not do, for the fact was the whole system, as regarded the duties to be performed by the Commissioners, was tainted by the defect that they were expected to do all their duties gratuitously. Neither the Lord Chancellor nor the Master of the Rolls received one single shilling, and the Attorney-General and Solicitor-General were really not paid a single farthing out of these moneys for their duties as Commissioners, but for the opinions they gave on State questions, and for which, as the Government would not pay them, they were quartered upon the Patent-office. The Commissioners had to a large extent been blamed for not doing duties for which they were paid, but they were really paid nothing. He would recommend that patentees should remember that the reason, when they go into a court of law, they were unable to support their rights was, that their title deeds were bad. If a patentee would take the trouble to ensure that the invention he has made was properly described in his specifi-

cation, which he would call his title deed, and then would take that into a court of law, he believed that in nine cases out of ten he would find no difficulty in enforcing his rights. But unless he does that, and takes care that instead of having his invention defined with boundaries that were elastic, if he endeavoured to put in his specification claims which he could not support, in order to cover wide ground, he forgot that this was the very thing that ruins his claim, and when his counsel takes his case into court he finds he cannot support it.

Mr. E. A. Cowper thought there was one argument Mr. Bramwell had hardly touched upon, although he had named it. There were laws in this country for the protection of life and property, indeed it was sometimes remarked that we think more of the protection of property than we do of life, or at all events of limbs; but what would be thought if it were open to anyone and everyone to take from a man a field of wheat grown on land he had recovered from the sea at great cost and perseveranse. Just so, an inventor worked and recovered from the boundless sea of ignorance the means of supplying in greater quantity, at a cheaper rate, and of a better quality, all the infinite variety of articles and manufactures that go to make up a nation's wealth. It was an every-day fact, and one admitted on all hands, that the laws of patent property must be carefully adapted to the special circumstances of that property. So, clever men, men more educated or original in their ideas, were at once acknowledged to have a property in their thoughts, and because others want them, they readily give them protection by copyright, not for fourteen years only, but for their whole lifetime. So another class of men work with their original thoughts in another direction, having a more practical tendency, and they equally have a right to have their labours protected to them for a few years, at all events until they can remunerate themselves. He would mention the case of a workman who invented a very valuable improvement in the mode of working the slide-valves of steam-engines, and it was particulary valuable when engines had to be reversed suddenly or, indeed, at all. So valuable was this invention that it was all but universally used in all locomotives and in all steam-boats; now this workman made a mistake, for instead of going to the Patent-office and paying five pounds, he showed it to a gentleman who gave him five pounds, he not thinking it a very valuable thing at the moment. Now it was a great pity that this man did not have the benefit of the Patent-laws, as he fully deserved to reap a fraction of the great good he did by his invention, which at the very lowest valuation could not have been worth less than £20,000. Another case he was even more intimately acquainted with. Years ago he had designed the common fog-signal, now universal on all railways, but he did not patent it because he thought, and thought wrongly, that it would be more quickly brought into use if left open. The result was that he received next to nothing for the invention, and it was not taken up so quickly as it ought to have been, by probably two years, and great loss of life occurred during that time, which might have been saved if it had at once been patented and a factory set to work to make and push the invention more than he could afford to do, having no security of reaping advantages from it, as he had no patent. It had been observed that inventors sometimes hit upon a lucky invention, and reference had been made to the improvement introduced by his father into printing machinery. Certainly this was an invention which had created quite a revolution in the dissemination of information, but he knew that his father had worked for weeks, months, and years, and had spent many hundreds if not thousands of pounds in his experiments, until at last the day came when his partner announced that he would risk £5 more upon it, and that was all. Happily the desired end was accomplished just within the £5, and it was very well to point to the lucky hit which came at the last moment, but wh labour, and money spent previously? thing when it was done, something co inking apparatus; for several printin been constructed which would give pression if time could be allowed to hand, the difficulty being to eff distribution of ink. This was at last its being distributed latitudinally an instead of one way only, and then the It had been said inventions might be w the inventors, but this was not the cas rare instances. He would name two; one v case; it was not quite such a process whi carry on by himself, because steam pow it, and so the inventor had a steam engi put up, and had the shafting run throu secret room, and in order to prevent an through, he ran the shafting through box, so that all view of his prevented, and he and his engine and out as well dressed gentlemen, persons suspected what was going case was that of a manufacture of th watches, who worked with his son springs by drawing them through d hardened them, but the amount of work very small indeed, whilst the invention wire after hardening is one of very gre deed. All wire for pianofortes was so years ago was known as "Austrian was very expensive, though now it c cheaply, as all steel ropes for stean made of this hard-drawn steel wire. however, put by the question of secret manufacturer would employ a large nu to work secretly? and he would ask country reward the vast number of in recorded in the Patent-office documents each man have a share in the products of He had taken the trouble to calculate lifetime of a patent, taking into accoun the third year fee is not paid, and also and found that the average life of a three years and one-third, so that o patentee has but a short time of it, the really valuable patents are kep owners, otherwise there would prizes to induce inventors to go It was a most remarkable thing that t 1852 had never been fully carried o "the Law officers, together with such persons as Her Majesty shall appoint, s missioners of Patents." Now Her M been advised by the Government to app persons," and of course had not done so a very great omission, for if the law carried out almost every evil would va

Mr. T. R. Crampton said, notwithstan been said against the American system were some good points about it, parti liminary investigation, without which many more applications. People could to be infallible, and his experience of A showed him that these investigations useful. You could easily improve an A you could also obtain what was equival protection, and you were not bound, as to deposit a model on making your appl time was allowed for so doing. There w however, in which the system might be as, for instance, that mentioned by Mr. ing a large subject into a great man which separate patents must be taken o to inventors being rewarded by hono posed by his friends to have had some in these matters, and to be as well

nothing as most people, but he must confess that he had always looked to a profit. He did not mean to say that he had not a certain *amour propre* in making an invention, and a feeling that he had done something whereby he gained the good will of his fellow men; but to suppose that any man in his senses would work at a subject for years simply for the sake say of being knighted, was absurd. What would knighthood do for him? Suppose he were an honest, respectable man, knighthood would be his ruin, and, from what he knew of persons in a better position, he believed they also would be worse off for honours of that description. In fact he could not conceive of any honour you could do a man which would justify him in spending his time and money for the good of the community. For about six years he had been investigating one particular subject, working at it almost unceasingly, with the command of unlimited capital and every facility and requisite for success, and was he to be simply rewarded by honour if he succeeded? It would not repay him for his time and money. Many persons thought he had succeeded in some things; in making small coal go farther than large; in automatic feeding apparatus; in puddling iron effectively by machinery; and in making steel in a Siemens's furnace from the commonest class of iron equal to the best qualities. If he were to be rewarded simply by honours he should say he was much obliged, but he should never have devoted his attention to these subjects if he had not a prospect of a more tangible return.

Sir Francis Knowles, Bart., thought there were one or two practical points on which great improvement could be effected in the present system. In the first place he did not consider six months was long enough for maturing the specification in many cases, and thought it would be better if there were an intelligent Board of Commissioners who had power at their discretion to extend the time within which the patent must be completed. This, he believed, would greatly assist the poor inventor, who had been so much spoken of, in finding a good Samaritan, who would assist him with capital to carry out his ideas; though he feared the good Samaritan too often played the lion's share while the inventor or patentee was reduced to that of the jackal. But again, when the patent was obtained, and the inventor's rights secured, they were very insufficiently protected. Too often a speculative manufacturer came forward and used the patent without paying a farthing, relying on the inability or reluctance of the patentee to embark in expensive litigation. Then if the latter did commence an action, the infringer was allowed to come into Court and plead that the invention was not new, and that it was not useful, though he might be using it every day and making money by it, and professed to be acting in the interest of the public. But if such were his real motive there was a process provided whereby he could get the patent repealed by obtaining the fiat of the Attorney-General, and proceeding on a *scire facias*. The truth was, however, he did not want anything of the kind, but simply desired to participate surreptitiously in the advantages of the patent. He would suggest, therefore, that the validity of a patent should not be allowed to be contested except by a *scire facias*; then if the patent were a good one, the only issue in case of infringement would be the fact of the infringement and the amount of damages. Such an alteration would, he believed, get rid of more than three-fourths of the patent litigation. In conclusion, he desired to pay his tribute to Mr. Bramwell for the admirable way in which he had vindicated the claims of British genius against hollow sophistry, and if any other sanction were required he would appeal to the higher and older one, "Thou shalt not muzzle the ox that treadeth out the corn." And, if not the ox, certainly not the man. He had also vindicated the claims of mind against matter, for which there was prescription older than that of any hereditary property, for from the former the latter derived all its value, and without it would be as valueless as when it formed only the hunting ground of the wild beast or of the naked savage.

Mr. John Imray said he wished they had had the benefit of Mr. Bramwell's assistance when, some years ago, they had to meet Mr. Macfie, and some other gentlemen, who were strongly in favour of the abolition of patents. Happily, however, they were able so far to influence the House of Commons as to postpone this abolition, and since then a strong reaction of opinion had set in, so much so that during the present discussion there had seemed almost a unanimity of feeling that patents ought in some shape to be maintained. The only dissentient had been Mr. Lloyd, who had brought his great powers of criticism and satire to bear on the views Mr. Bramwell put forward, and said that the inventors ought to be satisfied with honour and glory for their reward. This was, however, merely the sentimental view, which was hardly worth serious discussion. Reference had been made to George and Robert Stephenson, and to the statues in Euston-square; in other words when the inventor asked for bread he was offered a stone. But Mr. Lloyd forgot to mention that both these gentlemen made large fortunes besides. At the same time he agreed that when the Lord Chancellor and other legal dignitaries filled honorary offices only, and when learned counsel of great ingenuity and acumen were ready to conduct cases in law courts for the honour of the thing and for the love of justice, inventors might be asked to labour without any more solid remuneration. But leaving the realm of sentiment it occurred to him that a patent was very much in the nature of a lease. If a landlord had a piece of waste ground, he would let it at a very low rent for a certain term to someone on the condition that he put so much labour and capital into it, so as to make it fertile; and in the same way the State agreed with an inventor, that for a certain time he should have an exclusive privilege in return for his time and trouble. It was therefore, no longer a question of abstract right, but of simple contract, and the question was, whether it was not better for the State to enter into these contracts, and so encourage inventions, rather than let the ground lie waste. He was an inventor himself, and some of his inventions had cost him something better then the stone Mr. Lloyd wished him to be contented with; he was also an expert, often employed in patent cases either to support or break down a patent, besides which he was a patent agent, and had had some hundreds of specifications pass through his hands. He did not speak, therefore, without some knowledge of the subject, and his experience was that almost all the litigation, trouble, and annoyance connected with patents—and it was but a very small percentage—arose from the patentee or those who acted for him not properly defining the limits of the invention. It was just as if a person let a piece of ground without a proper plan, or leaving an indefinite boundary line, so that no one could say exactly how far it extended. He did not care for an examination as to the novelty or utility of inventions, but he did want to see each one so accurately described that there could be no doubt as to what it included, so that everyone might know when he was trespassing and when he was not. It was not right in his opinion for the State to take fees from inventors without doing something in return, and he should like to see associated with the present Commissioners a properly qualified body of gentlemen, whose duty it should be to examine the specifications and see that they were properly, accurately, and distinctly drawn. He could mention instances in which men, who had sworn before the American Commissioners that they intended at such and such a date to make an invention, had been able to keep out the man who had actually made the invention, and he could only say that if such a system were followed there would soon be an end to inventions altogether.

Dr. Collyer, after some remarks on the Vienna Con-

gress, went on to the question of compulsory licenses, which, he thought, meant depriving a patent of any commercial value. It often took an inventor ten years to complete an invention, and during this time he had to meet with all kinds of rebuffs and insults; and when at length he succeeded he was entitled to a reward. As an American who had been connected with the Patent-office, he did not consider that the objections made to the American system deserved any reply. The fact that two, three, or four bad patents had passed, was no reason for depreciating a good principle, and he was satisfied that good service was often done to an inventor by having his invention examined by competent men who could show him where his fault lay. Many a man was quite honest in supposing that he had invented something which had been known years before, and in such cases the assistance of the examiners was valuable.

The discussion was then adjourned to the Friday evening following (this day), December 18th, at 8 o'clock.

OBITUARY.

Benjamin Bond Cabbell. — Mr. Benjamin Bond Cabbell died on Wednesday, the 10th instant, in the 94th year of his age. He was educated at Westminster and at Exeter College, Oxford, and was called to the bar in 1816. He was a Bencher of the Middle Temple, a Justice of the Peace and Deputy-Lieutenant for Middlesex and Norfolk. He sat in the House of Commons in 1846–7 for St. Alban's, and in 1847 to 1857 for Boston. He was for long known as a patron of many charities and institutions connected with art, and many years ago he served as a Vice-President of the Society, which he joined as long ago as 1824.

GENERAL NOTES.

New Horizontal Engine.—Among the exhibits at the Agricultural Show was an improvement on the ordinary horizontal fixed engine, with separate boiler, shown by Messrs. Roby and Co. In this the whole engine is fixed on a solid bed-plate, the boiler, which is of the locomotive type, being suitably supported above the working parts and the fire-box, which rests on one end of the bed-plate. The object of the invention is to provide an engine which can be removed without much difficulty, and set up without much skilled labour, and without costly and extensive foundation.

Trade of France.—The returns of the imports and exports of France for the first ten months of the present year present somewhat analogous results to those of the United Kingdom. The value of the imports has increased compared with the corresponding period of last year about 9 per cent., while on the exports there is a diminution of about 1 per cent. The latter had for the six months of this year exhibited a great decline, and it would almost appear that a revival of trade occurred simultaneously both here and in France. Of the increased imports nearly the whole is attributable to cereals and raw cotton. With regard to the former, the position will undoubtedly be changed in next year's returns, owing to the abundant harvest and the commencement already of exports. Of other articles which exhibit any notable fluctuations, coal and wood have considerably declined, while hides and silk manufactures have largely increased. The exports of refined sugar have augmented 22 per cent., and all articles of consumption, with the exception of wines and spirits, exhibit large increases. The value of the butter shipped in the ten months is nearly three million sterling, of which we certainly take three-fourths, as also of the eggs, which are valued at one and a half millions. Of the manufactures generally known as *articles de Paris* there appears to be a great falling off. The imports of the precious metals had exceeded the exports in the ten months by 26½ millions sterling.

Indian Cotton.—The hand-loom manufacture of India is still a very large industry, and the supply to the people of India in cotton is now in about this proportion—225,000,000lb. are supplied by this country, 310,000,000lb. are the produce of native hand manufacture, and 40,000,000lb. are the produce of their manufactories by steam power. In 1859 India had but two mills for manufacturing cotton goods; but since that time the number has increased, and there are now mills in India containing 490,000 spindles; while other mills which will contain 240,000 spindles are being erected; and there are companies formed to supply a further increase of 280,000 spindles; so that, although to this point the development of the factory system in India has been comparatively slow, there are evidences of a very great and rapid extension, such as indicate the creation of a great national industry. The mills erecting and projected in India will double the present manufacturing power of India, and when these mills are all completed the mills of India will supply 80,000,000lb. instead of 40,000,000lb. as at present, which will equal about one-third of the goods we now send to India from this country.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The first course of Cantor Lectures is on "Alcohol: Its Action and its Use," by Dr. B. W. RICHARDSON, F.R.S. The following are the remaining lectures of this course:—

LECTURE III.—MONDAY, DECEMBER 21ST.

The influence of Common or Ethylic Alcohol on animal life.—The primary physiological action of Alcohol.

LECTURE IV.—MONDAY, JANUARY 18TH.

The position of Alcohol as a food.—Its effects on the animal temperature.—Hygienic considerations.

LECTURE V.—MONDAY, JANUARY 25TH.

The secondary action of Alcohol on vital functions.—Physical deteriorations of structure—general and special—incident to its excessive use.

LECTURE VI.—MONDAY, FEBRUARY 1ST.

Influence of Alcohol on the nervous organisation, with special reference to the mental phenomena induced by its use.—Summary.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) By Dr. B. W. Richardson, "Alcohol; its Action and its Use." (Lecture III.)
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C. 5 p.m.

TUES. ...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Annual General Meeting.
Anthropological Institute, 4, St. Martin's-place, W.C. Colonel A. Lane-Fox, "On Early Modes of Navigation, tracing the Development of Ship-Forms."

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FRIDAY, DECEMBER 25, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

The Council have arranged with Prof. McLeod, of the Indian Engineering College, Cooper's-hill, to deliver two lectures on Wednesday, January 6, and Wednesday, January 13, at 3 p.m. The subject will be "The Work and Food of the Iron Horse."

EXTRA MEETING.

The adjourned Discussion on Mr. F. J. Bramwell's paper on "The Expediency of Protection for Inventions," was resumed on Friday evening, December 18th, WILLIAM NEWMARCH, F.R.S., corresponding member of the Institute of France, in the chair.

Dr. Siemens, F.R.S., wished to be allowed to say a few words with regard to the Vienna Congress, which had been referred to at the last meeting, as he had taken a somewhat prominent part in connection with it. The idea of that Congress originated with Baron Schwartz Senborn, Chief Commissioner of the Vienna Exhibition, and invitations were issued to all nations, in the name of the Austrian Government, with a view to establishing International relations regarding the Patent-law. However, before the Congress assembled, the Austrian Government, like Frankenstein, became somewhat alarmed at their own creation, and the Congress, instead of being an official one, was simply an assemblage composed of manufacturers and others, especially the jurors who had attended the Vienna Exhibition, though Baron Schwartz still had the management of it. He (Dr. Siemens) was summoned to Vienna from Switzerland to conduct the business of this heterogeneous body, and amongst his duties was that of explaining if not translating the speech of any member of the Congress into any other of the four languages which were in use there. It was evident, therefore, that his position was not at all a bed of roses, and if in the end the Congress arrived at any resolutions which would stand the test of scrutiny, and form the basis for further efforts in the direction of an International relationship with regard to Patent-laws, he thought it might be said they had not met in vain. Mr. Webster, Q.C., who represented England at that Congress, worked most arduously in the endeavour then made to arrive at some reasonable conclusions, and he had since worked still more arduously in putting the transactions of the Congress before the English Government in an intelligible form. He believed that a better law would shortly be introduced into the German Legislature, which would compare favourably with that of other countries; and in this country also he believed legislation might be expected from the present Government. With regard to the English Patent-law, he might say that with all its faults he loved it still. But though its administration left much to be desired, there were elements in it extremely advantageous both to the inventors and to the public. One of the chief of these was that the tax was progressive, not by driblets, as was the case in France, but there were fixed periods during which the patêntee might try to give life to his invention, and if at the end of the period it did not answer, he might relinquish the claim by declining to pay any further fees. The American Patent-law had certain advantages of its own, and he thought the preliminary examination a good institution, though both in America and Prussia it was carried beyond the limits of usefulness. One speaker had compared an invention to a reclamation of land on the sea shore, and he understood him to draw from it the reference that the right of an inventor was indefeasible. Now he was strongly opposed to the idea of indefeasible right, and taking the same idea he would say that though a man was entitled to the fruits of his labour in gain of ground from the sea, there might be circumstances under which it might not be desirable, from its effect upon the tideway or otherwise, to make the reclamation. He would therefore rather compare an invention to a new-born child, which might become a man of great power, but in its actual state was utterly powerless. The parent of the child had not only rights but important duties; and so with the patentee, he had a public trust to perform, he ought to carry the idea which presented itself to him into practice and give form and substance to his invention. For so doing he was justified in taking his share of the benefit which it might produce, but for a certain time only, after which it would be given over to the community. He thought this was the view put forward by Mr. Bramwell, and in conclusion, he congratulated all those interested in this important question on having had the advantage of hearing this most able address and the almost equally valuable discussion which had followed it, for both, he believed, would lead to most important practical results.

Mr. H. Cole, C.B., said:—In the few remarks I am about to make, I intend to avoid the discussion of general abstract principles, and to confine my observations to some facts and practical points. Even then I do not intend to bring forward all the many details of this complex question and its numerous ramifications. It is more than twenty-four years since the Society of Arts began and carried out a successful agitation against the bad Patent-laws which then existed. On the facts of the case collected by the Society, Charles Dickens published "A Poor Man's Tale of a Patent" in *Household Words* of the 19th Oct., 1850, which circulated in thousands—hundreds of thousands—throughout the country, and gave the death blow to that bad system. This humorous tale with its true facts got rid of the "whole gang of hanapers and chaff-waxes." England having been, as Dickens said, "chaffed and waxed sufficiently." There is still a little chaffing and waxing in the obtaining a patent which might be well dispensed with. Under the system before 1852, about 700 patents yearly were issued in the United Kingdom. They yielded £66,000 a year in fees. The broad principles of reform which the Society advocated were—simplicity of registration; a graduated scale of fees from £5 to £100, payable at fixed periods; a full publication of all specifications, with proper indexes; and lastly, that "the surplus profits, after paying office expenses, should be directly applied to some public purpose connected with invention, but not carried to the Consolidated Fund." The Patent Act of 1852 in the main adopted these principles, and the result last year was as follows:—4,294 applications were made for patents, *i.e.*, patents have been sixfolded under the present law. Of these only 2,906 obtained Letters Patent, and as many as 1,320 were not finally completed. The gross total of fees rea-

lised £144,761, of which £95,284 went to the Treasury, whilst Smeaton's engine was broken up for old iron. All commendation should be given to Mr. Bennet Woodcroft for his works of publication and indexing. During this period some scepticism, in defiance of old practice and the opinions of political economists like John Stuart Mill and others, has been expressed, questioning if it be good public policy to acknowledge any rights of invention at all. This scepticism has declined of late, and I think the working men must have altered the views of the late Lord Chancellor. However wavering you may be in trying to form a dispassionate judgment on a difficult and abstract idea, I think the conclusion must be that the inventors' rights ought to be protected. It seems to me that Mr. Bramwell's paper, Mr. Fitzjames Stephen's remarks, and the able speeches of others in the late discussions, and above all the evidence afforded of the strides made in manufacturing industry through invention, render it quite unnecessary now to enter upon that question. The points to which it appears to me profitable to direct attention are—What improvements can be made in the present law and practice? I assume patents for inventions will continue. (1.) Ought the inventor to have an unchallenged right of registration of his invention at a cheaper cost than now? (2.) As all the onus of defending rests upon him, ought he to have that right unquestioned when applying for registration? (3.) Ought any kind of Papal infallibility to be called in to pronounce a judgement on the novelty and goodness of his claim? (4.) As at present, ought there to be graduated rates of fees, and ought these to be of the same amount? (5.) Can law proceedings be simplified and cheapened? As respects the first question, the fee of £5 is not high in itself; it might be lowered, but this would not materially affect the subsequent cost of taking out a patent, because the chief part of the cost is the agent's charges. It might perhaps be worthy of consideration, if these charges could be reduced by some official forms which the ignorant poor inventor could fill up, under the guidance of a recognised agent, at a fixed payment. As respects the second question, I hold it quite impossible for any tribunal to decide satisfactorily to the public if a patent should be granted or not granted. It would be fatal to inventive progress to give any tribunal such a power, and I am convinced the public would never tolerate it. How long would a tribunal of scientific doctors stopping an invention for crossing the Atlantic, or forbidding the plans of building for a Crystal Palace, last? But the Patent-office has by the present law sufficient powers, and might perhaps give a report on certain facts at a reasonable fee upon the request of an inventor for his guidance. Such a report should have no legal force until it was proved by a court of law to possess it. On the policy of renewed terms for patents at graduated fees I think there cannot be two opinions. It is a simple, effective, and self-acting process for getting rid of useless patents, and should be certainly maintained. In my opinion the present fees are not too high if they were appropriated for the benefit of invention, but they are greatly too high if treated as a tax payable to the Exchequer. I dare say the legal proceedings arising out of patents like most human arrangements could be improved, but as Mr. Fitzjames Stephen has shown, the very nature of the subjects is so complex, when inventors, capitalists, and manufacturers are all quarrelling, that much cannot be hoped for in this direction. I abstain from discussing the limitations to be put on the rights of inventors by granting compulsory licences. I think there ought to be compulsion by arbitration. They seem to me details for a small committee rather than a public meeting to settle. I have no doubt at all that any surplus fees ought to be applied, under legal enactment, to the support of a museum of scientific inventions worthy of this great country. The museum should be under regulations so that the Treasury ought not to have the power to refuse a miserable £150 to preserve Smeaton's pumping engine in 1766, which was at work ten years before Watt's steam engine. I have a conviction myself that the present times are propitious for re-considering this question of patents of vital importance to the manufacturing industry of this country, that the present Chancellor of the Exchequer and the Lord Chancellor will deal with this question as statesmen, and that this Society, inventors, and capitalists, and the public, will hereafter owe the present Government their gratitude.

Mr. T. Webster, Q.C., wished to refer to only one matter which had been a little misunderstood, namely, the question of the compulsory licenses. It had never been proposed by anybody that anyone could come in at his pleasure and share the property of an inventor. What was intended and expressed in the resolution passed at Vienna was, that in certain cases in which the public interest required it there should be a grant of a license to a competent person on reasonable adequate compensation being given. And he wished to call attention to this consideration, which had not yet been adverted to, but which was very much pressed at Vienna, namely, that this question of compulsory license was essentially a poor man's question. It was well known in this country, though the Americans had not yet found the pressure of it—and the same necessity did not arise there owing to the examination system, which prevented many useless patents being granted—that it was often to the interest of capitalists to buy up patents to prevent their being worked. In that state of things the law ought to step in and say that such dog-in-the-manger conduct should not be allowed, and that it should be impossible for a patent to be taken out in this country whilst all the articles made under it were manufactured abroad. It was that mischief which was felt very much in some cases, though in the majority he believed the evil was more imaginary than real, which led to the strong feeling in favour of a compulsory license, and induced the Congress, though at first very adverse to the idea, ultimately to adopt the resolution by a majority of three to one. And he felt satisfied that if the working men of this country, against whose interest it was supposed this would act, would only look at the matter in the proper light, they would see that this reform was essentially in their interest. He would not occupy the time of the meeting further, but he thought Mr. Bramwell might be congratulated on having added a great number of considerations which probably had never occurred to anyone before, and he believed the result would be that something would be done towards that reform in which the Society of Arts had taken part so long ago as a quarter of a century.

Mr. W. Griffith thought one observation which had fallen from Mr. Samuelson was rather calculated to produce a false impression as to the legal state of the question. That gentleman said that the present system of administration might be improved by calling in other persons to administer it. That might be perfectly true; and yet it hardly touched one of the essential evils which at present existed. Nobody could have higher respect for the Act of James I. than himself, and, as had been said, it showed the patriotism of the people of that day, and the justice and generosity with which they treated the inventors of new and useful articles. But what was the meaning put upon those words "new and useful" at the present time. According to the practice of the Law-officers of the Crown patents might be granted for similar objects. It had been decided by the House of Lords, in the celebrated case with regards to Betts's Capsules, that though the specifications were identical, two patents might be granted to different persons. Now was not that absurd; was it possible that when one thing was new, another thing described in exactly the same way could be new also? Yet such was the present practice, and in the Law Reports for the present month he found that the great seal had been affixed to two similar inventions upon the same day. This was not altogether a

theoretical objection, for if you had patents granted to two persons who brought forward things exactly similar there was sure to be much litigation afterwards, and the Patent-law would be abused, and rightly so, for being so wrong in its principles. Only the other day at the Patent Museum he had had put into his hands the last part of the evidence given before the House of Commons Committee, and he there found that both Sir Roundell Palmer and Mr. Grove said that the present law was so cumbrous and unworkable in its character that sooner than it should continue to exist they would have no protection at all. If patents ought to be protected, and if a person had a right to reap the fruits of his own labour, it was surely wise to advocate such reforms in the law as would separate the abuse from that which was really useful. He did not think anybody could contend in the present day on abstract principles that it was not just and expedient that such rights should be protected. If the farmer who sold a field had a right to reap the fruits, and if a man who laboured with his hands had a right to his wages, he who laboured with his brains had also a right to receive the fruits of his labour. On these grounds, and also because it was obvious that if they did not grant protection inventors would be running away to other countries and capital would follow them—he considered it both expedient and just to extend protection to inventions; but at the same time, while supporting this view, it was highly desirous to remove that which was useless and which brought that which was so good into so much disfavour and contempt. He therefore thought it would be wise for the present meeting to appoint a committee to consider the parliamentary aspect of the question. The Society had great influence, and if that were brought to bear on the Secretary of State he thought they would be more likely to attain the ends they had in view.

Mr. William Smith asked if Mr. Griffith knew for a fact that because the seal had been affixed to the two patents with the same title that the specifications were the same, considering that the latter could not have been published at the time.

Mr. Webster said it was notorious that the anomaly referred to did happen.

Mr. Griffith said it was so laid down by the House of Lords in Betts' case, and two cases of a similar kind were referred to in the authorised reports.

Mr. Bramwell, in reply, said, I am afraid that by this time you must be weary of the subject of protection for invention, but at the risk of causing you to be still more weary, I will ask your kind indulgence for some considerable time, while I reply to the various observations that have been made in the course of the discussion, and I will venture to demand your permission to pass, in one or two instances, beyond the boundaries of this room, and to be allowed to comment upon remarks which have been made elsewhere. In the very outset of my reply, I wish to clear up a misapprehension as to my views under which some appear to have laboured. Mr. Samuelson said that I regarded matters too much *couleur de rose*, and others have said I appear to be of opinion that our present system is the best of all possible systems, and that no alteration is wanted. This really is not so, as any one may see who will take the trouble to refer to the very first page of my paper. I state there that two things may well be considered; the one, what should be the nature of a Patent-law; the other, whether there should be any Patent-law at all; and then I go on to say that as it was impossible to discuss these two subjects in one evening, and it was idle to investigate details when the very principle was in doubt, I would devote myself to the consideration of the broad question whether or not there should be a Patent-law, and then I added that as I intended to discuss that question without entering upon the merits or demerits of the present law, it was only fair that I should, as against myself, take the law as it stood, and should consider whether, even with such a law, it was expedient to have protection or to do without it. Before my reply is concluded I think I shall have shown to you, not only that I believe the present law (or rather, as it would seem from the statement of Mr. Samuelson, the practice under the present law, and not the law itself) could in some respects be altered with advantage, but I shall also show you that I have had this subject of amendment under my consideration for years, and that I have borne my share in suggesting what those amendments should be. Notwithstanding the many kind things that, in the course of the discussion, have been said of my paper, I am in considerable doubt whether I ought not to apologise for having brought it forward, and whether I ought not to do so, on the ground that such a paper was unnecessary, and worse even than this, that it was suggestive of a going back. It is in this sense at all events that I understood Mr. Hinde Palmer's observations. You will remember he expressed his surprise that a paper should have been written which treated as still open to doubt the question whether there should be protection for invention, whereas he believed that question had long been settled in the affirmative. Any mortification I might experience on finding that I have written an unnecessary paper, is more than outweighed by the pleasure of hearing from a gentleman in Mr. Hinde Palmer's position as a recent member of the Legislature (and a member who, only three years ago, had the whole subject so thoroughly before him in his position of one of the Committee which sat in 1871), that the principle of protection is firmly established. Mr. Hinde Palmer certainly appears to be justified in his position by the general concurrence of the speakers who have addressed this meeting, and also by the tone of the press in their notices of these proceedings here. I repeat I shall be most heartily glad if Mr. Palmer is right, and if this paper of mine really was unnecessary, even though it would make me responsible for having uselessly occupied your time. But I cannot say I am quite assured that Mr. Palmer is right; I cannot forget that no longer ago than 1869 Mr. Macfie moved in the House of Commons, "That in the opinion of this House, the time has arrived when the interests of trade and commerce, and the progress of the arts and sciences in this country, would be promoted by the abolition of patents for inventions," and that although this motion was not pressed to a division, Mr. Macfie found no less a person than Sir Roundell Palmer (who, since then, as Lord Chancellor Selborne, has been at the head of the law in this country) to second that motion, and he also found Lord Stanley, the present Earl of Derby, to speak in his favour. I will not at this moment say anything further about Mr. Macfie, although I shall have occasion to do so before my reply is concluded, but I will ask the meeting to consider the gravity of the opinions of men like Lord Selborne and Lord Derby. The latter nobleman is a member of the Cabinet, and although his duties in that Cabinet are such that presumably the subject of Patent-law (except the question of an International law) does not fall within their scope, nevertheless it cannot for one moment be doubted but that the advice of a nobleman so distinguished in every way for uprightness, sound sense, and an earnest desire to do the very best that he can for the country, should be sought by his colleagues, and should have its full weight. Lord Selborne also, although now among the retired Chancellors, is a man whose every opinion must be listened to with the greatest possible attention, whether he be in office or not; and, so far as I know, neither Lord Derby nor Lord Selborne has ever since the debate of 1869 made any statement to warrant one in supposing that he has to the slightest extent modified his opinion upon the Patent-law question, or that he believes he perhaps was in error in supporting Mr. Macfie's motion, which, you will remember, dealt, as my paper does, not with details at all, but went to the very root of the question of patents for inven-

tion. Now I am not, I am sure you will credit me, vain enough to suppose, that even if my paper ever came to the knowledge of Lord Derby, or was brought before the notice of Lord Selborne, any arguments I advance in favour of the maintenance of protection for invention would have such weight with those noblemen as to cause them to change their opinion; but may I not hope that the strong expression of sympathy with protection which the occasion of reading this paper has evoked from the public press as well as from the speakers here, will have its effect upon the minds of such men as these, for I believe both of them are quite capable of imagining that when they found themselves opposed to the views of the public (as shown by the majority of the press), they may be in the wrong, and may be induced to reconsider the subject, and even if they cannot bring themselves to believe that protection for invention is the best thing, may still consider it desirable not to interfere with that which is evidently valued by the bulk of the community? As I have said, so far as I know, the opinions expressed by Lord Derby and Lord Selborne in 1869, have not been withdrawn by either of them. I believed when I wrote my paper, whether rightly or not I am not now certain, that legislation on the subject of the Patent-law was imminent, and I thought that I might do good by bringing before this Society, and, through its means, before the public, the expediency of protection for invention. With your permission, I will now say a few words upon the question of copyright. Lord Selborne, Lord Derby, and even Mr. Macfie see a great distinction between copyright in books and patents for invention, and they one and all would uphold the copyright while they would make an end of patents. Another great antagonist of patents, Mr. James C. Thorold Rogers, formerly Professor of Political Economy in the University of Oxford, although he perceives the great distinction between patentright and copyright, does not, as I shall shortly show you, uphold this latter form of protection with any vigour. I had intended to have considered the subject of copyright somewhat fully in my original paper, but I found that paper had reached to so great a length that I was compelled to make only the most cursory allusion to the question of the relationship that exists between copyright and patentright, both forms of protection for mental labour, and even now I must treat the matter as briefly as possible. Those who distinguish between a copyright and a patentright use as one main ground of this distinction the argument employed by Mr. Rogers in his letter to Mr. Macfie, at page 8 of the introduction to Mr. Macfie's book on the Abolition of patents, which is, "that in ninety-nine cases out of a hundred the patentee is only a simultaneous inventor, with a number of others, who lose their labour and ingenuity, because one man happens to get in first. It has always seemed to me that the weakness of the inventor's case lies in the fact already alluded to. Hence the fundamental distinction between invention and copyright, though I am no fanatical admirer of the latter privilege." Thus you will see the opponents of a Patent-law allege that while there is frequently simultaneity of invention in the improving of a machine or of a process, there never is, and there cannot be, in the nature of things simultaneity in the production of books, and therefore the opponents say, that when you grant a copyright to A you don't inflict any injury upon B, who could never have written a book similar to that of A, while when you grant a patentright to C, you do inflict an injury upon D, for he has made, or might have made, the same invention, but who, as regards obtaining protection, has been forestalled by C. Those who assert this simultaneity of invention, in doing so beg the whole question. They say, depreciating the merits of inventors, that in truth, generally speaking, the so-called invention is simply the means of supplying some new want, and that two or three persons can always find out how to do this. Indeed, these objectors discredit invention, until they all but put forward the proposition that the real inventor is the want itself, which directly it arises is sure to be satisfied. But I don't believe this is true. On consideration it is extremely difficult to say, when a want arises, if it is new. Wants always exist, and if at any time they are not pressing and clamorous, it is from the apparent hopelessness of satisfying them. Suppose in the course of the next hundred years some one were to invent a machine which would enable men to fly. The objectors of those days, should there remain any, would say, "Oh, there is no invention here; the patentee has merely supplied the want when it arose, and plenty of others could have done the same." But we of this generation are in a position to judge of the fallacy of such a statement, for the want exists now. We at the present day do want to fly, but we don't press this want, because we believe it is one that cannot be satisfied, but would i be tolerated if within the next year a successful flying machine were produced, that the deviser of that machine should be told he had not exercised invention, he had done nothing more than satisfy a want that had sprung up? It may be said that I have taken an absurd illustration in suggesting a flying machine. Not so idle, however, after all. But assume the case of navigating balloons. This has been, to a certain extent, accomplished; it is an admitted want; many minds are directed toward it, but so far from there being a concurrent supply of the want, not a single successful plan has yet been devised. We wanted the electric telegraph at the beginning of this century, but we didn't get it, and I shall have occasion to show you that the fish-joint was wanted for a quarter of a century before it was obtained. Thus it appears to me that it is nothing more than an unproved statement when opponents in effect assert that the true novelty is in the want, and not in the invention to satisfy it. In my paper I spoke of the Giffard Injector as an instance of a substantive invention, and as an instance also where, from mere inspection of the apparatus disclosing its nature, secret manufacture was impossible. A drawing of that implement hangs upon the wall, and an actual injector, and also one cut through the middle to show the internal construction, lie upon the table. I shall have to revert to the Injector when considering the question of preliminary examination, but I bring it forward here as another instance that a want is not satisfied as soon as that want arises. The principal purpose for which the Injector is employed is the supplying of steam boilers, and especially locomotive steam boilers, with feed water. Now, the want for an improved means of supplying locomotive boilers with feed water had existed ever since the opening of the Manchester and Liverpool Railway in 1830, and yet that want remained unsatisfied for a quarter of century. Even supposing it to be the fact that there is in some cases simultaneity of invention, I do not see what argument this is for withholding a patent. You will remember that I have based my advocacy of protection for invention not upon the individual right of the inventor, but upon expediency, having regard to the community at large. Regarding the question in this light one sees the gain to the community is that the thing should be invented and carried to the practical working stage; the fact that two men simultaneously and independently invent it does not increase the benefit in the least; all that the public cares for is that the invention should be brought to a working stage, and this being obtained the public does not consider whether the invention has been made once or twice. According to my view the public interest is satisfied so soon as a property in an invention has been given to the first applicant, and it has thereby been made worth his while to develope that invention. It is clear, therefore, that the fact of simultaneity of invention, and the giving of the patent to one man of the two only does

not detract from the benefit to the public, but it is alone on the ground of benefit to the public, taken as a whole, that I advocate the continuance of patents. I started by saying that I urged the continuance of protection for invention, not on the basis of the rights of patentees, but on the wholly unsentimental score of expediency; and thus it is I am not so much impressed with an objection often made by the opponents of patents that the giving of the protection to C when D had made the very same invention is a very hard case upon D, the second inventor. If C had not come first D might have had the patent. To a certain extent it is a hard case upon D; it was his own fault, though, for not coming in time. But how do you make the case of D any better by destroying property in invention altogether? What is it you have done? You have secured that C and D shall be on an equality; but by what means have you done it? not by giving D anything for himself, but by depriving C of what he otherwise would have had. I will ask whether, even admitting simultaneity of invention, the opponents of a Patent-law have shown to you that such a state of things affords any valid reason, even in the interest of the two inventors, for withholding protection from both, and whether the opponents have in the slightest degree grappled with the question that the public would suffer from its not being to the interests of either inventor in the absence of a Patent-law to develope his invention. Moreover, the upholders of copyrights say that copyright does not interfere with the freedom of trade in the way in which patents do. This again I cannot understand. One man writes a book and is protected by his copyright, another man invents a printing machine and is protected by his patentright. The book and the machine are both successful. A rival printing machine maker wishes to make the machine, and he cannot on account of the patent, upon which the cry is raised of interference with freedom of trade. A rival publisher wishes to print the book, and he cannot because of the copyright, and although in this case printers and paper makers are as much prevented from the exercise of their trades, as in the other case ironfounders and machine makers are, yet the copyright is said not be an interference with trade. Remember further that in the case of the machine the interference lasts but fourteen years, and that the power to interfere with the patents has been acquired at considerable outlay in Government fees, to say nothing of the great cost of developing the original invention, while the interference by copyright is for the author's life *plus* seven years, be that life as long it may, and as a minimum (however short the life may be) the copyright is for 42 years. Further the obstructiveness of patents is often urged. It is said the patentee is not now bound to grant a license, but is it not equally true that the owner of a copyright is not bound to license anybody? However valuable a book may be, the owner of the copyright may refuse to bring out a second edition, and without his sanction no one can do it, nor make a reprint of that book until at least 42 years have expired. Moreover this 42 years' enjoyment of monopoly has been obtained at the mere cost of the gratuitous delivery to certain departments of a few copies of the work, and the monopoly of copyright extends to many foreign countries. Depend upon it the distinction between copyright and patentright is too subtle for the general mind, and that thus when the patentright falls the judgment of the public will demand that copyright shall not long survive. You will have observed that the first sign of this inevitable connection between the destruction of patentright and of copyright is given by Professor Rogers, who significantly says, "I am no fanatical admirer of this latter privilege." Thus much on copyright. I will now address myself to reply to the observations of some of the speakers, and foremost among them I must place Mr. John Horatio Lloyd. I am very glad indeed that the advocacy of the opposition to the principle of patents was in his hands. I say the advocacy of the opposition to the principle of patents, because Mr. Lloyd, although he very candidly admitted that he believed, in the absence of any other reward, that some kind of Patent-law must remain, left us in doubt that he objected to such a law upon principle; indeed his conversion, even as regards the question of practice, seemed to be anything but complete, and more and more did this appear as he warmed in advocacy of the opponents' views; so evident did the hollowness of his conversion become that it elicited the remark from one of the speakers, "He who consents against his will is of the same opinion still," and I am by no means sure that I ought not after all to rank Mr. Lloyd amongst the opponents to the practice rather than to the principle of a Patent-law; but to whatever extent his opposition may really go, I am, as I have said, glad that the advocacy of the non-protectionists fell to Mr. Lloyd. He is one of our most able counsel, as I need not remind those who heard his brilliant speech on Wednesday, the 9th of December, in this room; and further, as he has told us, he is a counsel who has a professional knowledge of patents, having frequently advised upon them. Thus therefore, those who oppose a Patent-law cannot say that in this discussion they were left without an adequate representative; and I may take it that the very best which can be said in opposition to such laws has been said. I will now, therefore, reply to the observations of Mr. Lloyd as representing the embodiment of the opposition to the principle of protection. Mr. Lloyd complained that my paper was one-sided, and that while I had given my views of the case, I had not put forward those of the opponents—that in truth mine was an advocate's paper. Now let us see what the facts are, and whether Mr. Lloyd was justified in those remarks. I started in my paper by pointing out that the opponents of a Patent-law allege there were four incentives that would suffice to cause invention to flourish in the absence of any Patent-law; and after having endeavoured to refute them, I went on to state that, even assuming my contention were right, and that these incentives were not adequate, still there were persons who said the evils attendant upon a Patent-law were so great that any harm which might happen to us from its abrogation would be less than that which would arise from its preservation. The alleged evils I told you were seven. Now I will ask whether I have failed to state fully my opponents' case. If I had omitted anything, would not that omission have been at once specifically pointed out? But has anything of the kind been done; has anybody instanced a fifth incentive, or put forward an eighth evil? Has Mr. Lloyd suggested either the one or the other? If he has not, where is the ground for his complaint that I do not state the opponents' side? I have stated not only all that I could think of, but, as it turns out, all that he could think of; for he has not been able to bring forward a single addition either to the incentives or to the evils. Supposing I had raked up some other incentive or other sin, would not Mr. Lloyd have been the first to accuse me of "setting up giants to knock them down?" And would he not have said that no one ever suggested either such an idle inducement or so paltry a grievance? And in effect Mr. Lloyd has said this; for, so far from adding to the number of either the sins or of the incentives pointed out by me, he discards one of the sins; and, to my great surprise, that which he discards is the sin of all others, which in the eyes of Mr. Macfie and his supporters renders the Patent-law intolerable. Mr. Lloyd says he does not allege that the Patent-law operates as a limitation of free trade, properly so-called. I could hardly believe I heard correctly when Mr. Lloyd made this remark. I agree with him, of course. I have said, and I have endeavoured to prove by illustration and by argument, that a Patent-law is no more an interference with free trade in any reasonable understanding of that phrase than is the possession of any other property, and that one must go to a communist rendering of free-trade for a justification of the expression that a Patent-law interferes with

t. But take Mr. Macfie's book on the abolition of patents, and look in the index, and you will find there "Trade interfered with by Patents," and a reference to some half-dozen pages, where this point is urged. However, if there are to be future discussions on this question, the opponents of the Patent-law will have to explain away as best they may the admission of their champion in this discussion, that patents do not interfere with free trade. To my great surprise, a shrewd, practical man like Mr. Lloyd, well versed in the ways of the world, says he thinks the suggestion that invention is promoted by the expectation of reaping the reward to be derived from patents places invention upon a low platform, and he seriously put forward honour as a sufficient incentive to invention, and to invention carried to a practical result. He did this so well, and so eloquently, that I could see a feeling of indignation at my sordid spirit arising on the countenances of many of his hearers. However, I am glad to say, that I do not stand alone in beliving that the incentive of honour is insufficient. The *Times*, in a leading article which appeared on this subject on Wednesday, the 9th, says:—"As to the plea that those whom the Patent-laws now attract may be adequately rewarded by merely honorary distinctions, it is perhaps due to to the seriousness with which it is offered to refrain from regarding it as ironical," and I must say that, if Mr. Lloyd had not in this discussion shown, happily for me, that there were those who believed in such a reward, I should have felt I well deserved the implied rebuke of the *Times*. But Mr. Lloyd, as in duty bound, having made the suggestion, endeavours to defend the adequacy of the incentive. He says, there are great men who have given to the world the benefit of their discoveries who took out no patents—large-minded men who thought only of the good they were doing and of the honour to be derived therefrom. Mr. Lloyd made this statement, but did he tell us who these men were? Did he give us one single instance? I will venture to say not one, unless indeed it were Ronalds, the first suggester of the electric telegraph. Mr. Lloyd did not tell you that Ronalds, who took out no patent, confined his invention to the making of a telegraph in the garden of his own house, and that having done this so long back as 1816, he left the invention in that stage, and brought it no further forward than the condition of a scientific curiosity. So electric telegraphs remained dormant and useless, at least to the world, until Wheatstone and Cooke invented practical apparatus, acquired property in that invention by a patent, and then, it being worth while, vigorously pursued the matter, and the telegraph, which, as I have said, had lain dormant for so many years as a mere scientific idea, became an actual working fact. What do the public want? More Ronalds or more Wheatstones? On reflection I am not quite sure whether Mr. Lloyd did not intend to include the Stephensons among those who worked only for honour. He brought their names forward at this part of his argument, and it is possible he did intend to include them. Most certainly I am not going to deny that these men were large benefactors, not only to their country, but to the human race, neither am I going to deny that they obtained honour, but I will ask did they not obtain the very substantial rewards which I am urging are necessary as an incentive to exertion, and moreover were not the Stephensons patentees? I shall have to refer you, in the course of the evening, to a patent granted to Robert Stephenson. I do not know whether I am right in supposing that Mr. Lloyd had the Stephensons in his mind, but if he had not, then, as I have said before, not one solitary instance did he give us of the great benefactors who worked for honour. He asked, in impassioned terms, would not one's heart glow in passing by a statue that had been erected in commemoration of the great inventions of some disinterested discoverer? I will go entirely with him here; I will go even further, and I will say that if I were the son of a meritorious inventor, whose sole reward had been a posthumous statue, my heart not only would glow, but would burn, not with joy at the honour to be derived from the statue, but with indignation at the wretched laws of a country which could secure to an inventor no better reward. Mr. Imray most cleverly summed up the whole matter by saying, "The inventor asks for bread, and you give him a stone." I was gratified to see Colonel Strange, and many other gentlemen of position, stand forth and say boldly and fearlessly that in perfecting their inventions, although they were not indifferent to the good these were to do, the strong immediate support of their labour was the hope of gain. Mr. Lloyd next objects to the cases I have chosen, which I have called typical cases, in support of my views. He says they are cleverly picked out, and that they are not fair, and he compliments me upon my skill in selecting them, and in putting the drawing of the Siemens furnace upon the wall; but although he is of this opinion as regards the bulk of my typical cases, he states I have brought forward one that—if anything were wanted to show the reckless manner in which patents are granted —gives the strongest evidence that could be brought to prove it. The case of the fish-joint. I will ask you to bear with me at a little length upon this question of the fish-joint. Some of my observations upon it belong equally to another portion of my reply, that portion in which I hope to say a few words upon the amendment of the law; but to prevent repetition I will, so far as the fish-joint is concerned, state all that I have to say about it here. On the wall I have hung drawings relating to this subject. One figure shows you the fish—as known long before the days of railways. You may find it described in "Tredgold's Carpentry," the second edition of which was published as long since as 1828, and I have no doubt the fish is to be found in earlier works than this. Fishing, as I have depicted it, consists in placing end to end the two pieces of timber which it is desired to unite, and in putting on the opposite side of these pieces (and extending some considerable distance above and below the joint), two other pieces, which are the "fishes." Bolts are passed through the fishes and the two pieces of timber, and in this manner the joint is made. Such a joint as I have shown is one that would be employed in the vertical pumping rods technically called "spears" in a mine or pit. The mariner's way of making a "fish" was to wind cordage round about the "fishes," and in reading "Anson's Voyages" and other books of sea adventure, you may come across such an expression as this, "the fore-top-mast was badly sprung, but we fished it." You will find a full description of the mariners' use of the "fish" in the 1815 edition of Falconer's "Marine Dictionary" under the title of "fish-joint." Moreover the fish, under the name of "splint," is used by surgeons for temporarily holding in position a broken bone, and the French engineers who have adopted the English invention of the fish-joint apply the surgical term to it and call it *joint à éclisse*. Thus it is clear, beyond the shadow of a doubt, that "fishing," as well to unite separate pieces of timber as to strengthen a cracked or sprung part, was well known, not only before the date of the fish-joint patent, but before the very introduction of railways themselves. I must not give you the history in detail of permanent way, for it would occupy you for several nights were I to do so, but I will content myself by saying that after many trials, the form of permanent way that was in most general use prior to the fish-joint is shown in the drawings I have placed on the wall. In the first diagram there is a representation of portions of the two rails on each side of some joint, which rails were carried in cast-iron chairs supported on wooden sleepers, and these, in their turn, supported on the ballast. At the very joint itself there was placed a wider and heavier chair, called the "joint chair," resting upon its sleeper. A wedge was driven in between the jaws of the chair and the side of the rail, and the chair itself

was spiked down to the sleeper, and in this manner the permanent way was laid. Now assume that the wheel of a locomotive, or of a carriage, was coming along, say from right to left, when it got into the neighbourhood of the joint it would seek to bend down the right-hand rail upon which it was, and the rail, being all on one side of the centre line of the chair and sleeper, would tend to cause the right-hand side (that side of the sleeper supporting the rail) to be depressed, while the other side would be correspondingly elevated; the result would be to cant the sleeper, and to raise the left rail on to which the wheel next had to pass. The transferring of the weight of the loaded wheel from the right-hand side of the joint to the left will obviously have the effect of reversing the cant of the sleeper, and of causing the left-hand side to go down and the right-hand to come up; and thus for every one of the numerous wheels in a train which pass over the joint there would be a rocking of the sleeper. The first result was the loosening of the key, thus affording greater freedom for the movement to take place, and the next result was the triturating of the gravel beneath the bottom of the sleeper, so that in wet weather the ballast speedily became reduced to a muddy mass, and the road was out of order until the sleeper was re-packed. This disturbance of the road was a great source of expense; moreover the wheels were injured by the blows, and travelling was rendered most unpleasant. I daresay very many in this room no longer remember the noise caused by passing over an unfished road. It is almost impossible now to find any such roads in England, but on the Continent some may still remain, and the travelling upon them is most disagreeable. Moreover, as I need not say, such a condition of the road was scarcely safe, even for the light engines and slow and infrequent traffic of former days. But, with the common joints in use before the date of the fish, it would be absolutely impossible to work railways having their present amount and style of traffic. You will see that the joint sleeper was constantly getting out of level, and, what was more, that the end of the rail was raised and presented to the wheel, causing it to be put in danger of being thrown off the line. But there was a further source of injury and a further danger arising from the use of a joint chair, and this was that the end of the rail was extended laterally, and I may tell you the cause of this. Supposing that you were set, as a task the reducing of a two-inch bar of iron to a thickness of one-inch, and that you might do it in any part of the length of the bar which you preferred. Your very instinct would tell you to take one of the ends of the bar, and not to apply your efforts to the body part, and your instinct would guide you correctly, because in making a depression from two inches to one inch, accompanied of course by a corresponding widening of the bar if you made it in the body of the bar, you would have to disturb not only the mass immediately below the hammer but the mass on each side of this first mass, which latter masses unite the first with the other parts of the bar, while if you take the end of the bar, you only have to disturb the similar mass on one side of your operations, the other side having no connection with any other metal, and thus it is that the end of any bar or of any rail is the most vulnerable part. Now, with the old joint chair, the end of the rail rested on the bottom of the chair which acted as an anvil. Moreover, as I have told you, the ends were raised and lowered at the passage of each wheel, and thus a blow was struck; there was in the bed of the chair an adequate resistance to receive that blow, and in this manner the ends of the rails were spread out into a fan shape, as I have sketched them. Now, if a new rail, which was not so spread out, were laid into a joint chair in juxtaposition to an old rail that was, there was presented to the advancing wheel a lateral projection likely to be struck by it. The foregoing were the express admitted defects in the joints of rails, and they had existed for more than a quarter of a century. Many attempts have been made to cure these defects. A figure here shows one of these. In this instance the ends of the rails were what is technically termed "scarphed" (a carpenter's term), and thus it was hoped that by bringing the ends of each rail beyond the centre line of the chair the rocking of the sleeper would be prevented. But I have already told you the end of the rail is the most vulnerable part, and you will see that this scheme possessed the disadvantage of halving the end of the rail and making it still more easy to attack; this plan did not answer. No less a man than Robert Stephenson set himself to remedy the evils arising from imperfect joints. The chair which Stephenson patented, you will see by the drawing, was made with the interior of the bottom of the chair segmental; and was placed on a sort of rocking bed-piece, on which the ends of the rails might lie, Stephenson's hope being that the movement might take place between this rocking bed-piece and the chair itself, and might not extend to rock the sleeper in the ballast. This plan failed. Another device used to some considerable extent in the United States, the rails for which were manufactured in England, consisted in splitting the rails longitudinally for the whole of their length, in placing the joints of one-half, say the right half, midway between the joints of the left hand half, or to use a bricklayers' phrase "breaking joint." This scheme had to be given up, for it involved making that which might, looking at the weight of metal, have been one strong rail, into two weak ones, which failed. Now this being the condition of things prior to the date of the fish patent, and "fishing" itself being as old as anything probably well could be, let us see what the fish patent was. In the ordinary section of rail the joint chair is wholly done away with, and the joint is over a void. This, perhaps, may not now strike you, who observe this construction every day of your lives upon railways, as anything extraordinary; but I can tell you that the idea of putting a joint over a void was most repugnant to the engineering mind, which said, "What! have the very end of the rail, the joint, unsupported? The suggestion is sheer madness; anybody must know that of all the parts you ought to support, the rail end is the one," and so everybody thought for twenty-five years, and so some persons unhappily think to the present day, for they absolutely combine a joint chair with a fish. But what are the facts. We know that the end of the rail is the most vulnerable part, and that with the old joint it yielded so as to spread out side-ways; it did so, because it had the chair taking the place of an anvil below it, and in this way the blows that were given to it by the advancing wheels were effective. But once put the rail end off the anvil, and over a void, and the blows became harmless. The consequence is, that by the introduction of this mode of jointing with a suspended fish-joint, the ends of the rails are preserved from the damage under which they formerly suffered; moreover, there is no joint sleeper to be rocked, and that great source of derangement to permanent way is got rid of. Leaving on one side the comfort to the traveller, I am not exaggerating, when I say that the superiority of the fish-joint as compared with any joint in previous use, has a money value in this kingdom alone, in the greater endurance of rails, wheels, and permanent way, and in the power to carry heavier and quicker traffic, that must be measured by hundreds of thousands per annum, if not by millions, and yet this is the invention for which Mr. Lloyd says a patent never ought to have been granted. I have already commented on the assertion made by the opponents of patents, that really in nine cases out of every ten there is no invention; but as soon as a necessity arises, the means of satisfying that necessity will occur to any dozen men of ordinary ability. But is not this fish-joint instance a strong proof to the contrary; here, according to the opponents, there is no invention at all. They say the fish existed already

everybody knew it, and yet I have shown you nobody improved the joints of rails by its use. It cannot be urged this was because no one was devoting his mind to the question of rail-joints. Many men were doing so. I have given you three instances of the way in which they endeavoured to cure the evil, not one of them succeeded. The fish was there to their hands, but no one applied it to rail-joints until there came Wm. Bridges Adams, a carriage builder, not a civil engineer, and the carriage builder did apply it, and he told the engineers that they were wrong to support the joint, and that the joint ought to be over a void; and what happened then? The engineers did not believe it, and they said it was all nonsense; they disputed the carriage builder's opinion, and it was not until a civil engineer, who is now dead, became interested in the patent, and devoted himself to getting the thing at work upon the railways that the joint came into use; at present its adoption is all but universal. Now, with whom do you agree—with Mr. Lloyd or with myself? Was this a case for a patent, or was it really one of those idle things which any man could have done? As I have said, Mr. Lloyd's conversion does not appear to be by any means complete. He seems to entertain very curious opinions as to the kind of inventions for which patents should be granted, in fact, opinions so curious that they appear to amount to a prohibition of patents grants at all. In the first place if I follow his arguments correctly, he would never give any patent for an improvement, and in the second place he never would give one for an original invention which may be afterwards superseded by an improvement; but when he has excluded these two classes of invention I don't see what remains. He challenged me to say who invented the electric telegraph, and who invented steam propulsion, implying that the persons who had got patents for those matters had got them wrongfully, because the patents ought to have gone to the undiscoverable original inventor. With respect to the electric telegraph, I have already told you what happened in the case of Ronalds, who had no patent; he failed to bring the telegraph into the practical form which was useful to the public. Wheatstone and Cooke did bring it into that form. But, as I understand Mr. Lloyd in his view, if anyone should have had the patent at all it would not be Wheatstone, but Ronalds. But the next phase of Mr. Lloyd's argument would have forbidden the patent to Ronalds. What did Mr. Lloyd say about Dr. Siemens' Regenerative Furnace when considering that as a patent invention? Why he said that, clever as it was, it was a thing that was about to be superseded by something better, and implied, as I understood him, that therefore it was not worthy of the patent protection which it had enjoyed. I do not agree with Mr. Lloyd that it is going to be superseded; I believe there is ample room in the world both for it and for the extremely ingenious and meritorious invention which Mr. Lloyd alluded as likely to supersede it. But, why if it were true it was about to be superseded, should not the inventor of such a furnace have reaped some of the benefit which during many years it has bestowed upon all sorts of industries and during which years the alleged superior invention had no existence? I may tell Mr. Lloyd that in conversation with the inventor of this second furnace only last Tuesday week, when we were considering this question of the Patent-law, the inventor said to me "Do you think that I should have devoted six years of my time and very many thousands of pounds to perfecting my invention if I had not had the protection of a patent," and on Wednesday last that gentlemen (Mr. Crampton) came here and repeated the statement before the meeting. In the same way with respect to the invention of Dr. Potts (that Mr. Lloyd thought had never been practically employed, in which, however, he was mistaken, as almost every engineer knows), according to Mr. Lloyd, Dr. Potts ought not to have a patent because his plan has been superseded. I am really at a loss to see to whom Mr. Lloyd would give a patent. Not to the inventor, because at some future time his plan may be superseded. Not to the improver, because he is only the improver, and not the first inventor. There is another proof of the very bad way in which the converter of Mr. Lloyd has done his work. Mr. Lloyd told us a man may reward himself by becoming the maker of his own invention, and he says if Crompton had not thought so why didn't he take out a patent for his mule? I will tell Mr. Lloyd why Crompton did not take out a patent. In the year 1780 when Crompton invented his spinning mule, he was but a young man, living in the then small market town of Bolton, and working as a journeyman weaver. We are asked why a man in this situation did not journey to London, which probably he must have done on foot, and at the end of his journey find £300 to pay the then cost of a patent for the United Kingdom. Was it not more natural for Crompton, being in such a position of life, and having his limited knowledge of the world, to endeavour to protect himself by a secret manufacture; and I need not tell Mr. Lloyd, as a lawyer, that when Crompton had once sold the produce of his manufacture, although the produce might have been made in secret, his patent if subsequently taken out would have been in great peril. Mr. Lloyd admits that secret manufacture is demoralising, but it is not every opponent who does so. Since I wrote my paper I have read Mr. Macfie's book, and I find that I am supported by the book in one of my objection to secret manufacture, namely that the workmen would be tempted away. What says Mr. Macfie? (at pages 62 and 63). "Th[at] the patent system has an effect on wages, which deman[ds] the serious consideration of the friends of working me[n] I believe it helps to keep wages low. The aboliti[on] would work in this manner—whenever in any establis[h]ment an improvement is introduced, the fact of its [use] becomes of course speedily known throughout the establis[h]ment and in other establishments. The employés, who [in] their ordinary occupations must come to know what [the] improvement is, and how to work according to it; for t[his] is a matter of necessity, especially now that the operati[ons] are conducted on large scale with the indispensa[ble] aid of men intelligent and independent very soon find t[hey] are in request. To prevent their leaving, they are offe[red] an advance, which itself, in its turn, may be outbid." [I] am glad that in this respect Mr. Lloyd does not ag[ree] with Mr. Macfie, and that he does not consider th[is a] desirable state of things. Mr. Lloyd says that in [my] ingenuity I have imagined inventors of a most unlik[ely] character as the producers of substantive inventions, [and] that I have done so in order to show how difficult it wo[uld] be for such men to become prosperous manufacturers. [He] accuses me of having created a "fanciful country pars[on]" for the illustration of my argument. It is true I s[elected] the case of a parson, but I do not do so in general ter[ms]. I identify him as Cartwright, the inventor of the po[wer] loom. Is that a creation of fancy? I will give ano[ther] instance of a parson—Bell, the inventor of the rea[ping] machine; he was a Scotch minister. I will now s[ay a] few words about the incentive to invention to be cre[ated] by national reward, because to my mind anyone (ex[cept] Mr. Macfie) who once admits that some reward is t[o be] given to the inventor over and above that which he [can] obtain from manufacture, will eventually find hin[self] driven to admit the expediency of a Patent-law. [Mr.] Lloyd, I believe, says that he would give some rew[ard], but does not see how to do it, except by the grant [of a] patent. Lord Derby (see Mr. Macfie's book), alth[ough] he would not grant a patent, still thinks that som[e re]ward should be given, but confesses that he cannot [see his] way of how to carry it out. Sir William Armstrong [(in] the same work) says he believes reward should be g[iven], but he is not prepared to state by what means the g[rant] of rewards could be carried into execution; and [I am] convinced, as I have said in my paper, that any [such] scheme must break down in practice; and it is or

ground I venture to predict that those who admit reward necessary, will find themselves compelled to preserve a patent right, except in one instance (I must always except Mr. Macfie). He sees no difficulty. Those obstacles which were too much to be solved by the minds of Lord Derby, of Sir William Armstrong, or of Mr. Lloyd, have no terrors for Mr. Macfie. Read from page 84 to page 88 of his book, and you will find the whole thing cut and dried. There is to be £200,000 per annum set apart for the purpose of the rewards and of the attendant expenses. He calculated that £125,000 will suffice for the rewards; there is to be in each year one great prize of £10,000, and then the value of each prize dwindles down, and their number increase until one gets to a class where there are as many as 400 prizes, but only of £50 each; and after this we come to "honour" medals and certificates. These prizes, including the honour, which I am surprised to see Mr. Macfie put last, as being of less value that £50, while he gives the front rank to the £10,000, are however only to be awarded after the invention has been tried and proved practically successful, which, according to my view, might be any time or never, as it would be nobody's interest to take it up. Moreover, the prize is not to be without cost or trouble, because by clause 11, where there are rival claimants, the question of deciding priority in respect of time and merit is to be borne by the disputants. I should think that the balance out of the £50 reward would, under such circumstances, be rather small. Mr. Lloyd has accused me of assuming a lofty air in this matter, but at the risk of a repetition of the accusation on some other occasion, for it cannot be made to-night, I must again say, that any person who puts forward such a proposition as this which Mr. Macfie has advanced is fairly open to the charge of not having made himself acquainted with master of his subject. One prize of £10,000. What does he suppose Bessemer spent before he made a ton of metal that was commercially valuable? What does he suppose Dr. Siemens spent before his furnace was in practice? Why such an amount as £10,000, so far from being an adequate reward, would not pay the expenses of developing a large invention. And remember that it is only when the invention is developed Mr. Macfie would give his prize (apparently he sees the difficulty of awarding for inventions that are untried), and he would ask you to believe that a Bessemer or a Siemens would go to work, spend his thousands and his valuable time to perfect an invention which, when finished, would be open to the whole world, and would do all this to stand the chance of getting a sum that would not cover his expenses. With respect to patent litigation, quoting from the appendix to the report of the committee of 1871, I told you that the average of cases which had reached a primary decision in patent matters was only 8¼ per annum. Since the paper was read a friend of mine, a solicitor, has caused the *Times* to be searched from the 1st of November, 1873, to the 31st of October in this year, and he finds that during that twelve months there are nine patent cases reported. Now, as I have said, that is an extremely small amount of litigation, looking at the enormous interests involved. But still that litigation, small as it is, is necessarily the part of the patent question which is most strongly before the legal mind. In the patent system, as in other matters, lawyers see humanity at its worst. All the dispute, trouble, and litigation they see; the large majority of instances in which things go on quietly and smoothly they do not see; necessarily they are induced to take a gloomy view of the working of society. During the twelve months, in which there have been the nine patent cases, how many actions have there been, does one suppose, on bills of exchange, or against railway companies? The number of such cases has, doubtless, been very large, but persons know that bills of exchange, and railway companies must continue. Nobody ever suggests they should be got rid of, and yet as the very principle of patents has been for many years in dispute, those to whose attention patent actions have been brought do not look upon them in the manner in which they would look upon actions in other matters, as being part of the prices to be paid for a great benefit, but as something which proves the whole system to be so radically wrong, that it should be swept away. If this line of reasoning were to be followed, what is there that might not be swept away? My friend, the solicitor, must have had some curious speculations in his mind as to how far such sweeping measures might extend, for he told his clerk to extract from the same folio of the *Times* the number of reported actions for breach of promise of marriage; these amounted to forty-four, while the patent cases, as I have said, reached only to nine. Looking at the fact that the lawyer, of necessity, sees humanity at its worst, I am very glad indeed to find that men of high position at the bar, like Mr. Fitzjames Stephen, Mr. Hinde Palmer, Mr. Aston, and Mr. Webster, come here and advocated the continuance of patents, because if a man who sees a thing at its worst, still believes it is worth continuing, I have every right to claim his evidence in my favour, while it would not be at all unfair for me, if he were an opponent (as I am afraid my friend Mr. Lloyd still is in his secret heart), to say "I don't value your opinion in opposition as much as I should do that of a man who saw the bright side of the question as well as the dark one." Not only do lawyers see the dark side of the patent question, but that dark side is particularly repugnant to them. There are a sufficient number of shipping cases, of railway cases, and of a variety of other cases to enable men of eminence at the Bar to make some one class a speciality, and you find barristers who are at the front of their profession celebrated for their command of some particular branch of practice, but the very paucity of the patent litigation prevents there being more than one or two leaders who have a reputation for patent business. The juniors, who advise on specifications and matters of that kind do find constant employment, but in the case of a leader this is not so; and as in every instance litigants naturally wish their cause to be advocated by some celebrated man, they are compelled generally to select as their leader one to whom a patent case is an unusual event, and who therefore approaches it with the same sort of difficulty with which a barrister who is principally familiar with shipping cases would approach the grappling with a case upon Ritualism to be heard before the Privy Council. I do not for one moment mean to say that the leader who is taken out of his usual line of business cannot deal with the patent case, but I say that he does not like it. I believe, however, that my comparison of the shipping case and the Ritualistic case is not even strong enough to apply to the patent question. The shipping and the Ritualistic case may be both learnt from books, and without for one moment undervaluing the importance of either class of case, there is nothing but argument involved in them, such arguments as a highly trained mind delights in. There is very little sheer drudgery, but with a patent action this is not so, for in them the barrister is called upon to make himself familiar with the details of some machine or of some process. Now I know many men of very great ability, who are capable of expressing an opinion of the highest value on matters political, social, and even artistic, who, when you ask them to investigate the construction of a machine in order that they may appreciate its merits, appear to be absolutely helpless, and who give way to despair when brought face to face with mechanical intricacies. It may be that the next generation, who will have profited by the more scientific training that is now being given at our universities, will not find themselves in so great a difficulty; but the men of the present day, educated thirty or forty years ago at Eton and at Oxford, notwithstanding their acquaintance with classical literature, and it may be even with mathematics, had rarely

any training in physical science, and had none in science as applied to manufacture, and to most such men the very documents that we mechanical engineers use to express our meanings one to another, namely, diagrams drawn in geometrical elevation, are absolutely unintelligible. The untrained eye abhors a geometrical drawing, and requires perspective, while the trained man rejects the perspective as wholly useless, because he cannot gather dimensions from it. It is true that any member of the Bar, or any country gentleman, recognises an architect's geometrical elevation of a mansion, but he does so because he is constantly seeing houses and mansions, and very frequently so far as the houses in a street are concerned he gets only a front view, and there is nothing in it to be very suggestive of perspective. Moreover, the architect takes care to put some colour on his drawing, and the blue tint of the glass in the windows, the red of the brickwork, the yellow of the stone, and the smoke out of the chimney-pots all proclaim, even in the absence of perspective, "this is a house." But give nine of such men out of ten a drawing, not of the familiar house, but of some entirely unknown machine—a drawing, moreover, without colour or shading as well as perspective, and the probability is that they will frequently confound the spaces between levers for the levers themselves, and that the whole thing will be to them a puzzle as great as Egyptian hieroglyphics would be to mechanics. One can well understand how it is that a man in high position, accustomed to grasp with facility the most complex problems in social life and in law is annoyed at finding himself met on the very threshold of a patent case with difficulties of the nature I have described. I will ask you to let me give you one case in point. The late Sir John Rolt, when he was at the Bar, had to lead in a patent case about a spinning mule, and it fell to my lot to endeavour to explain, not by drawings, for that was hopeless, but by the most expensive models, the spinning mule about which he had to address the Court. I happened to reach the room where the model was before Sir John Rolt arrived, and when he opened the door and saw the model, which was rather a large one, and before he saw that any one was in the room, he uttered, in the most dismal manner, these words, "Good Lord! how am I to understand all this?" Sir John was a most patient pupil, and many and many a weary hour did he devote with me to the understanding of this machine, and on the morning when he was going into court he said, "If after all your care I fail in describing this, as I certainly shall, don't laugh at me, but think what your position would be if you had to go and argue a question of contingent remainder." Now here you have an instance of a man among the very highest in his profession, of a most acute mind, who had honestly and laboriously endeavoured in the interest of his client to impress upon that mind matters which to a mechanical engineer were as well known as the rudiments of the law were to the counsel, who even at the last moment doubted how far he had succeeded in his endeavours to master a subject which he had to explain to a judge, and, if the action had been at common law, to a jury also, and this judge labouring under a similar inaptitude to that under which the counsel labours, has to gather the gist of the invention from a man who is not even sure from one moment to another whether he can remember the lesson he has so painfully learned. Is it to be wondered at that under these circumstances patent cases are viewed with dislike by the judges as well as by the Bar, and that although these cases as you have seen only amount to nine (carried to a primary decision), in one year, they create a feeling of dislike; and is it strange that this feeling should, all unknowingly, bias the opinion of such men as I have mentioned and make them adverse from patents as a whole. I shall have to revert to this point when considering the improvement of the law. Mr. Lloyd and Mr. Samuelson both appeared to think I regard too lightly Holland and Switzerland, and Mr. Lloyd complains of me for quoting Lord

Houghton's summary mode of disposing of Swiss pr
tentions to originality. I am told that in Switzerlan
there are meritorious manufactures; I was already awa
of it, but that does not affect my position. My argume
is that the extinction of a Patent-law would check inve
tion in the country in which that extinction had tak
place, and although I am told there are meritori
manufactures in Switzerland, I have not been told t
there is invention, nor has anyone said that there
any invention in Holland, but Mr. Samuelson sugg
the sugar refiner in Holland might manufacture
burdened with patent dues and thus compete success
with the sugar refiner in England. It may be
isolated cases of this kind can be found, but the
question is what is the balance of advantage, bec
that is really the thing to look to. Further let me
out this to you, that small States can behave in a ma
which may be for their own immediate advantage
for the disadvantage of their neighbours, while
conduct could not be pursued by more important
tries. Let me give you an illustration. Suppose t
men live in a London square, and they have separatel
each say £10 a year to keep up the central inclos
trees and flowers. A house becomes vacant, an
into the hands of a churl, who examines his leas
finds that, by some curious oversight, although
are conferred upon him of entering the enclosure
times, no obligation is cast upon him to contri
keep it up. Such a man as that may, if he is n
vented by shame, refuse to pay his subscriptio
other nineteen householders would say "You
shabby fellow, but we are not going to deprive o
of the enjoyments of the garden because you fail
your share. We must put up with your conduct
garden would still be kept up, and this man wo
his paltry advantage. But suppose ten houses
the twenty were let in a lump to a churl, who
power of refusing that either he or his tenant
subscribe to the maintenance of the garden.
would happen then? Would the other ten ke
I think we may be quite sure they would not;
whole thing would go to wreck, to the los
churl as well as of the ten men who were willin
their share. And so it is with the Patent
State like Holland, with its two millions of
ants, may abrogate the law, and inventors w
on inventing for the benefit of such countries
land, the United States, and France; but let o
countries be unwise enough to forego protection
tion, in such a case I undertake to say that inven
receive a shock which would arrest its develop
Samuelson put forward supposititious instance
an English manufacturer might be at disadva
one living in a country where there is no P
but did not Mr. Aston give, not a suppositio
actual instance of a most striking kind, whe
clusively showed that it was due to a Pate
to a Patent-law only, that an English manuf
enabled to hold his own against his Swiss ri
Mr. Aston's reply, there is no need for me to
subject, but I cannot refrain from asking wh
question were thoroughly investigated, it w
found that the false notions of political eco
prevail with so many of our workmen we
of the burden under which our manufactu
and not the fact of their having to compete
country which had not a Patent-law. I am
to the combinations among workmen to inc
Those appear to me to be perfectly justifiab
alluding to those combinations which have fo
to decrease the work done, and to put ar
equality one with another, not by raising
and the unskilful man to a level of producti
upon that of the industrious and the dexte
bringing these latter down to the level o
Mr. Samuelson told you I ought to have
Patent-law of Germany was a law only

thought that I had done so, not indeed by classing Germany among those countries which have no Patent-laws, for that would not have been correct, but I told you that the law was so bad that one effect of it had been to drive Dr. Siemens away from his own country, where he could get no protection for his inventions, and to bring him to reside among us. England, at all events, in this instance, has nothing to complain of. The Queen has obtained an illustrious subject, while English engineers and men of science of this country rejoice in the accession to their ranks of one who commands not only their esteem but their warmest affection. Although, perhaps, it might come more properly in that part of my reply where I speak upon the amendment of the law, I think, on the whole, it will be better to give you here an instance of the folly, for I can use no other word, of those who in Germany have the conduct of the Patent-law. I explained to you the other night the nature of Dr. Siemens' Regenerative Furnace, of which a drawing hangs upon the wall, and you remember I told you the way in which he trapped the outgoing heat and stored it up to be utilised again, was by passing it through a mass of cellular brickwork, which having both a great specific heat and also the power of resisting high temperatures, is eminently qualified for the purpose Dr. Siemens had in view. The Examiners in Prussia refused Dr. Siemens a patent for his Regenerative Furnace on the ground of want of novelty, and they were good enough to give the way in which this furnace had been anticipated. They refused Dr. Siemens' patent for his Regenerative Furnace on the ground that in the houses of the knights who returned from the Crusades ovens were to be found lined with stones, which had absorbed heat from a fire and then gave out that heat to whatever had to be cooked, and thus, according to their view, had Dr. Siemens' Regenerative Furnace been anticipated. I will now say a few words upon the other branch of the subject which has been discussed. The Amendments of the Law, or rather, as Mr. Samuelson tells us, the Amendment of the way in which the existing Law is carried out. I will ask you to refer to an article in the papers for Sessions 1865 and 1866 of the National Association for the Promotion of Social Science, beginning at page [illegible] of the volume for those years, headed, "Report of the Sub-Committee on the Patent-laws." Of this committee I was, as I have said, by no means an idle member, and the result of our deliberations are to be found in that report. I will state to you, with the greatest possible brevity, some of the leading recommendations, and I think, when you hear them, you will agree that nearly everything which has since been demanded or suggested is embodied in the recommendations of that committee. With respect to the granting of patents this was only to be done after an examination for novelty and not for utility; and I shall have to say a few words upon that point before I close. If the opinion of the examining-officer were adverse to the novelty of the invention, the applicant, nevertheless, if he insisted, was to have his patent, but subject to the following conditions—that the adverse report should be recorded and printed with the specification; that in any proceedings, either for or against the patent, the patentee should give security for costs, and that in the case of his being defeated in an action upon the ground stated in the adverse report, he should pay every shilling of his opponents' costs as between attorney and client. We also gave an appeal from the examining-officer. We then made certain provisions about disclaimer. Next we considered the point which, in my judgment—and I am glad to find it is confirmed by the observations of Mr. Aston and of Mr. Imray—is the most important of all the points in which improvement may be made, I mean the securing a clear, definite, intelligible specification, a specification which shall be not only a guide, but a warning. You will find that according to our regulation the patentee was to be called upon to make the final specification clear and intelligible, and on his failing to do so, the adverse opinion of the Examiner was to be printed with the specification. With such provisions did we hedge round the granting of a patent. But you will see that we did not propose any examination as to utility. This question was the subject of discussion during many of our meetings. But we came, at last, to the unanimous conclusion that any such examination was likely to produce more harm than good, and it is upon that I shall shortly address you. The examination for novelty, when pursued in a sensible and proper spirit, is one which may perhaps (for I am compelled to speak doubtingly) be safely entrusted to competent men. But the question of utility is a far wider and more difficult one. I gave you an instance of this in the case of Dr. Potts, when in my paper I supposed a Board of Examiners at work to ascertain to what untried invention shares in the national reward should be given, and I suggested that such men would be very likely in the case of Dr. Potts to deem his invention altogether impracticable, because they would say his proposition of sinking a hollow pile by exhausting the air from it was an absurd one, as it was only a roundabout way of putting upon the head of the pile the slight load equal to the pressure of the atmosphere. But these men, as I told you, would have been wrong, and yet in the case of an examination as to utility such a patent might readily have been refused by very able men too confident in their own opinion. Suppose, however, the Examiners had been right and Dr. Potts wrong. What would have been the harm to the public in granting him his patent for this useless thing? I will repeat the truism to which I gave utterance in my paper, that if a thing be useless, nobody wants to use it; it stands in nobody's way, and the only harm done is the loss of the time and money of the inventor. But don't let us for the sake of protecting one inventor against himself by the exaggerated Paternal Government style of treatment, cause the public to lose the benefit of an invention being brought into practical use, which that inventor feels to be a sound one, although he may not be able to explain the grounds upon which his invention would act. For, with all due deference to Mr. Lloyd's law, I believe there is no obligation on an inventor to explain the principles of action, all he is bound to do is to describe how to carry out his invention. Further, on this question of examination, I have very great fear of it even in respect to novelty; and to show the danger attendant upon examination, as well for novelty as for utility, I will take one of the highest cases I can think of—the case of James Watt. I believe that a large number of educated men in England, not engineers, are under the impression that James Watt was the inventor of the steam-engine, and many who know better still think that before his time no powerful mind had been directed to the subject. But this was not so. Newcomen had brought the steam-engine to the condition of an automatic machine that could be depended on for exerting great force in pumping, and Smeaton had devoted himself to perfecting Newcomen's engine. The readers of Smeaton's works and of the Transactions of the Royal Society well know that Smeaton possessed one of the most powerful minds we have ever had in England, and that his celebrated engine at the Chase-water mine was a triumph of mechanical skill. Now let us see of what that engine consisted, and to aid us in this, be good enough while following me to look at the rough drawings I have placed on the wall. Before the time of Watt we had the boiler generating steam, we had the cylinder, with the piston in it, moved up partly by the steam, at a feeble pressure, but principally by the counterweight of the pump work in the mine: the piston having completed its stroke, the steam was shut off by self-acting machinery, and no longer by the act of the attendant; we had similar machinery effecting the injection of water into the cylinder. The steam was condensed in the cylinder, a partial vacuum was made, the atmospheric pressure forced down the piston, which de-

pressed its end of the beam, and in doing so raised the other end with the pump rods and pumped the water. Now that was the condition in which Watt found the steam-engine. Let us see what it was that he did. He simply added a separate vessel called the "condenser," which, when the piston had got to the top of its strokes, was put into connection with the under side of the cylinder. The injection of water was then made into this separate vessel and not into the cylinder itself. The vacuum was created and the piston descended. Steam was re-admitted, the piston ascended and an ordinary pump drew out of the condenser the condensed steam and condensing water which had accumulated in it from the previous operation, so that the condenser was ready to receive another cylinder full of steam. Now this invention immediately reduced the consumption of fuel by one-half, but imagine James Watt going before examiners for his patent. It is difficult for us to believe now, with the reverence that we all have for Watt's name—the public at large because they believe him to be the inventor of the steam-engine; the engineer because he knows the value of Watt's improvement—that his patent would have been refused. But is it so sure that it would not have been both on the ground of want of novelty and on that of inutility? On the score of novelty, they would have said, "Why you have the boiler, the cylinder, the piston, the valves for admission and outlet precisely as they were before. You use a pump for pumping out the water of condensation, but the pump is but an ordinary pump. The task of Smeaton's engine was to work a pump, and, moreover, he had on his engine a special pump to raise water to the injection tank. You use injection of water to condense your steam; what is there that is new in this engine of yours except a trumpery suggestion that, instead of doing the whole operation in a single vessel, the cylinder, you will complicate the engine to give a gloss of invention by the introduction of a supplementary vessel?" I really do not think I am exaggerating in saying that this would have been the comment of intelligent men in Watt's days if they had had the power of determining whether the invention were novel. And as to its utility, would they not have said, "Why you are doing the very same things as were done by Smeaton, and you are simply doing them, as we have told you, by two vessels instead of one. What can be the advantage in that?" Perhaps you will tell me. Watt might have answered these objections by saying, "Look at the engine which I have altered; it does its work with half the coals? And is that nothing?" But recollect that he would have wanted the protection of a patent before he dare run the risk of discovery while experimenting with the engine. I am convinced I have not overstated this case, and should it not make us pause before we determine upon instituting examinations which, in the anxiety of the Examiners to do what they conceive to be their primary duty, videlicet? Protecting the public against a non-useful patent might end in withholding from a benefactor like Watt the protection that made it worth his while to develope his invention. Is there any pressing need which calls upon us to run such a risk? Suppose it had been the truth that there had been no value in condensation in a separate vessel? Well, then, the fire-engine, in its unpatented condition, would have been as good as Watt's patented engine. Nobody would have cared to have tried Watt's engine, and no one would have been impeded from making the unpatented one. I will give you another and a most instructive instance —an instance drawn from one of Watt's inventions, and directed solely against an examination for utility. I allude to the steam jacket. All those years ago, Watt, under the direction of that which appears to have been a marvellous instinct, said that in order to make an engine work well, the working cylinder ought to be surrounded, not merely with a non-conducting material, because that anybody might have thought of, but with a jacket containing steam, and then that outside this jacket, but not without the jacket, a clothing of n conducting material should be used. Such jackets w supplied by Watt, but after his time they fell into use, except in Cornwall, the steam-engines of wh county were for so many years superior in t economic performances to those of any other par England. The results obtained by the Cornishmen w so good that other engineers were compelled to give t meed of admiration. But they all of them derided steam jacket, and said, "Manifestly this must be wr You are increasing the surface that is exposed to cooling influence of the air, and it is this influence does all the harm. Thus the jacket must be worse useless." And these were not mere unedu mechanics who said so. The most scientific write had on the steam-engine, Tredgold, whose work, eve the present day, is a text-book, fell into this error, said that the jacket was simply a source of incre condensation, and was worse than useless. Would Ja Watt have had any chance under an examination the merit of a patent of obtaining one for his s jacket? clearly not. Every practical engineer and s scientific man of his day, and for half a century a wards, would have said that this was one of the delu of an otherwise great mind, and yet Watt was r We not only now know, thanks to a French engi the principle on which the benefit from a steam j arises, but we know that those wonderful result economy of fuel which have saved ocean navig commercially, which have within the last twelve y reduced the consumption of coal from 5 lbs. per indi horse-power per hour down to 2 lbs., or even less, ca be attained without the use of the steam jacket. I I have given you sufficient reasons why there sh on no account be an examination for utility. As I said, it is just possible that an examination for no may be of service. This meeting, however, has had strong evidence to the contrary. Mr. Wood, w long connection with the English Patent-office re him a good judge, is of opinion that the American sy is an utter failure. Mr. Smith, who has also had experience, fully confirms this view, and I shoul inclined to pause before we committed ourselves t examination even for novelty. In the first plac don't want it nearly as much as is commonly supp There is already an examination for novelty—no official one, I admit, but one actually made by inten patentees. You have been told by Mr. Aston number of patents which are taken out, the numb which the third years' duty is paid, and the numbe which the seventh years' duty is paid, but he ha given you another set of numbers, which I think a at least equal significance, and that is the diffe between the number of patents applied for and number finally obtained. This difference as stat Mr. Cole to-night amounted to as many as 1,39 1873, or practically 40 per cent. of all the patents were granted and 32 per cent. of all that were applie Now these numbers represent almost entirely the r of the investigation into novelty carried on by th tending patentees, that is to say, they get their provis protection, and between that and the time when th compels them either to give up that protection or to plete their patents, they discover that their sugg invention was not new, or else that it is not useful. such an examination for novelty as this is, so far goes, a perfectly safe one in the interests of the pate but there is always great danger that unless you hav very best men—not pettifogging men but men of l and comprehensive minds—an examination for no may be made the means of discouraging most inge and valuable inventions. An instance of that was the other night in relation to no less a manufacture the Bessemer steel process. I told you in the early of the evening that I should have to revert to Giffard Injector. Now the Giffard Injector is a ma by which a current of steam, issuing from the b

with the enormous rapidity due to its pressure above the atmosphere, is brought into contact with water, in which it induces a current of so great a velocity that the water, and the steam which that water has condensed, unite together into a jet powerful enough to penetrate the very boiler from which the steam had issued against a pressure, such as is used in locomotives, of 100, or 140 lbs. on the square inch. Now can you imagine an Examiner for novelty saying, "This instrument works by an induced current. An induced current is old. You cannot pass at the foot of a waterfall without finding that the descending water has induced a current of air. Moreover, forge-fires in Spain and elsewhere have been blown by currents of air induced by falling streams of water. Further, every fire on a locomotive is urged by a current of air induced in the chimney by the waste steam blast. Therefore induced currents are old, and this machine of yours, being based upon an induced current, is wanting in novelty;" and remember, in doing this, the Examiner would not be doing anything nearly as outrageous as that which the German Examiner did in respect of the regenerative furnace. I will tell you plainly that I am afraid of an inferior class of Examiner who, in his desire to do his duty, might be tempted to try, by reducing everything to its elements, to go, so to speak, to the very alphabet of things. It is common to hear in a court of law in a patent action, the counsel for the defendant say to the jury when deprecating novelty, "What was there in the invention? Let us analyse the machine," and he does so, and shows that it is made up of certain levers and wheels, and then he says to the jury, "You have heard me ask the plaintiff whether he pretended to be the inventor of a lever, and he told me that he did not, or of a cog-wheel, and he admitted that was old." And so the counsel goes on, and having clearly established the fact that all the parts of the machine are old, he appeals triumphantly to the jury to find a verdict in favour of his client. I am glad to say that the jury very seldom do anything of the kind. They do not as a rule, suffer themselves to be led away by the sophistry of counsel, however ingenious it may be, but having heard of all the pains and labour which the inventor had bestowed on bringing his invention to perfection, they feel an honest sympathy with him and look at the merits of the invention as a whole. But, although this is so with a jury who are trying, be it remembered, an action relating to an invention that is in practical use, and has been infringed, I am afraid that in the case of an Examiner considering the novelty of an untried invention, we should have to encounter that which I call the "alphabet spirit," by which I mean that if there were an Examiner upon a question of copyright, he might—on the same principle that I fear will govern many Examiners in determining upon the novelty of an invention, the setting too high a value upon old elements—be betrayed into saying that there was no ground for a copyright in "Paradise Lost," because in the whole book he had not found a single letter that was not in the alphabet. Remember the account Sterne gives us of certain classes of critics. "And what of this new book the whole world makes such a rout about? O! tis out of all plumb, my Lord, quite an irregular thing! not one of the angles at the four corners was a right angle. I had my rule and compasses, &c., my Lord, in my pocket—Excellent critic." Just one other matter before I part from this subject of refusal of patents for want of novelty. You may remember that I base my whole advocacy of patents upon the broad and sure if not elevated ground of expediency, and not upon consideration founded on the supposed rights of inventors. Viewing the matter in this light I am strongly inclined to believe that, paradoxical as it may seem, there are perhaps special circumstances under which it would be expedient in the interests of the public to grant a patent for that which was not new, and I think the readiest way of putting before you what I have in my mind, will be to state the particulars of a case that actually occurred. When you have heard it I believe but few, if any, words will be wanted to make its general application. The case is this. Some three or four years ago there was an action in respect of the infringement of a patent for a multiple furrow plough; the infringement was clear, the defendant having made so servile a copy, that without the closest inspection no one in court could destinguish between the model of the defendant's infringement and that of the plaintiff's invention, further the defendant being so servile an imitator it was idle for him to put forward "want of utility." His substantial defence was "want of novelty." After having searched through the copies of prior specifications, the defendant, however, could rake together nothing that would materially help him, for although there were plenty of multiple furrow ploughs to be found, not one of them possessed the peculiar features which made the plaintiff's invention a success. At the very last moment, however, the defendants put forward an anticipation of the patent by a publication to be found in a book published more than 130 years before the date of the plaintiff's patent. The book turned out to be a very rare one, but the plaintiff's solicitors succeeded in finding a copy at the British Museum; on examining that book the plaintiff found in it a description of a multiple furrow plough, which, although it did not anticipate his invention, went quite as near doing so as did any of the prior specifications that had been examined. Having stated these facts, I will now give you their very obvious application. Suppose that book of 1732 had contained the description of the plaintiff's very plough; the book as I have told you was a very rare one not to be found in the scanty libraries of farmers and of agricultural implement makers; but should a tribunal to examine into the novelty of alleged invention be established, the men who may be appointed to it will no doubt endeavour to inform themselves as far as possible of everything that may bear upon the subjects that will come before them, and an official who investigated any matter even to its remote antiquity might possibly in his researches come across this all but buried book. According to the present law such an Examiner must tell the applicant, the inventor of the improved plough, "You cannot have your patent, your plough is not new, for although neither you nor perhaps any other engineer or farmer is aware of it, there is a book more than 130 years old in the British Museum which contains a full description of your very invention." The applicant would find there was nothing left for it but to withdraw his petition for protection. As a natural consequence he would give the whole thing up, for it would no longer be worth his while to push his supposed invention, and the public would remain without the plough because the re-inventor was left without a patent. It does seem to me, that it is not expedient in the interests of the public that the matter should terminate in this fashion. I admit the difficulties that surround the question, difficulties so great that they may even turn out to be insuperable, but in any revision of the law I do trust that earnest consideration will be given to the question, whether it is not possible, and whether it would not be in the interest of the public, that some means should be devised by which a patent might be granted to an inventor (in fact, so far as all practical anticipation went) although it might turn out he was only an useful awakener of that which was idly dormant. I will now revert to the further recommendations of the Committee in 1866. Having as I have told you provided means for improving the obtaining of patents, they then turned their attention to the mode in which the patentee should exercise his right, and considered whether he ought to be under compulsion as regards the granting of licenses. Again after most anxious deliberation they came to the conclusion (although they were possessed with the strongest feeling against interference

with property in a patent), that it would be expedient in the general interest that a patentee should be bound to grant licenses. With respect to the granting of licenses the terms, if they could not be agreed on, were to be settled by an officer to be appointed by the Commissioners, and these terms were upon application either of the grantor or the grantee, to be subject every third year to revision. Further that on the application from those manufacturers who may be affected by a patent, the Commissioners should have power on such terms as may be considered right, and with the consent of the patentee, to purchase out of any surplus funds arising from the fees paid for patents, the patentee's invention, with a view to its being thrown open to the public. I still believe that it is expedient there should be as a rule compulsory licenses. But my attention has been called to cases where such licenses clearly ought not be granted. To settle the terms of the license there should be again an effective tribunal, such a tribunal as one would employ for determining the question of sufficiency of the specifications. The duties of such a tribunal would be most onerous. Just consider what they would have to bear in mind. How much better is the process of this patent than the former state of the manufacture? What did it cost the patentee in money and in time to perfect his invention? What bargain was he compelled to make with some manufacturer in the way of reduced royalty in order to get his invention put to work? I especially call your attention to this point because the first impression of some of the members of the Committee was that licenses ought to be granted upon equal terms. Now it is a very common case for a patentee to agree with the manufacturer who first tries the invention for a low royalty. Clearly such a low royalty merely represents so much of the patentee's money spent in perfecting his invention and should not be taken as a guide for a common royalty. Again a large manufacturer may undertake to work under the patented invention, and to produce so many yards or tons of goods per annum. It may well be worth the while of a patentee dealing in this wholesale way to give that manufacturer better terms than he would give to one who enters into no undertaking as to quantity. All such matters must be determined in each case as it arises. Again there are, as I have just said, instances wherein no licenses ought to be compellable. Such instances are rare but they exist. Imagine a man having invented an improvement for utilising some waste material, say hopbine; there is only a very small amount of this product in the world, not more, probably, in England, than one or two manufacturers could deal with. The invention may only be of use as long as the material is cheap, but if several manufactories are established, and there arises a keen competition, then the very object of the invention will be frustrated. When, therefore, a patentee can show that he or one or two licensees are competent to grapple with all the trade that can possibly arise under the invention, then no injustice is done to the general public by refusing to compel the granting of other licenses. On the contrary, the public is benefited, because it is made worth the while of some persons to continue an industry that, if thrown open to all, would not attract the attention of any. If the system of compulsory licenses be adopted, then no further complaint can ever be made that a patentee stops an improver who comes after him. Mr. Hinde Palmer spoke on this point as though I had said in my paper that patentees in these relative positions always agreed; what I really stated was that in nine cases out of ten they did so, and, speaking roundly, I think I am correct. However, in any reform of the Patent-law, it might be well to get rid of this ground of complaint. The next thing to which the Committee of 1866 directed its attention was the trial of patent cases. Their recommendations were briefly these;—that no proceedings should be commenced except upon the certificate of a competent examining officer; that application for such certificate should be founded on a written statement,

specifying the part of the invention alleged to hav
infringed and the manner of such infringment, and
the plaintiff should be bound by this statement in
subsequent proceeding. If the examining officer
that there was no ground for the proceedings, th
tended plaintiff should not be allowed to take those
ceedings, except upon the following conditions:
his statement and the adverse opinion should be
in evidence; that the plaintiff, unless the judge th
proper to relieve him from it, should give securit
costs; and that if the plaintiff were defeated upo
grounds stated in the certificate, he should pay all
in the action of the defendant, as between attorne
client. With respect to the trial itself, it was r
mended that in every case the judge should have a
assessor, and that there should not be a jury unl
the request of both parties. Certain other mino
visions were made. Now I think, with the except
the proposition for International Patent Right, th
embraced in the foregoing report of the Commit
1866 everything that is demanded, and perhaps
than is really required, to free the working
Patent-law from any of the defects under which
alleged at present to labour. In common with C
Strange, and I trust in common with the maj
those present, I was extremely sorry to hear Mr. S
son's suggestion that the persons to whom wer
entrusted the duty of superintending the w
of the Patent-law in future were to
their functions, if not gratuitously, at any
upon the receipt of a very small emol
Now, to my mind, this is entirely wrong. I ha
belief in the efficient execution of gratuitous work.
"great unpaid" has become a term of reproach.
what it is that you want. The Examiners as to
must be men constantly engaged at their work.
must be various grades of these. I presume t
regards such Examiners it is intended, even b
Samuelson, there should be adequate varying sa
but over and above even the highest of these yo
some one man in respect of mechanical inventio
another in respect of chemical invention, men w
not readily be found; men of large experien
doubted character, not crotchety, but of a judicial
The time of such men would be fully occupied, a
to be supposed that persons like these, who, as I
said, are rare to find, and who probably by th
talents that would make them valuable are prosper
their profession, should give up that professio
devote themselves for mere honour, or a small sa
the most arduous duties. These same men would
persons who would examine, as a final appeal, in
sufficiency of the specifications, and they would
the persons to determine, or to preside over a trib
determine, all questions of compulsory license.
over, they would be the officers who would
whether there was a *prima facie* case made out
instituting of a patent action, and they would
assessors with the judge. Now, undoubtedly the
interests involved in the manufactures carried on
patents are, as I have had occasion to say, som
enormous, and evidently it must be for the ben
the whole community that the very best assistan
money could obtain should be procured for the c
out those industries in peace, quiet, and certaint
for determining litigation in respect of patent r
when litigation did arise. No man has a higher
for the Bench than I have, nor is there any one w
a deeper sense of the importance of the duties
devolve upon its members. I bear in mind th
only are all sorts of cases involving property deter
before them, but also that the whole criminal law
to the awful responsibility of trials involving th
of death, depends upon the uprightness and intelli
of our judges. But having all this fully in view,
it as my deliberate conviction that it would be fa
easy to find to-morrow fifteen other Puisne Judg

fectly competent for the duties which would devolve upon them, and whose appointment would give entire satisfaction, than it would be to find the three or four men required for, and capable of fulfilling, the functions we have been considering in relation to the Patent-law; and I am quite sure that in any appointments to be so made a grave mistake will be committed if, both in social position and in emolument, the heads of the Patent Establishment are not placed on a level with the Puisne Judges and Vice-Chancellors. Remember that not one shilling need be taken from the taxes to pay these men. There is now a surplus of £90,000 per annum from patent fees. The opponents of patents say, "If you can't amend the practice of the Patent-law there shall be none at all." You know I do not agree in this, but if they were right this £90,000 per annum would be lost to the country. In any event, therefore, it is in favour of the taxpayer that so much out of this £90,000 as is necessary for the due working of the Patent-law, including the highest salaries of its principal officers, should be appropriated to that purpose, because that sum does not come, as I have said, from the taxpayers, but comes from a source, the patent fees, which would be wholly destroyed according to the opponents' views were the practice of the Patent-law not improved, but which, if patents continue, will still leave a handsome surplus after the payment of every necessary expenditure upon an ample and befitting scale. Such an arrangement as I propose I believe would work creditably and well. The unpaid system, I am certain, would not so work. You could only get men to devote their leisure to the matter. Now, as men of position have next to no leisure, you would get but a very small share of the time of each man, you must, therefore, have a large and a varying body. Whenever this is the case, the secretary or other permanent officer becomes, in truth, the tribunal, and practically every patent question would rest in his hands, and the whole system would speedily fall into utter discredit. I will now close this lengthy reply by apologising to you most sincerely for the time that I have taken in addressing you, pleading as my excuse the great importance of the subject under consideration and the number of speakers whose views I have had to consider and to deal with; and I am glad to be able to close it with a far more hopeful feeling than that with which I brought my paper to a termination, for at that time I had great doubt about the general sentiment in regard to the principle of a Patent-law. These doubts have now been, to a great extent, removed by the expressions of opinion that have been offered in this room, and also by the unanimity of the press. I hope I am not too confident, therefore, in looking upon the abrogation of patents as now not a thing to be feared, and that whatever legislation we have to look forward to will not take that shape, but will deal with the necessary improvements, and will remove the last objection to those laws which I most honestly believe to lie at the very root of our prosperity as a manufacturing nation.

The Chairman, in moving a vote of thanks to Mr. Bramwell for the able paper which he had read in the first instance, and for the reply which he had now given, expressed his hearty concurrence in the universal praise which had been given to Mr. Bramwell, and ventured to express a hope that both these papers together with the discussion might be published in a separate and easily accessible fo·m. He also thought it would be desirable if the report of 1866 were printed as an appendix to i·. He was instructed by the Council to announce that they had formed a committee which he was quite sure would not allow this matter to rest.

The vote of thanks having been unanimously passed, and briefly acknowledged by Mr. Bramwell, the proceedings terminated.

The following is a copy of the correspondence referred to by Col. Strange in his remarks during the discussion, as having taken place on the subject of appointing paid Commissioners of Patents.

(COPY OF THE MEMORIAL.)

To the Right Honourable the Lord Romilly, Master of the Rolls.

MY LORD,—The great use of patents is to make known the inventions, processes, and secrets of others. It is therefore highly important that the mass of information accumulated at the Patent-office should be made available, so as to make known as far as possible all inventions and modes of manufacture for the benefit of the country. The advantage of so doing would be immense, and would help to keep the manufactures of this country in advance of others. Action in this direction on the part of the authorities has been prayed for in every memorial that has been presented.

One of the first memorials was presented by the Institution of Mechanical Engineers, with Mr. Robert Stephenson as President at its head. This was presented in 1853 to the Right Honourable Frederick Lord Chelmsford, Lord High Chancellor of Great Britain, the Right Honourable Sir John Romilly, Master of the Rolls, Sir Fitzroy Kelly, Her Majesty's Attorney-General, and Sir Hugh McCalmont Cairns, Her Majesty's Solicitor-General; and prayed for greater facilities being given to persons making inquiries in any branch of knowledge at the Patent-office.

The second memorial in 1862 was presented to the Right Honourable Sir John Romilly. It prayed amongst other things for "a building as an office for patents, including in it a complete library, a commodious reading room, and suitable offices for a proper staff of clerks and others to prepare well-digested and numerous abstracts and abridgments of inventions and processes, made public either by the specifications of patents or otherwise, and whether English or foreign."

A third memorial was presented to Sir John Romilly in 1864. It prayed not only that the efficiency of the office should be increased, but called the attention of the Commissioners to recent reductions in the staff and its disorganised state; which staff was "utterly inadequate to satisfy the requirements of persons seeking information among the very numerous works contained there." The memorialists went on to state that "they had entertained the hope that, so far from a reduction being made, there would have been an increase ordered to such an extent as would have enabled the abridgments of the specifications in the various branches of art (which abridgments were commenced about seven years ago) to be pushed vigorously forward, so as to complete the abstracting of the whole of the original specifications, and to keep up those abstracts from year to year as new matter is furnished. Your memorialists feel it is hardly possible to overrate the advantages to be derived by the public from a complete and intelligent system of abstracts; and they venture to urge upon the consideration of the Commissioners the necessity of at once providing a sufficient number of qualified persons (to be under the entire control of the scientific officer appointed by the Commissioners to superintend the specifications) to assist that officer in preparing such abstracts, and also to collect and epitomise scientific information generally."

The president and members of the Institution of Mechanical Engineers addressed a memorial in 1864 to the Right Honourable Lord Westbury, then Lord Chancellor, bringing under his Lordship's notice the fact "that very great loss and delay are occasioned to manufacturers, inventors, and others, by the want of a complete classification and the prompt indexing of all inventions, whether patented or not, foreign as well as English. Such a systematic arrangement as is needed is quite within the compass of an efficient staff of officers possessed of technical knowledge, and could be at once proceeded with; the state of inventions could then be ascertained, and the common case of several persons patenting the same thing would be avoided."

In 1864 a Select Committee of the House of Commons inquired at great length into the working of the Patent-office; and reported, in accordance with the general tenor of the evidence, that much more was required to be done at the Patent-office to render it efficient; that more attendants were required, and "that the want of increased accommodation was so much felt as to prejudice the due administration of the Patent-law" (paragraphs 3 and 4 of report; answers 10 to 13, 18 to 21, 658 to 662, 667, 817, 863, 1038, and 1039 of evidence).

We merely allude to the opinions expressed by the Select Committee of the House of Commons, scientific men, manufacturers, engineers, and inventors, as the various memorials and other documents are in the possession of the Commissioners of Patents; but we would further mention that the various Commissioners of Patents have from the year 1858 reported from time to time to the Lords of the Treasury that great improvements were wanted, and a good building urgently required for the purposes of the Patent-office.

In conclusion we beg to state that it is our decided opinion, and that of many of those who have signed various memorials, that it would conduce greatly to the progress of manufactures and the advancement of commerce, if the large stock of knowledge of inventions and processes, both patented and open, stored at the Patent-office, were made available to manufacturers and the public generally; and this your petitioners believe would best be compassed, if Her Majesty were graciously pleased to appoint that "other person as Commissioner of Patents," as contemplated by the Patent-law Amendment Act of 1852, and if the staff at the Patent-office were augmented by the addition of a sufficient number of persons, possessed of good technical knowledge, and well able to abstract all specifications as they came in daily, so that they might at once be entered into an efficient Subject-matter Index, which would give a true indication of what was in the specifications. In addition to this of course the large number of specifications already at the office would require to be abstracted and entered in a similar manner in a new edition of subject-matter indexes, that would really indicate what was contained in each specification, which the present indexes do not. Further, we beg to urge that similar subject-matter indexes be formed of all inventions and processes comprised in the very numerous indexes and tables of contents of the scientific books contained in the excellent scientific and technical library of the Patent-office; so that any person using due diligence might easily learn with tolerable certainty whether an invention were new or old, which is not now the case.

We beg to append a sample page of such two subject-matter indexes as we would submit are urgently required. It is almost superfluous to mention that there are now several hundred thousands of pounds accumulated surplus, and an annual surplus of about sixty thousand pounds, contributed by the very class of persons who would benefit by such improved indexes.

L. L. Dillwyn, M.P.
Richard Baggallay, M.P.
Charles Fox, Mem. Inst. C.E.
Charles Hutton Gregory, President Inst. C.E.
Edward Woods, Mem. Inst. C.E.
C. William Siemens, Mem. Inst. C.E., F.R.S.
Robert Mallet, Mem. Inst. C.E., F.R.S.
Frederick J. Bramwell, Mem. Inst. C.E. Council.
Edward A. Cowper, Mem. Inst. C.E.

20th March, 1863.

(Copy of Reply of the Master of the Rolls to Mr. Dillwyn.)

Rolls, 31st March, 1863.

Sir,—I transmitted to the Lord Chancellor the memorial presented to me on the 20th March instant by yourself and the gentlemen who accompanied you, relative to the present state of the Patent-office, together with my views on the subject; and we have since considered the matter in consultation together.

The result of this is that we are prepared to recommend to Her Majesty's Government that three gentlemen should be appointed to act as Commissioners of Patents together with the Lord Chancellor and the Master of the Rolls for the time being—one to represent mechanical science, another to represent chemical science, and a third to represent the subjects more usually and more especially comprised in the term, "Natural Philosophy." We should propose that the gentlemen to be recommended to Her Majesty for this purpose should be, as regards the first, from gentlemen to be nominated by the Society of Mechanical Engineers; as regards the second, from gentlemen to be nominated by the Chemical Society; and as regards the third, from gentlemen to be nominated by the Council of the Royal Society. But we are not prepared to recommend that any salary should be attached to the services of these gentlemen. We trust and believe that gentlemen fully competent for the purpose may be found, who have sufficient leisure, and who, from their love of science and their desire to disseminate more widely the discoveries made in the branches of science, would be willing to give their services without remuneration, and to superintend the general management of the Patent-office, to see that the indexes and abstracts of the specifications are made accurate and complete, and to redress the other defects complained of in your memorial, acting in all these respects in conjunction with the Lord Chancellor and the Master of the Rolls, to whom they would refer whenever the occasion might require it.

I think it, however, desirable to repeat that, on full considering the subject, both the Lord Chancellor and myself have arrived at the same conclusion that it would be inexpedient to create either one or more salaried officers for this purpose; and to say that we should both, if applied to, recommend Her Majesty's Government not to accede to that part of the views of the gentlemen who composed the deputation, which had relation to the creation of paid officers.

Romilly.

L. L. Dillwyn, Esq., M.P.,

The session of the Federal Polytechnic School at Zurich, commencing with the present month, is attended by 676 students, comprising 84 who are following the preparatory courses of study. They are divided as follows amongst the different schools:—School of engineering, students; School of Mechanics, 188; School of Chemistry, 88; Architecture, 85; Forestry, 14; Agriculture, 14; the School for Scientific Training, 26. Of this number there are 277 Swiss, whilst the Austro-Hungarian empire sends 160 students, Russia 78, Germany 39, Italy 26, and Sweden and Norway 18.

Egyptian blue, which has been known to the Egyptians from the remotest times, is, according to investigations made by the Chemical Laboratory at Berlin, composed of 70·25 part of silicic acid, 16·44 cupreous oxide, 2·30 ferric oxide and argillaceous earth, 8·35 chalk, and natron. Egypian blue can be imitated by melting together a mixture of 70 parts sand, 15 cupreous oxide, 25 chalk, and 6 soda.

In engineering shops in Germany a new kind of driving band is being adopted. It is made from hair, presumably that of the alpaca, and is delivered by the maker in a single piece without seam. It has a coating which consists principally of minium. It is spoken of as most satisfactory, and as being more durable than either gutta-percha or leather.

MISCELLANEOUS.

RIVERS' POLLUTION.

THE SANITARY AND ECONOMIC MANURE COMPANY, LIMITED, FACTORY-LANE, SALFORD.*

This company is engaged in carrying out my plans for the treatment of towns' refuse, which have for their object the promotion of the sanitary condition of towns, as well as the prevention of rivers' pollution.

It is now generally acknowledged that the pollution of rivers is due to two main causes, there being the discharge into them of the refuse of works, and of the sewage of towns. To prevent the former, no course seems open but that of requiring the proprietor of the works producing the refuse so to treat it that before the liquid leaves the premises it must have attained a certain standard of purity. This can, no doubt, be accomplished, and with positive benefit to the manufacturer. As regards the latter, the sewage of towns, the same remarks apply excepting that a community composed of varied interests, must be called upon to attain the same standard of purity before passing its liquid refuse into a running stream. That this can be done if insisted upon by the Government of the country, I entertain no doubt, and with advantage to the community doing it.

Sewage, which contains fæcal matter, contributes in a greater degree to the pollution of rivers, and to the increase of the difficulty of cleansing the sewers' contents, than sewage which does not contain fæcal matter. Apart, therefore .from its demand upon the already too limited water supply of our towns, and its evil effects from a sanitary point of view, I would in the first place prohibit the use of the water-closet where its refuse is to be carried away by means of the common sewer. I do not mean by this that I would prohibit the use of the water-closet altogether, but I would put a tax upon it by charging for the water it consumed, and would call upon the user to make provision for the removal of his own refuse from his own premises without passing it on to his neighbour; this could be accomplished by the aid of Captain Liernur's pneumatic system perhaps more effectually than by any other known system. If I understand his system correctly, I shall be right in saying that it can be applied to the dry closet as well as the water-closet; if so, a great objection to the working of the Rev. Mr. Moule's earth-closet in the upper stories is removed.

For the masses the water-closet system is an exploded idea. The old ash-midden or cesspool, saturating as it does the subsoil of the dwelling, and on the other hand giving off its poisonous gases as the accumulation decomposes, and now and then distributing more effectually its poisonous odours in the process of emptying, is condemned, and ought to be legislated off the face of the earth.

The pail system, which provides for carrying away the fæcal refuse of the dwelling, will no doubt become the general substitute for the midden or cesspool, but it must be in a form vastly superior to that it has been allowed to take in Rochdale and some few other towns before it can rid itself of the not inappropriate name given to it by Mr. Baldwin Latham when he calls it a "stink pot." By a proper use it can be shown to have a claim to the title of "Sanitary pail," but then it must provide for the constant and repeated deodorisation of the fæcal refuse committed to it. It is to be regretted that this fact has been lost sight of by many who have adopted the pail system. I fear the idea of manufacturing manure has prevailed with these to the detriment of the sanitary effect. This serious defect of the pail system is effectually overcome by my cinder-sifting ash-closet system, each addition of excrement being totally disinfected by the distribution over it of ash dust, by automatic action which also delivers the cinders ready for refuse as fuel. The arrangement is very simple and adapted to any premises, the cost being trifling. The occupant of the house is called upon to do nothing out of the ordinary mode of throwing ashes through a hole in a side wall whence they fall upon a screener instead of into a pit. The soil pail will last a family of five persons fourteen days, and its contents will be perfectly free from smell during the whole time. It is under the exclusive control of the scavenger, and at or about the period named is carried bodily away and replaced by a clean one. The cinder-sifting ash-closet, invented in the year 1866, may therefore be said to possess the following advantages:—

1st. It makes use of material (the ash dust) already in the premises for arresting the decomposition of fæcal matter, and so obtains a sanitary object.

2nd. It secures all the advantages of the dry earth-closet without the cost and trouble of providing dried earth.

3rd. It saves all the unconsumed fuel in the form of cinders for reburning by the occupant of the house.

4th. It produces a valuable manure by the combination of the fine ash dust with the fæcal matter.

5th. It costs in its application to new premises little if anything more than the old ash-pit system.

6th. It reduces the labour of collection by two-thirds, owing to the utilisation of sifted cinders.

7th. It can be shown as compared by the old system to produce for a town with 100,000 people a clear gain of at least £10,000 per annum; and when compared with the water-carriage system, a clear advantage of £13,000 per annum.

My ash-closet system has been adopted by the Manchester Corporation, though in a comparatively imperfect form, but at no less cost. Time will not permit me to enter fully into the details of my system for dealing with the liquid refuse. In a pamphlet I published in the year 1868, I advocated the double or separate system of drains, one for rainfall and one for sewage. My own experience in the interval more than confirms me in the views I then entertained. I have since invented special arrangements for a double system of sewers which provide for flushing and ventilating. In the pamphlet referred to I also advocated and described a plan I had devised for a system of intermittent filtration over parcels of prepared natural soil. I have had the pleasure of observing that the Rivers' Pollution Commissioners, in the report of 1871, so far supported this view as to recommend its adoption in some modified form, and it has accordingly been carried out with more success than appears to have attended any other form of sewage cleansing.

I have worked out several improvements in my plan since I first introduced it, but they will require too much time to explain in detail.

My system embraces besides an apparatus for cleansing the liquid before leaving the premises, and also an intermittent system of filtration of liquid refuse from subsiding drain pipes before passing it into the main drain. This is accomplished by providing one outlet into the main drain for a certain district; a large town being divided into districts proportionate to its size. The system is especially applicable to villages, and small communities.

Lord Derby's remarks at Liverpool in 1872 then seemed to me very appropriate, and worthy of the consideration of all interested. He said, "it is quite on the cards that the next generation may find out that the gigantic drainage works in which so many millions have been spent, are comparatively useless, and what we want now is not so much a few schemes of national dimensions as a more minute and careful supervision of little local details."

J. CONYERS MORREL.

* Received too late for insertion in last week's *Journal*.

ITALIAN INDUSTRY AND COMMERCE ABROAD.

A series of reports from the Italian consuls in different countries has recently been published by the Government, and contains a variety of interesting information relating to the industrial and commercial occupations of Italians in those countries, and the earnings of those belonging to the working class. The reports of the consuls in France and Algiers appear to be the most important.

Commencing with Paris, it appears that in 1872 the number of Italians engaged in industrial, commercial, or financial pursuits (not comprising workmen) was 677 against 722 ten years previously. They are chiefly painters, commission agents, stovemakers (*fumistes*), image-makers, jewellers, hatters, tailors, innkeepers, wine-dealers, keepers of restaurants, keepers of cafés, dealers in provisions, bird dealers, artificial flower makers, opticians, shoemakers, makers of mosaic, and manufacturers of articles in india-rubber.

The stovemakers do business of about 4½ milions of francs yearly, and employ about 1,500 Italian workmen, who earn from 3·25 to 5 francs per day. This trade, however, is not so flourishing as it was in former years. The painters turn over about 1,200,000 francs yearly, and employ 1,000 workmen, whose earnings are from 4 or 6 francs to 10 francs per day. The commission agents do business of 11,400,000 francs annually; it appears that they now purchase in Italy a large quantity of cotton and wollen fabrics instead of buying them as they did formerly in Paris. There are 200 makers of plaster casts in Paris, doing business to the value of 700,000 francs yearly. The wages of the journeymen average from 5 to 6 francs per day, though first-class men earn considerably more. The jewellers employ 50 Italian workmen; their wages vary from 5 to 10 francs and upwards per day. The value of this business is about 6 millions of francs annually. The Italian straw-hat makers have formidable rivals in the French and Germans; they import the straw from Tuscany and manufacture it in Paris to suit the French fashions. The 50 Italian people employed by these manufacturers earn from 3 to 5·50 francs per day. There are about 200 Piedmontese journeymen tailors employed in Paris, and they are paid from 5 to 7 francs per day. Fourteen hotels in Paris are kept by Italians, and their receipts amount to 360,000 francs yearly. The dealers in wine do business for 200,000 francs. The sellers of lemonade and ices have diminished in numbers, and are now only sixteen, doing business of 450,000 francs. The dealers in Italian provisions do business of 525,000 francs annually. The makers of artificial flowers are seven in number; the opticians eight, doing business of 1,240,000 francs; and the pianoforte makers from 4 to 500,000 francs annually. The india-rubber manufacturers and dealers in coral do a fine trade. Very little can be said respecting the shoemakers, makers of mosaic, and other trades, but there are a large number of masons, sweepers, and street musicians in Paris.

At Marseilles there is a large number of Italians, the colony being composed of not fewer than 50,000 persons. However, the number of Italian masters is comparatively small, as the great part of the colony are engaged in manual labour.

There are twenty-nine Italian commercial houses engaged in trade between Italy and France, and the trade between Marseilles and the Levant, Black Sea, and Rio de la Plata, is to a great extent in the hands of Italian merchants. These houses export to Italy, hides, wool, codfish, refined sugar, cotton, wine and spirits, soda, chloride of lime, crystals, porcelain, glass ware, stoves, jewellery, and pianos; they import from Italy, cattle, cheese, butter, raw silk, tallow, corn, rice, vegetables, chestnuts, oranges, fresh and dried fruits, hemp, marble, sulphur, iron ore, coral, straw-hats, &c. Italian shipping competes successfully with the French f freights at the port of Marseilles.

At Lyons at one time there were a considera number of wealthy Italian firms engaged in the s trade, and they supplied the manufacturers of th city with silk to the value of 150 millions of fran annually, or about three quarters of what was requir At the present time the manufacturers draw their sup direct from Italy, and many of the most importa Italian firms no longer exist. On the other hand, Italian merchants have imported of late years a la amount of wine and cattle; 40,000 hectolitres of Itali wine were consumed at Lyons in 1872. There i considerable demand also for Italian chestnuts.

The commission agents do business at Lyons in of about 40 million francs. There are three Italian manufactories, employing about 300 workmen. Ital contractors are engaged largely in carrying out wo in the department of the Rhone and other places.

There is also an Italian foundry at Lyons; a ma factory of maccaroni; and two of the largest cafés kept by Italians; one of them employs forty Ital waiters, and realises 50,000 francs per annum.

There are a large number of Italian silk weavers, it is estimated that they form one-fifth of the wo people engaged at the 100,000 looms at Lyons, wh produce to the value of 500 million francs of silk st every year.

A great part of the trade and manufacture of o Nice is in the hands of Italians. Oil is exported o large scale from Italy, but is refined at Nice. Sev Italian firms are engaged in the straw-hat, marble, slate trades, but as regards manufactures there are c paratively few Italians employed.

At Cette the Italian colony is poor and few in numb there are, however, three large Italian houses eng in the wine trade, realising a profit of 160,000 fra yearly.

At Chambery there are two Italian makers of ma roni. In the other large towns in France there are few Italians, and they are engaged in industries or c merce on a very small scale.

In Algiers the Italians carry on business on a l scale. There are several large mill owners, contract and purveyors of army stores.

At Philippeville there are five large commercial ho The trade of fish salting, or curing, is almost entirel the hands of Italians, principally of Sicilian origin. Calle the Italian vessels engaged in the coral fis produced about three millions of francs in 1871.

At Bona there are from 344,000 Italian workm At Oran there are two manufactories of maccaroni, the remainder of the Italians resident are princip workmen.

In conclusion, a large number of the Italians in Fr are workmen, who return to their native country a little money; still many permanently settle in Fr and neither they or their families ever return.

Kaolin, or china-clay, has recently been rec mended as a convenient material for use in fining wine quantity of kaolin, amounting to about half per cent. o weight of the wine to be operated on, is mixed to a p consistency with a small quantity of wine, and this is added to the bulk of the liquor to be clarified, when impurities in suspension are caught up by the finely-div clay, and rapidly thrown down as an insoluble dep Should the kaolin contain iron as an impurity it mus digested with dilute hydrochloric acid, every trace of being, of course, washed out before the material is us clarifying.

At the Port Clarence works, belonging to Messrs. Bell Brothers, an excellent deposit of salt has found. Boring has been carried on for nearly a year, this perseverance has at length been rewarded with discovery of salt near Middlesbrough. The value of th the chemical works of the Tees and the Tyne will be gr

CORRESPONDENCE.

PATENT LAW.

Sir,—After the exhaustive paper of Mr. F. Bramwell's, and Mr. H. Palmer's conclusive remarks, it becomes an undoubted fact that the Patent-law is both necessary and beneficial. One of many instances in support of this view within my own experience is that of the inventor of the Aneroid barometer, a French advocate of limited means. Not being a mechanician, he found it necessary to resort to one to get his invention manufactured, but after expending much time and money in long and elaborate experiments he found his means exhausted. How was he to proceed without his invention being protected? This gentleman luckily found in a fellow countryman, established in England, the needful support which enabled him to patent this instrument, which but for such assistance might have been kept secret till this day. Without a patent his fate would doubtless have been that of many other poor inventors, that is, either to be entirely swamped, or have to abandon the greater part of his reward. The workman's incentive to invention (as in the case above cited it was chiefly) may be honour in the first instance, but necessity is the mother of invention in most cases, and when it is not, generally the pecuniary element is equally necessary to enable the invention to be matured and brought into the market.

The Patent-law being admitted to be necessary in spite of its defects, and legislation having been promised, the great thing is to agree what its defects are, and what the best remedy. Frivolous and duplicate patents are admitted to be one just ground of complaint, occasioning waste of time and money, and other annoyance to the manufacturer and inventor. This defect arises in great measure from no preliminary examination taking place, the duties now performed being purely of a formal character.

The United States legislation points a remedy for this in a preliminary examination, and it is a question whether such an examination as would prove highly beneficial might not be carried out under the present enactments of the law of 1852. Should, however, it be deemed necessary to obtain fresh legislative power, this would admit of further alterations of a highly useful character.

Firstly, the reduction of the fees. The examining system would take the place and act the part of high fees, as a safety-valve to prevent the flood of useless patents.

A low rate of fees would stimulate the inventor by giving him the hope of securing the fruits of his ingenuity to himself without being dependent upon the capitalist, and having to share the return with him, sometimes losing it altogether.

This facility need not prevent the often beneficial arrangement between maker and man, but renders it mutual, and the consideration more equitable.

Secondly, in the working of the law of 1853, an abuse has crept.

The establishing provisional protection was one of the great benefits of the new law, as it was presumed to give priority to the first applicant, until he either completed his application by obtaining a patent or abandoned it altogether. Relying upon this fancied security, he utilised the longest time allowed by the law for completing it (about four months), and often experimented and published his invention, sometimes for the purpose of obtaining funds to carry it out, or finish his patent. But what was his surprise when, after mastering great difficulties in the way of improvements, and making the necessary outlay, he found himself opposed when applying for his patent by another, who had applied for provisional protection after himself, but had pushed on quickly and obtained his great seal or patent before him. And he was ousted, the Lord Chancellor awarding to the last the right to the patent over the first applicant although protected.

Such cases luckily are of rare occurrence, but they serve to defeat the admitted intention and beneficial action of the law. This is a defect requiring legislation to remove.

Thirdly, the French certificate of addition system might be used under the examining system to protect slight improvements, and so diminish the number of patents, and supersede the expensive mode of amending specifications by a disclaimer and memorandum of alterations.

With regard to legislation a move has been made in the right direction by the recent Judicature Act, in providing an assessor. The machinery of the Examining Board proposed would doubtless further assist in the trial of patent cases.

But this reform, as well as the present large demands for space, render a new building for the Patent-office indispensable, and such being the case, the advisability of combining the Patent Museum in one after the model of the Patent-office at Washington is strongly urged. We want a building worthy of the importance of the subject, combining convenience with architectural effect consistent with the character of the first manufacturing country in the world.—I am, &c.,

W. A. Gilbee.

4, South-street, Finsbury, E.C.
December 14th, 1874.

Sir,—I have been honoured with an invitation to attend the discussion on patents for inventions. Much I regret not being able to be present and take part. There is much to be said in favour of Mr. Horatio Lloyd's conclusion that a reformed law and administration of patents is, to say the least, tolerable. The last Parliament's Committee on Patents received evidence to this effect from two very decided opponents of the system that exists, the eminent M. Schneider and Mr. Muspratt. The evidence of the great Frenchman (for which see the "Bluebook" report) was weighty and lucid, and well deserves to be studied. It recognised the fact that every now and then there arise in the minds of men ideas which are entirely original, and which are so distinguished in their character that, in order to work them out and duly reward them, exclusive privileges may fairly be granted to their authors, exceptionably by special Act, and he instanced, as an invention of the kind, Bessemer's process.

The speech of Mr. Samuelson last Wednesday was thoroughly practical. He laid hold of the grand difficulty, which is this:—Exclusion from the right to use new inventions, or liability to heavy penalties as an alternative, exposes the British manufacturer or shipowner, &c., to disadvantages which cripple him in competing with foreign rivals more favourably situated, that is, with manufacturers, &c., who are not thus subjected to restraints and burdens. Of course a world-wide international patent system or return to a protective commercial policy would go far to counteract the disadvantage; but we are far from such remedies.

It is a satisfactory precedent that appear to have been set in the renewal of Mr. Henry's patent. But I fear a royalty of even so little as his two shillings a gun may act prejudically on commerce. To my mind a national reward, if this inventor has not already reaped enough, would have been better. I in person realise the change that has taken place in the principle on which manufacturing businesses are conducted. That principle is, to carry on extensive operations, conducted with a small average margin for profit in trust that many a little would make a muckle. In a business, for instance, like that of sugar refining (a business by the way of immense service to the general commerce, and which

therefore it is of vast importance to retain), where the margins are proverbially small, royalties, however seemingly moderate, may be really destructive if refiners abroad are not liable to them. A royalty is a tax just as much as if it were imposed by the State and levied by an exciseman. Free trade is a farce and cruel folly, when under its cover we subject the home producer to invention taxes, and make no equivalent charge on imported goods manufactured by the same machinery and processes, it may be, as Mr. Samuelson instances, in Holland, where there are no patents at all.

Mr. Hinde Palmer alluded to a meeting of workmen which Lord Selborne, by special request, honoured with his presence. I was there. The attendance was small, and the facts do not at all warrant the inference drawn. I am not aware that working men have paid much attention to the subject of patents. No doubt a clique—I do not use this term disrespectfully—some years ago made a movement in order to either influence working men to believe in patents or to let it appear as if they did believe. But the movement was miserable in character and extent. The conviction is, that no portion of the community has grasped the subject and mastered it. I do not admit there has been any retrogression. On the contrary, the now accepted notion that there ought to be compulsory licensing manifests a great stride in public opinion.

I have not yet ceased to hope that the simple and sensible solution of the invention problem by instituting international rewards in money and honours, on the general rule, will some day commend itself to statesmen who wish to emancipate and double trade and navigation. —I am, &c., R. S. Macfie.

Dreghan, Colington, Edinburgh,
12th December, 1874.

STREET PAVEMENT.

Sir,—I fear Mr. J. F. Streatfeild is not aware that a mass meeting of omnibus and cab proprietors, town carmen, and London horse-keepers, was held at the Freemasons' Tavern, to protest against the unsafeness and cruelty of the asphalte pavement for horses. Were that pavement good and safe, they would be only too glad to have it generally adopted, but experience shows the reverse, and hence the protest against it. I can assure Mr. Streatfeild, from personal knowledge, that horses get fearful injuries by falling on the unyielding asphalte. A horse is at this moment lying dead in King William-street, City, having slipped up on the asphalte. If Mr. Streatfeild will drive a horse for a few days on the asphalte, and again a few days on the wood, he will soon discover which is the safer pavement. I drive daily, and have considerable experience in both.—I am, &c.,

W. E. B.

P.S.—Like Mr. Streatfeild I have no connection with any paving company.

London, Dec. 17th, 1874.

The Metropolitan Underground Railway Company of Constantinople have now completed all their arrangements for public traffic through the tunnel between Pera and Galata, and have applied to the Minister of Public Works for the official approval and authorisation necessary to commence the service. A commission of inspection has appointed Edhem Pasha to test practically the soundness of the works and the efficacy of the arrangements, and it is expected that the trains will shortly be open to the public.

Forty or fifty of the most prominent telegraphers in America, as well as many other prominent men interested in the science, met in Chicago on the 21st ult., and organised an American Electrical Society. Its objects are the interchange of knowledge, and the professional improvement of its members, to advance electrical and telegraph science, and the establishment of a central point of reference.

GENERAL NOTES.

The Old Smeaton Engine at Carron.—With regard t this engine of which so much has been said of late, and t which reference was made by Mr. Cole in his remarks o Patent-law Amendment last Friday, it may be interesting t state that it was broken up some two years ago to mak room for the erection of three new blast furnaces. Th only part preserved was a portion of the steam cylinder wi the date on it. This, with a suitable inscription, it is inte ded to fix on the face of a large retaining wall built on t site of the old engine.

New Source of Soap.—The Commissioners of t permanent exhibition of the French colonies, to whom already due the credit of having brought to a success issue so many interesting works, has lately called t attention of the Marseilles soap-boilers to the seeds of t *carapa*, which are perhaps destined to assume some c siderable importance in the production of soap. This t of the family of the *meliaceæ*, abounds in French Gui where it forms, especially in Chachipour, immense fore Twice a year it yields an abundant harvest of seeds, wh at certain periods cover the soil to a depth of more t 10 centimetres (4 inches). These seeds, on being subje to pressure, yield an oil in quantity equal to 35 per cent their weight, which is very good for making soap, and might also be used for lighting purposes.

Timber in Natal.—The coast lands of Natal thickly wooded, but it is not here that the timber forest the colony are found. The larger trees on the coast are twisted, hollow, or narrow, to be widely available for pl timber, yet they are all useful for certain specific purpo The ironwood, whose stem is sometimes 18 inches w affords a very heavy and compact wood, useful for axles other purposes requiring great strength. There are m other woods found upon the coast, of especial value to waggon maker, and these may probably be found valu hereafter by the boat builder and cabinet maker. In cer localities of the uplands, fine timber-yielding trees found. The most important is the yellow wood, a var of yew; sneezewood and stinkwood are both long-fi tenacious woods, of good service to the cabinet maker; there are two species of ironwood extremely close-gra and dark-hued. The one, known as African ebony, w be of great value in England for church furniture carving. In addition to these, there are many o descriptions, such as the red and white milkwoods, the pearwood, of a dull colour, but uniform texture; and the ivorywood, a very beautiful wood of a fine rich ros colour, taking a high polish.—*Nautical Magazine.*

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, should be forwarded by cheque or Post-o order, crossed "Coutts and Co.," and made p able to Mr. Samuel Thomas Davenport, Fina officer.

SCIENTIFIC MEETINGS FOR THE ENSUING WE

Mon. ...Institute of Actuaries, 12, St. James's-square, S.W., 7
London Institution, Finsbury-circus, E.C. 4 p.m.

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Gladstone "The Voltaic Battery. The Cell a effects." (Juvenile Lecture.)

Thur. ...Royal Institution, Albemarle-street, W., 3 p.m. Gladstone "The Voltaic Battery. The Replac of Metals." (Juvenile Lecture.)
Geologists' Association, University College, W.C., 8

Sat. ......Royal Institution, Albemarle-street, W., 3 p.m. Gladstone "The Voltaic Battery. Electrical composition." (Juvenile Lecture.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,154. Vol. XXIII.

FRIDAY, JANUARY 1, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

The Council have arranged with Prof. McLeod, of the Indian Engineering College, Cooper's-hill, to deliver two lectures on Wednesday, January 6, and Wednesday, January 13, at 3 p.m. The subject will be "The Work and Food of the Iron Horse." As the number of seats is limited, Members can only avail themselves of these lectures for their families by obtaining tickets from the Secretary, and these will be issued in order of application. Each Member is entitled to a ticket admitting one adult and two children.

MEMORIAL TABLETS.

Memorial Tablets have been affixed to the following houses, in commemoration of their having been at one time the residence of the distinguished men named:—

Benjamin Franklin, 7, Craven-street, W.C.
Sir Joshua Reynolds, 47, Leicester-square, S.W.
Lord Byron, 16, Holles-street, Cavendish-square, W.
Napoleon III., 3A, King-street, St. James's, S.W.
John Dryden, 43, Gerrard-street, Soho, W.C.
John Flaxman, 7, Buckingham-street, Fitzroy-sq., W.
George Handel, 25, Brook-street, W.

CANTOR LECTURES.

The first lecture of the course of Cantor Lectures on "Alcohol, its Action and its Uses," by Benjamin W. Richardson, M.D., F.R.S., F.R.C.P. was delivered on Monday, December 7th, 1874, as follows:—

Lecture I.

The History of Alcohol in Relation to some of its varied Services to Mankind, in the Arts and in Science.

We had before us a few weeks since an interesting national event. It was that of an Archbishop and a Minister of the Crown speaking almost at the same time, on one of the most important subjects of the day, viz., the part performed by alcohol on the national stage as it is set forth and played upon at this period of our history. The distinguished prelate took naturally for his view of the subject the moral influence of alcohol, and from this point denounced alcohol, in whatever form it presents itself for human consumption, in terms as eloquent as they were persuasive and forcible. The statesman took for his view of the subject the financial influence of alcohol; he gave a clear and by no means exaggerated estimate of the importance of an agent which, in these kingdoms, rests on an invested capital of not less than one hundred and seventeen millions of money; and submitted, in conclusive terms, an argument, which, contrasted with that of the prelate, means that an agent so commercially potential cannot be materially interfered with in the present stage of our civilisation, whatever may be the result of its influence on the community for good or for evil.

To the utterances of the church and of the legislative chamber we are accustomed to listen with such regard, that when any representative of either body speaks, we turn an ear almost automatically, and accept what is said as commanding respect, even though we dissent from the opinions that are expressed. No one therefore who stands out of these spheres can hope to obtain a hearing extended so far and wide, and equally authoritative.

And yet there is scope for honest utterance on another side of the alcohol question. The prelate and the legislator can hardly have more intimate conversance with the influence of alcohol than the physician and man of science. To the moral view of the question and to the legislative may well therefore be added the physical, and it is to this I shall try to direct public attention in these discourses, conscious, fully, of the disadvantages under which I should labour were it not for the countenance and support I shall hope to receive from you.

The strain running through all these lectures, in however diverse a manner the subject matter of them may be pursued, will then be simply this. Of what physical value has alcohol been to man; of what value is it to man? We know it is of no value to any other animal, and thus we limit our inquiry at once to the highest order of the animate series of natural development, or of natural creation.

In the studies that are in this sense to be undertaken, I will not fail to remember the injunction placed upon me to speak simply and plainly; not to offend pride of learning by too great simplicity of statement, nor yet to embarrass humility by a display of technical language and of the abstruse technical reasoning, for which the subject in hand affords so much opportunity. As far as possible I will strive to be plainness itself, and that, not only in mode of expression, but in matter of it, I mean in truthfulness of expression, as far as I am guided by the light that enables me to see what is nearest to the truth.

I shall propose in this description to glance first at the value of alcohol to man in a general sense; that is to say to its value as an agent useful for other purposes than as a fluid to be imbibed. From this I shall be naturally led to consider its action, physically, on man, and its use as a fluid consumed with, and, according to common acceptation, as a food. Lastly, I shall be brought to treat upon its secondary action on the vital functions, physical and mental, *i.e.*, on the deteriorations of structure and function, which may follow its use.

The Term "Alcohol."

The first employment of the word alcohol is obscurely recorded. Bartholomew Parr, one of the most learned of our scientific classics, taking the usual derivation of the word as from the Arabic *A'l-ka-hol*, a subtle essence, says it was originally employed to designate an impalpable powder, used by the Eastern women to tinge the hair and the margins of the eyelids. As this powder, viz., an ore of lead, was impalpable, the same name was given to other subtle powders, and then to spirit of wine exalted to its highest purity and perfection.

The earliest systematic and truly scientific use of the term that I can discover is in Nicholas Lemert's "Course of Chemistry," published in 1698. There the word is used as a verb, "to alcoholize," and the definition of this is said to be "to reduce to alcohol, as when a mixture is beaten into an impalpable powder." The word, says Lemert, is also used to express a very fine spirit; "thus the spirit of wine well rectified is called the alcohol of wine."

The word employed in this sense merely tells us of a refined fluid substance obtained by a subtle process of separation from a grosser substance. But it was not applied to the special fluid now under our consideration until long after that fluid had actually been separated. Then it was used as a supplementary term to the earlier terms, *Vinum adustum, Vinum ardens, Spiritus vini, Spiritus ardens*, by which a spirit obtained from the grosser fluid, by the action of fire, was known and described.

FERMENTATION AND WINE.

We must now go back to a much earlier study, viz., to the study of the primitive fluid, from which the subtle spirit was derived. In the history of the production of alcohol we gather, in fact, the use of two of the most prominent words of our modern language: fermentation and distillation. They each mark distinct progressive epochs in natural science.

The term fermentation brings us in contact with the primitive fluid. It leads us to ask how, from the vegetable world, by change or mutation of its matter, a new product was evolved? The origin of this procedure is so old we have no possible means of tracing it. Before ever the word chemistry or the science which that word implies was dreamed of, this process of obtaining the crude liquor, from which alcohol was ultimately extracted, was in active operation. By some accidental discovery it had been started by human hands, and the act of first lighting and reproducing fire was hardly a less wonderful development of the higher faculties resident in man, than was this discovery. The operation itself, originally, was, we may presume, very simple. As there is a spontaneity in nature to produce fire, as for instance, when a metal like iron strikes a stone, so there is a spontaneity of fermentation in vegetable matter—especially in the juices of fresh ripe fruits in warm weather—which fact being observed first, from the motion induced in the fluids, and secondly from the crude products that were left, would lead naturally to the contemplation of the steps of the process, to its easy, artificial, and more perfect development, to a method of separating and purifying the products, and afterwards tasting and using them.

The products of fermenting fruits were limited to four; an active air which escapes freely; a froth or yeast which floats above as a crust; a heavy mass or lees which sinks to the bottom; and a fluid which remains apart. These portions, each readily separable, indeed, separable of themselves, were soon understood in respect of their virtues. That invisible air, which escapes so actively, is a deadly vapour or miasm; that froth, unpleasant to the taste, is an active promoter of the motion that springs from the fruit; those lees are like sediment from muddy water, excrementitious, to be cast away; but that remaining subtle fluid, to the palate so grateful, to the senses so exhilarating, to the heart so forcing, to the intellect so exciting or so deadening:—let it be brought forth in the daintiest cups the handicrafts can fashion from the rude earth! It is not, to the savage, a mortal thing at all. Water flows in open streams, a common liquid, at which cattle and creeping things may drink; this must be the drink of the superior intelligences from whom the savage came! It lifts the man who takes it into a higher sphere of life, or it degrades him to the lowest. It introduces him, as it were, to a new human organisation that is not to be a passing phenomenon, but, for good or for evil, is to remain for ages.

The fluid is wine.

The discovery is an epoch surpassed by none other in the history of one portion of mankind, and the early dawning civilisations show their wonder at it in their mythology. Egypt claims the invention for her god Osiris, Greece for Bacchus, and Rome for Saturn. The Greeks, most ambitious to be connected with the origin, assert that the very name belongs to them, for the drink was first discovered in Ætolia by Orestheus, the son of Deucalion, whose grandson, Oeneus, was so called from Oinos, which was the old name of the vine. Or else the discovery was by Oeneus himself, who first pressed the rich grapes. Thus Oinos—oinon—vinum—wine. Then by these nations the praises of wine and of the wine gods, one and all, were sung into the later times. The first of the Roman poets, excited to his labour by Mæcenas, the friend of Augustus, who would that the vineyards should flourish, is thus prompted to invoke Bacchus, under the name of Pater Lenæus—

> "Hither, oh, Lenæus—Father Lenæus, come.
> By thee with heavy viny harvest crowned,
> The pasture flourishes. In the full vats
> The vintage foams.
> Hither Lenæus, Father Lenæus come,
> And, with thy buskins off, in the new wine,
> Stain, thou, thy naked legs even with me."

And thus on until our own era, in which,—alas for the mutability of even god-like virtues!—under the title of "The Worship of Bacchus," our veteran artist, George Cruikshank, has turned the praises of his brother artist Virgil, into scorn, and has transformed Pater Lenæus the wine giver, into the destroyer of every civilisation over which he has become enthroned.

It is worthy here of special remark that the invention of wine was local on the planet and that it came from some centre of the ancient world lying near to those points from whence our modern civilisation took its rise. For when that civilisation concentrated itself into bands or armies, or navies, for the purposes of discovering new portions of the earth, where other savage nations, as they are called, dwell, it found the wine god, the wine cup, and the wine equally unknown. A good three quarters of the old world knew no more of wine than did the people who invented it, until they were taught to know it—then they learned about it fast enough.

The practice of exciting fermentation and of obtaining the coveted fermented liquor once known, the knowledge was extended, until from varied vegetable substances wine became a product extracted by an art that was successful, however rude. The discovery of the ferment, that is to say of the body that would produce fermentation, was sufficient to set in mutation or intestine motion a whole series of fermentable vegetable substances, and to extend the manufacture of various vinous fluids to an unlimited degree. From the expressed juice of the grape the transition was easy to other juicy fruits, such as the mulberry, the apple, the pear, the peach; from these again to those juices which exude from trees, as from the eastern palm tree, and from these again to such similar looking substances as manna and honey. From fruits, moreover, it was an easy transition to seeds, and from seeds that were soft and succulent to seeds that were hard and of the character of what we now call grain.

From all these varied sources of fermentable substances there was produced for ages the fluid containing the basis of alcohol. Its most common name was wine, though the term was modified by adjective additions signifying sometimes its colour, sometimes the place where it was made or marketed. Thus were introduced the white and red wines, the Vino Tinto and the golden unctuous Vino Greco. Even after the discovery (of which I shall soon again speak) of the existence of a distinct essence or spirit in wine, the original fluid held pre-eminence over all other strong drinks, and in the early and middle stages of civilisation in Europe the number of wines that were used exceeded anything we now have in common use. Here is a list of ancient Roman wines in illustration of this fact. The wines are arranged in nine groups:—

ANCIENT ROMAN WINES.

1	Calenum
Falernum	Cœcubum
Massicum	Albanum

Setinum
Surrentinum

2
Chium
Lesbium
Leucadium
Naxium
Mamertinum
Thasium
Mœnium
Mareoticum

3
Album
Nigrum
Rubrum

4
Vetus
Novum
Recens
Hornum
Trimum
Molle
Lene
Vetustate edentulum
Asperum

Merum
Fortius

5
Coum
Rhodium
Myndian
Halicarnassum

6
Cnidum
Adrium

7
Mustum
Protropum
Mulsum
Sapa
Defrutum
Carenum

8
Passum
Passum creticum

9
Murrhina

This list by no means exhausts the names of wines of ancient date, but it is a sufficient indication of the extent of the "wine trade," if I may say so, long before our State Minister's invested capital reached its 117,000,000 of wealth. As a matter of some historical interest, it is worth a moment or two to touch on the special qualities of a few of these vinous drinks.

The wines of the first group were home wines. The Falernian was, it is believed, something like our modern Madeira, and was not commonly used until it was ten years old. After it was twenty years old it affected the body unfavourably, causing headache. This was the experience of Galen.

The wines of the second group were foreign. The Chian, also called the Ariusian, was in three varieties —austere, sweet, and intermediate; the Lesbian was considered diuretic.

The wines of the third group were named after their colour—white, dark, and red. The white were thought to be the thinnest and least heating; the dark coloured and sweet the most nourishing; the red the most heating.

Group four is named after qualities, of age, and the like: as old (Novum); new (Vetus); of the present year (Hornum); of three years (Trimum); mellow (Molle, Lene, Vetustate edentulum); rough (Asperum); pure (Merum); strong (Fortius).

The wines of the fifth group, marked Myndian, Halicarnassian, Rhodian, and Coan, were made with salt water. They were considered not to be intoxicating, but to promote digestion.

The two wines of the sixth group, viz., Cnidian and Adrian, were also medicinal wines. The first, it was believed, engendered blood and was at the same time a laxative; the second was diaphoretic.

Of those of the seventh group, the Mustum was wine newly made, or the fresh juice of the grape. The Protropum was the juice which runs from the grapes without pressing. The Mulsum was a mixture of wine and honey. The Sapa was Mustum boiled down to a third. The Defrutum was the same reduced to half, and the Carenum was the same reduced to a third.

Of the eighth group, the Passum was a sweet wine, prepared from grapes that had been dried in the sun. The Passum creticum, also a sweet wine, is believed to have been the same as the wine which our forefathers called Malmsey; the veritable wine in which the Duke of Clarence, brother of Edward the Fourth, elected to be drowned.

The wine called Murrhina, placed in the last group, has a curious history. The Greeks had a wine of this kind, which consisted of pure wine perfumed with odorous substances. The Romans had a wine similarly named, which is supposed to have been wine mingled with myrrh. It was administered to those who were about to suffer torture, in order to intoxicate them and to remove the sense of suffering.

The ancient wines retained their place probably until the end of the middle ages, but we have no reliable evidence bearing upon this point, if we except an occasional reference by some poet or physician to the subject of wine. Very slowly the names, rather than the wines, changed generally. The Roman conqueror who built his villa on our islands, and fitted it with so much taste and means of luxury, added to it his wine-cellar, in the manner he had been instructed by his forefathers, and from it took out his red and white and old wine, as we do now; boasting possibly of the vintage from which it was grown, and eloquent as to its age and perfect ripeness. If he had no old port, he had old Falernian or Passum; his rough and his sweet, his light and his heavy wines, the same as our connoisseur of to day; except, perhaps, that he knew a great deal more in the way of fact about the vintages than his modern follower.

How the wines changed in name through the centuries will be gathered from the lists of the wines of Europe in use in the last century, collected by the distinguished chemist Neumann, and here subjoined:—

Wines of Italy.

Vesuvius.

Vino Greco
Mangiaguerra
Verracia
Vino Vergine

Tuscany.

Florence (white and red)
Monte Pulciano
Montalneo
Porte Hercole

Lombardy.

Modenese
Montserrat
Marcemino
Brescian
Veronese
Placentine
Lumelline
Pucine

Naples.

Campania or Pausilippo
Muscatel
Surentine
Salernitan
Chiarello
Carcassone
Lachryma Christi
Albano
Montefiascone
Nomentan
Monteran
Velitrin
Prænetic
Il Romanesca
D'Orvieto

Sicilian, Sardinian, and Corsican.

Catanean
Panormitan
Messinian
Syracusan

Genoa.

Vino di Monte Vernaccia
Vino Amabile, or Vino di Cinque Terre
Vino Razzese
Muscadine
Rosatz
Vino Piccante

Wines of Germany.

Tyrolese Tramin
Etsch
Wine of Worms
Edinghof
Ambach
Rhenish
Mayne
Moselle
Neckar
Elsass
Hock
Bohemian
Silesian
Thuringian
Misnian
Naumberg
Brandenburg

Wines of Austria and Hungary.

Klosterneuberg
Brosenberg

Edenburg
Tokay

Wines of Spain and Portugal.

Aland
Alicant
Sherry (or Xeres)
Spanish Malmsey
Tarragan
Salamanca
Malaga
Cordova
Galicia
Andalusia
Vino de Toro
Spanish

Vino Tinto
Madeira

WINES OF MADEIRA AND CANARIES ISLANDS.

Madeira Sec
Canary or Palm Sec

WINES OF FRANCE AND SWITZERLAND.

Languedoc
Picardy
Champagne
Burgundy
Vin de Beaune (or Partridge eye)
Cote Roti
St. Laurence
Frontiniac
Muscat de Lion
Cahors
Hermitage
Grave
Vin d'Haye

Neufchatel
Velteline
Lacote
Reiff

Some of the wines here enumerated derive additional names from peculiarities in themselves. Sec, from which we derive the name of the wine Sack, on which Sir John Falstaff so keenly enjoyed himself, means dry; the wine being made from half dried grapes. Malmsey was called by the Italians, "Manna alla bocca e balsamo al cervello" "Manna to the mouth and balsam to the brain."

From the same chemist of last century, who has collected for us such a long list of wines, we are supplied with a very instructive table of analyses showing the strength of spirit present in the different specimens. The wines analysed are tabulated in alphabetical order. I believe this to be the first true chemical analysis that was ever made, on an extensive and comparative scale, of different wines:—

TABLE OF THE CONTENTS OF DIFFERENT WINES IN A QUART OF EACH.

	Highly Rectified Spirit.			Thick, Unctuous Resinous Matter.			Gummy and Tartareous Matter.			Water.			
	oz.	dr.	gr.	oz.	dr.	gr.	oz.	dr.	gr.	lbs.	oz.	dr.	gr.
Aland	1	6	0	3	2	0	1	5	0	2	5	3	0
Alicant	3	6	0	6	0	20	0	1	40	2	2	6	0
Burgundy	2	2	0	0	4	0	0	1	40	2	9	0	20
Carcassone	2	6	0	0	4	10	0	1	20	2	8	4	30
Champagne	2	5	20	0	6	40	0	1	0	2	8	3	0
French	3	0	0	0	6	40	0	1	0	2	8	9	20
Frontignac	3	0	0	3	4	0	0	5	20	2	4	6	30
Vin Grave	2	0	0	0	6	0	0	2	0	2	9	0	0
Hermitage	2	7	0	1	2	0	0	1	40	2	7	5	20
Madera	2	3	0	3	2	0	2	0	0	2	4	3	0
Malmsey	4	0	0	4	3	0	2	3	0	2	1	2	0
Vino di Monte Pulciano	2	6	0	0	3	0	0	2	40	2	8	0	20
Moselle	2	2	0	0	4	20	0	1	80	2	9	0	10
Muscadine	3	0	0	2	4	0	1	0	0	2	5	4	0
Neufchatel	3	2	0	4	0	0	1	7	0	2	2	7	0
Palm Sec	2	3	0	2	4	0	4	4	0	2	2	5	0
Pontack	2	0	0	0	5	20	0	2	20	2	9	0	40
Old Rhenish	2	0	0	1	0	0	0	2	20	2	8	5	40
Rhenish	2	2	0	0	3	20	0	1	34	2	9	1	6
Salamanca	3	0	0	3	4	0	2	0	0	2	3	4	0
Sherry	3	0	0	6	0	0	2	2	0	2	0	6	0
Spanish	1	2	0	2	4	0	9	4	0	1	10	6	0
Vino Tinto	3	0	0	6	4	0	1	6	0	2	0	6	0
Tokay	2	2	0	4	3	0	5	0	0	2	0	3	0
Tyrol Red Wine	1	4	0	1	2	0	0	4	0	2	8	6	0
Red Wine	1	6	0	0	4	40	0	2	0	2	9	3	20
White	2	0	0	0	7	0	0	3	0	2	7	0	0

If these analyses include all the spirit in the wines named, it is clear that the amount of spirit in them was exceedingly small, when compared with what is present in the wines of the present day. Falstaff might readily drink a pint of sack at a draught that contained rather less than seven and a half per cent. of spirit.

The only other diluted rival of wine obtained by fermentation was the liquid derived from corn. Tradition, active again in giving celestial origin to strong drinks, has assigned the introduction of the art of making this product first to Osiris, the divinity of Egypt, and afterwards to the goddess Ceres. The fluid thus produced, became, in Saxon language, known as beer, bere, from barley, or perhaps from the Hebrew, *bar*, corn. Tacitus calls it Zythum. The Egyptians, it is said, made it first for the common folk that they too might receive the gift of Osiris. In its original state beer was what we would now call the sweet fluid or wort fresh from the vat, and untinctured with any additional substance. So it continued probably until the ninth century, when it began to be treated with the *lupulus*, or hop. The first mention of this plant is made by an Arabian, named Mesue, of about the year 850, but he does not refer to it in relation to beer. The hop not only flavoured but tended to preserve the beer, and in a few centuries it became of general use. In the reign of Henry the Sixth the use of hops was for a time forbidden, on the ground that they spoiled the beer and rendered it dangerous. An order prohibiting hops and sulphur for beer was also made in the reign of Henry the Eighth. But the hops at last won their way. It is worthy of notice that Neumann, who analysed the beers of last century, as well as the wines, found that the beers contained an amount of spirit varying from 5 per cent. in the weakest to 10·90 per cent. in the strongest kinds. The malt liquors of the last century were, it appears from this, of much the same strength as those of the present.

Thus in the history of alcohol the first step of discovery was that of its production from vegetable matter by the process of fermentation. As so produced it was a mixture of that which we now call pure spirit, or alcohol, with water, and with small quantities of other extraneous substances of minor moment.

On the nature of the fermentative change by which the juice of the fruit, or the exuded fluid of the plant or tree, or the seed or the sweet sugar, is transformed into the new product, speculation has been rife for a hundred years at least. In this day the atomic constitution of water, of alcohol, and of the substances which yield alcohol are known, and the atomic change of constitution that takes place is known; but the reason of the process is, according to my judgment, as little understood as it was when the discussion began. Probably, indeed, the latest theories that have been advanced are rather a retrogression, by a line of learned subtleties from the earlier views, than an approach to simplicity of truth. I do not, therefore, venture to trouble you with any description on this head. One word I would add in the way of a guard against misuse of terms from assumed analogies. We often hear processes described as fermentative, which in truth have no relation, by any proved physical argument, with the true process of fermentation of vegetable matter connected with the production of wine. To take one example; we speak commonly of the zymotic or fermentative diseases, applying the term to those maladies which, in the form of contagious fevers, become epidemic. Hence many are led to believe that in these diseases there is in the body an actual fermentation like that in wine or beer; a comparison no closer, according to our knowledge as it now actually exists, than might be instituted between the same process and the so-called ferment of a mob when it assembles to give vent to its turbulent rage.

DISTILLATION.

I have said that for many centuries there was nothing known to mankind beyond the formation of a vinous fluid. At length a new process was brought to bear on wine, which simple as it is to us now, was in its early days, and for many long days afterwards, a wonder and a mystery. This was the simple act of distilling wine, and of obtaining from it by distillation a fine spirit containing no water. The discovery of distillation of wine has been attributed to Albucasis, or Casa, an Arabian chemist and physician of the eleventh century. The evidence on this point is not very convincing. It is true that the refined body called spirit of wine began to be known in the alchemical and Arabian schools about or soon after the time of Casa, and from that circumstance

rather than from direct evidence derived from his works, the discovery has probably been imputed to him. However, it is historically correct that from the school of Albucasis the discovery sprang. The alchemists or adepts were conversant with pure spirit, and, says Boerhaave, when they had reduced it to the utmost subtlety, they made use of it in the preparations of all their secret menstruums.

Distillation itself was probably an imitation of nature, for nature is ever distilling and condensing. In the cold, water condenses on the leaf and on the grass, as dew, and ascends as vapour in the sun. This process of raising water into a state of vapour by heat, and condensing it by cold, the simplest of immediate imitations of nature, would by easy transition pass to other liquids, and with special ease to that liquid which has rivalled water as a drink for man—wine.

The pure spirit of wine in its earlier use was applied mainly to chemical and medicinal purposes, and indeed many centuries elapsed before the process of distillation became active for the production of those stronger drinks, which, under the name of "spirits," are now in such common use in daily life. Brandy, from *brennen*, to burn; thus brantwein, brandy, is a comparatively late term in European literature. Gin, contracted from Geneva, is not to be found as signifying a spirituous drink in our vocabularies of two hundred years ago. The term rum is assigned to the native American peoples, who so designated the vinous spirit distilled from sugar; and whiskey (Celtic usquebaugh, water, though it may have been known as a distilled drink as long as brantwein, has not been Anglicised, I believe, for more than a century and a half.

In the earlier modes of distillation the instruments used were simple but effective. They consisted of the furnace, the receptacle to the furnace, the receiver which stood within the receptacle, and the alembic or condenser, which was made of tin or other metal.

A diagram of an ancient alembic is here before us. It was in truth a very scientific instrument, and caused a perfect collection of the distilled fluid. The spirit from the crude wine ascended from the heated reservoir into the conical tube, and then downward through the returning exit tube into the receiver.

The adepts were, indeed, marvellously mechanical, and when we recall that they neither had cork nor elastic tubing, nor gas, we wonder by what clever devices they were so successful. They had many useful arts, I am sure, which we have improperly forgotten, and which might with advantage be revived. Some of their plans, for a long time thought to be fanciful and useless, are being again considered of value. Here is an instrument called a cohobator, and here is another called a circulator, in which they caused spirits to boil and distil, and condense and distil again, for months, in some cases. The fluids went round and round in the circulator like the wheel of fortune, and many an adept has looked upon his fortune as spinning in that wheel, from which the elixir of life and the philosopher's stone were, in his ardent imagination, to be evolved. These and several other similar instruments, for which I am indebted to Mr. Robbins, of Oxford-street, are on the table before us.

To sum up, let us remember the four stages in the general history of alcohol, from the first to the time when it came strictly under analytical chemical observation, and, in regard to common knowledge, to the present time.

(a) The stage of manufacture of wine or beer by fermentation. A stage extending from the earliest history until the time of the adepts, say about the eleventh century of the Christian era.

(b) A stage when there was distilled from the wine a lighter spirit called, first, spirit of wine, and afterwards alcohol.

(c) A stage when this subtle or distilled spirit from wine was applied in its refined or impure state to the arts and to science.

(d) A stage when this same process of distillation was applied to the production of alcoholic spirits for the use of man as spirituous drinks, under the names of brandy, gin, whiskey, rum — a stage comparatively modern.

USES OF WINE.

We will, if you please, leave now for a time the consideration of wine and alcohol as drinks, and dwell briefly on the uses to which these fluids have been applied for other purposes. The study is peculiarly interesting, and I could easily carry you on during the whole course of these lectures with the narration of it. Unfortunately, every word I have to say must be introduced into this hour, so that I can refer only to the salient points, and to a few only of these.

From the first, the preservative or antiseptic quality of wine was recognised, and the fluid was employed for the preservation of animal and vegetable substances. The Roman butchers, who, like our modern butchers, sold their fresh and their salted meats, prepared their salted flesh in the following manner:—The animals they intended to preserve were kept from drinking any fluid on the eve of the day on which the killing took place. After the killing, the parts to be preserved were boned and sprinkled lightly with pounded salt. Then, having well dried off all dampness, the operators sprinkled more salt, and placed the pieces so as not to touch each other, in vessels that had been used for oil or vinegar. Over the whole they poured sweet wine, covered the contents of the vessels with straw, and, when they could, kept down the temperature of the room in which the vessel was placed by sprinkling snow around. When the cook wished to remove the salt from the meat, he took it out of the wine and boiled it first in milk and afterwards in rain water.

Long previous to the Roman era this preservative process of wine had been recognised and applied. Palm wine was used by the Egyptians in their most costly processes of embalming the bodies of the dead. This same application of wine, or spirits of wine, for the preservation of animal and also of vegetable substances, has been maintained up to our time. In our museums the specimens therein preserved, in the moist state, are immersed in spirit, and the modern art of embalming is not perfected without the employment of the same antiseptic agent.

Early after the discovery of the properties of wine the fact must have been observed that from a change in it another substance was producible, to which, in these days, we give the name of vinegar. To prevent the formation of vinegar in wine the ancients boiled the wine, and to remove the acidity arising from vinegar they added gypsum to sour wine, and thus rendered it palatable. Vinegar itself they employed for purposes precisely the same as we in this day; they partook of it with vegetables, they employed it for preservation of animal and vegetable substances, and they applied it for numerous medicinal purposes. After the process of distillation was discovered by the adepts, the distillation of vinegar was also carried on, and in this way was obtained that strong vinegar which enters so largely into various uses as an acid, called aromatic vinegar.

Very early in history wine was employed for another purpose, that, namely, of extracting the active principles from plants and other substances possessing, or supposed to possess, medicinal virtues. Dioscorides, one of the fathers of medicine, and particularly of that part which pertains to the use of curative substances, or medicaments proper, is full of descriptions of vinous tinctures, some of which were sufficiently potent even for our present use. On the table before us is a vinous tincture of this kind, which has a very singular and, I had almost said, romantic history. This is the wine of Mandragora. In the isles of Greece there has grown for ages a plant called mandrake; it belongs to the same family of plants as our belladonna, or deadly nightshade. From the root of this plant the Greeks extracted, by means of wine, a narcotic, and what in this day we should call

anæsthetic. Some, says our learned Dioscorides, boil the root in wine down to a third part and preserve the decoction, of which they administer a cyathus, about what would now be a common wineglassful, for want of sleep, or for severe pains of any part, and also before operations with the knife or cautery, that these may not be felt. Again, he says, a wine is prepared from the bark without boiling, and three pounds of it are put into a cadus (about eighteen gallons) of sweet wine, and three cyathi of this are given to those who are cut or cauterised, when, being thrown into a deep sleep, they do not feel any pain. Again he speaks of a preparation of mandragora called morion, which causes infatuation and takes away the reason. Under the influence of this agent the person sleeps, without sense, in the attitude in which he took it, for three or four hours afterwards. Pliny, the Roman historian, much later, bears evidence to the same effect, and adds the singular remark that some persons have sought sleep from the smell of this medicine. And again, Lucius Apuleius, the author of the book called the "Golden Ass," who lived about 160 A.D., and of whose works eleven editions were re-published in the fourteenth and fifteenth centuries, says that if a man has to have a limb mutilated, sawn, or burnt, he may take half an ounce of mandragora in wine, and whilst he sleeps the member may be cut off without pain or sense.

It is unquestionably to this same anæsthetic wine our own Shakespeare refers in his half-imaginary, half-legendary Middle Age history. This is the wine of that insane root, which, says Macbeth, "takes the reason prisoner." This is the wine that Juliet drinks, and the action of which the Friar Lawrence describes—

> "Through all thy veins shall run
> A cold and drowsy humour, which shall seize
> Each vital spirit; for no pulse shall keep
> His natural progress, but surcease to beat.
> No warmth, no breath, shall testify thou liv'st,
> The roses on thy lips and cheek shall fade
> To paly ashes; thy eyes windows fall
> Like death when he shuts up the day of life;
> Each part deprived of supple government,
> Shall stiff, and stark, and cold, appear like death:
> And in this borrow'd likeness of shrunk death
> Thou shalt remain full two and forty hours,
> And then awake as from a pleasant sleep."

It follows therefore from the history of scientific discovery that our modern great advance of removing pain during surgical operations is in fact, if not as old as the hills, as old almost as wine. But is the story true, you say? I answer yes, and the answer is from experiment. Thinking it a subject of very great interest, I instituted, a few years ago, an inquiry into the matter. Through the kindness of my friend, Mr. Daniel Hanbury, F.R.S., I obtained a fine specimen of mandragora root, and I made once again, after a lapse of probably five centuries, Mandragora wine. I tested this, and found it was a narcotic having precisely the properties that were anciently ascribed to it. I found that in animals it would produce even the sleep of Juliet, not for thirty or forty hours, a term that must be accepted as a poetical license, but for the four hours, named by Dioscorides easily, and that in awakening there was an excitement which tallies with the same phenomenon that was observed by the older physicians.

Thus, one of the first uses of wine to man was amongst the most noble and beneficent that man, by his ingenuity, can confer on his kind, and if wine had ever been used in this way and in none worse, Pater Lenæus might have retained his supremacy in the good opinion of all the world.

Besides using wine for extracting the virtues of the vegetable kingdom, our ancient chemists tested it on metals and made it here subservient to their purpose. What they called the extract of Mars was a solution of iron made with an astringent wine, and reduced into a thick consistency by fire. Eight ounces of the rust of iron, powdered very fine, were put into an iron pot and covered with four pints of strong red wine. The iron crucible was then set on the fire and the mixture, stirred with an iron rod, was boiled to a third; then it was strained through a cloth and evaporated into an extract. To this extract wonderful curative powers were ascribed, and indeed it was a very useful medicine. The metal antimony also was subjected to the action of wine. The so called liver of antimony was treated with white wine and dissolved in it: to this day we retain the remedy. It was originally called the emetic wine.

Uses of Spirit of Wine or Alcohol.

After the process of distillation of wine was discovered, the use of the new spirit rose rapidly into application in a variety of ways. The adepts, the Middle Age chemists of whom I have spoken, kept this distilled spirit long a secret. They found in it a solvent for many things that before were insoluble. Oils, resins, gum resins, balsams were now brought into a medium that acted towards them as a menstruum, and straightway they were dissolved. The East Indian Styrax Benzoin yielded a balsam which, dissolved in the distilled spirit, was a fortune to the chemists. The Commander's balsam, or balsam for wounds, or Friar's balsam, was soon the reputed heal-all of every injury.

The useful first extracted out of the new distillate, beauty was next remembered. Alas for the female face divine, the cosmetic and the subtle wash that should veritably make young faces old and assumably make old faces young, were soon in process in the laboratory of the adept who could distil wine. Again the artist came in for a share in the discovery. The once insoluble and useless resins and ambers were dissolved for his brush, and gave him coatings, preservatives, and washings, of which previously he had no conception.

This spirit of wine burns. It does not touch oil for the light it gives, but how strange! it burns away without a trace of smoke, and with an excellent heat. So the spirit lamp in due time is invented. A trifle say you? Nay, it was as great an advance to the chemist who first used it as the gas in the Bunsen burner is to us.

Once more; this subtle spirit has in it the virtue of preserving all organic substances with which it is brought in contact. It masters putrefaction itself; perchance the elixir of life is therefore found. It dissolves insoluble bodies; perchance it will by careful study and experiment reveal the grand secret of transmutation. In this way reasoned its first masters.

I must not dwell longer over these details of minor things of major usefulness. I must turn to some applications of our refined spirit which are major in fact as well as in use, in theory as well as in practice, in science as well as in art. In this regard we have to consider alcohol as the basis of other essences not less potent than itself.

The process of distillation of essences from liquids and from vegetable substances once established, it was but natural that some adept should turn his hand to mineral bodies and try if they would not yield some new product that should be of effective and novel quality. Into the distillatory soon pass, therefore, all manner of things, from the horn of the stag or hart, to the skull and brain of the dead man. Among other substances there was submitted to distillation this green stony crystal found in the earth, and called green vitriol, in Latin *vitriolum*. The result of the distillation of this *vitriolum* was to obtain as a yield, in the retort, the heavy oily corrosive fluid called, originally, spirit of vitriol, called now oil of vitriol or sulphuric acid.

Many were the fanciful things thought of by the adepts concerning this oil, and even to the letters of which the word *vitriolum* is made up they attached a mystical symbolism. In course of time they began to combine and to distil other fluids with the corrosive sulphurous oil, and amongst the first of fluids used in this manner stood spirit of wine. The experiment did not deceive them, for it gave them as a product one of

the most useful and wonderful of liquids. To them this new liquid as it first was taken from the retort was an infinite marvel. They poured it on water and it floated, on spirit and it floated. They poured it into their hands, and, lo! it boiled there. It escaped from them into an invisible state or air before they could well bottle it; it burned and exploded. It caused, when it passed off from the surface of the living body, an intense cold. It dissolved wax, oil, fat gums, resins, balsams, and yet when it was set free it let them fall again. It was so light that a measure which would hold twenty pounds weight of water would only hold seven pounds of this light intangible liquid. What name shall they apply to this substance, the lightest known? They designate it by a term indicating the lightest thing they can conceive: they compare it with the refined medium, with which the philosophers imagine the firmament to be filled, and they give it the same name. They call it *æther*.

Of what strange after use this magical fluid has been to man we all know. It was introduced early into medicine, and was well studied last century by Dr. Ward and by Mr. Turner, of Liverpool. In our own time, it has been discovered to have the power of suspending sensation and sensibility after being inhaled by the lungs, and by its means there has been reintroduced to the world that beneficent and long lost art of rendering the body insensible to pain during surgical operations.

More recently by a study of the application of ether for the production of intense cold, I myself introduced that local use of it for benumbing the body, called the ether spray.

The value of this secondary alcohol to man is indeed inestimable. You know how valuable it has been in photography as the volatile solvent of collodiom, and in the various departments of the fine and useful arts it has rendered equally good service.

From the distillation of *vitriolum* our adepts soon passed to other solid substances. They distilled saltpetre, and so got the spirit of nitre, which we call now nitric acid; they distilled common salt in combination with oil of vitriol, and so got spirit of salts (marine acid), which we call hydrochloric acid. Again, with these new spirits they distilled spirits of wine to obtain new ethers, nitrous, and marine. Then a chemist, the Count de Lauraguais, distilled together acetic acid and spirit of wine, by which process he obtained acetous ether. Thus by these double actions, a numerous series of useful ethers has been obtained, it were too long for me to enumerate.

From the observation of the fermentation of wine we derive, in a certain sense, our first knowledge of gases. Van Helmont gave to the gas which comes from the fermenting of vegetable matter the name of *gas sylvestre*, and from this may be dated the origin of the study of these invisible forms of matter. Priestly made some of his early observations on the gas which escaped from fermenting malt in a brewery at Warrington, and was led step by step to the liberation of gases from mineral and earthy substances, and so to the discovery of oxygen. Upon that discovery, coupled with his method of collecting gases by displacement of water, and of trying their qualities, came the process of distilling and collecting a gas from coal, and thus coal gas.

After the discovery of the element known as chlorine, and of the compounds of that element with other elements, another new era was opened in the history of alcohol. By passing chlorine through alcohol, Liebig obtained that narcotic substance which we call chloral hydrate; and by treating alcohol with chloride of lime, the same great experimentalist produced for us chloroform, an agent which has rivalled ether in its service as a soother and saver of pain. If you glance at the table of anæsthetics or sleep producers which is before you, you will see by the names in italics those substances which come from alcohol. All that have proved of most use excepting one, nitrous oxide or laughing gas, have this common origin.

List of Substances that will produce Anæsthetic Sleep.

Nitrous oxide gas	Tetra-chloride of carbon
Carbonic oxide gas	Heavy carburetted hydrogen gas
Carbonic acid gas	*Olefiant gas or ethylene*
Bisulphide of carbon	*Ethylic, or absolute ether*
Light carburetted hydrogen	*Chloride of ethyl*
Hydride of methyl or marsh gas	*Bichloride of ethylene* (Dutch liquid)
Methylic alcohol	*Bromide of ethyl, or hydrobomic ether*
Methylic ether gas	Hydride of amyl
Chloride of methyl gas	Amylene
Bichloride of methylene	Benzol
Terchloride of formyl, or chloroform	Turpentine spirit

Had the time not been expended, I could have brought before you further illustration upon illustration of these secondary uses of alcohol to man; but I must stop, content in having recalled to your minds some of the more striking facts in the history of the curious and important agent which is now the subject of our studies.

MISCELLANEOUS.

PROTECTION FOR INVENTIONS.

The last number of *Iron* contains a letter from Messrs. Moy and Shill, which illustrates the working of the German patent system. They say:—"Our patent steam-engine is considered to be a very great novelty in steam, and we considered it worth while to apply for a patent in Prussia. We applied very soon after obtaining provisional protection in this country, which was in November, 1871, but we could get no answer from Prussia until after our final specification in this country had been printed; and then, after many months of delay, of course we obtained the stereotyped reply, 'Not new.'

"But the application for a German patent for our aerial steamer will be still more interesting to your readers. Our application was made in good time, as in the former case; yet for about eighteen months we could get no answer at all; and we only got an answer ultimately in the following roundabout manner:—A gentleman named Bennett sent a description of our aerial steamer to a French journal called *L'Aeronaute*. Some of the officials in Berlin read this article, and wrote to Mr. Bennett for further information. Mr. Bennett handed us their letter, and we wrote to the authorities in Berlin that if they would deal justly with us, and grant us a patent, we would, in return, furnish them with information; and we mentioned the date of our application. In answer to this, we received a letter stating that the examiners at their Patent-office had examined our specification and refused to grant a patent; and we have heard nothing more from Germany in the matter.

"It is remarkable that in Germany it costs the same amount of money whether a patent is granted or not. We should be happy to be informed what really will induce the worthy examiners to open their eyes and sharpen their intellects, and enable them to see something new as well as useful in English inventions.

"Allow us to add, that it seems to us to be a great pity that, when Prince Bismarck was consolidating Germany into an empire he did not also consolidate the Patent-laws, and amend the mode of administration in in Berlin. Perhaps somebody can inform us what states in Germany are more favourable for obtaining protection. Such astute legislators as the Germans ought to see that their conduct tends to cause such men

as Dr. Siemens to become aliens to the land of their birth, and impart additional lustre to the land of their adoption."

CHANNEL PASSAGE.

THE BESSEMER STEAMER.

The *Bessemer's* engines being complete she made a trip on Monday, the 21st ult. The steamer should have started at nine o'clock in the morning, but she was detained till after ten o'clock by a thick fog on the Humber. The fog was succeeded by a heavy snowfall, which was at its worst when the measured mile was passed, and lasted till the afternoon, leaving an insufficient duration of day-light for the trial of engine power and speed, and compelling the pilot to return to Hull. The bearings of one of the engines showed a tendency to heat, rendering some slight adjustments necessary. The day was not, however, wasted, as on the run back to Hull, with the steam at a pressure of only 19 lb., and the engines making only 20 revolutions, the speed against a strong head wind was ascertained to be 14 knots, or over 16 miles an hour, which was considered to make it certain that a very high speed indeed will be attained with full steam power, which should be 30 lb. pressure, and with the engines making nearly or quite 30 revolutions. The steering of the ship was admirable, the ship answering the helm very quickly, and turning in a very small circle for so large a vessel. The behaviour of the lower freeboard bow was watched with great interest by Mr. Reed, the designer, and all on board. The bow wave carried was remarkably small, and even when steaming at over 16 miles an hour, against a strong head wind and some sea, the low deck was seldom covered by the waves. As the trial was simply for the information of the contracting engineers, only ordinary north-country coal and the usual staff of stokers were employed. This preliminary trial developed no defects of any kind in the *Bessemer*, but has gone far to establish the accuracy of the views upon which she has been built, as regards the performance of the ship and of the engines. On one point the trial exhibited a very remarkable and highly-satisfactory result—namely, the manner in which the two sets of paddle-wheels worked together. The effect of the broken water of the forward wheels is so slight in its action upon the after pair of wheels that the difference between the revolution of the two wheels was never greater than one or two revolutions. The ship was taken into the Albert-dock on her return to Hull, to enable the saloon and its machinery to be completed, and to prepare for the official trial of the engines.—*Engineer*.

The *Athenæum* reminds its readers that many vessels which are sold as being tinned are really coated with a mixture of tin and lead. M. Fordos has addressed a paper to the Académie des Sciences, in which he states that water, acidulated with 1 per cent. of acetic acid, being allowed to stand in such vessels, dissolves out some of the lead.

The *Swiss Times* says that in the year 1873 the United States imported from Switzerland articles of the following values:—Woollen and cotton fabrics, 15,261,000f.; embroidery, 56,439,200f.; cheese, 10,753,605f.; silks, 140,716,800f.; straw goods, 11,490,200f.; clocks, watches, and articles for their manufacture, 67,881,700f.; and musical boxes, 2,254,600f.

According to the *North China Herald*, the Chinese are congratulating themselves on a magnificent cotton crop this year. The yield, it is said, exceeds that of any season for the past ten years. It may be assumed, remarks the *Herald*, that the success of the cotton crop will have its effect in diminishing the demand for cotton goods of foreign manufacture, but not to any considerable extent.

A series of experiments has lately been made by the Russian Government with reference to the use of electricity for the head-light of locomotives.

NOTES ON LIGHTNING CONDUCTORS.*

The Halles Centrales, Brussels, consist of two larg
naves, 160 metres (525 feet) long, supported by 60 cas
iron columns, on which rest the main girders. Th
wings are united to these interior columns by wrough
iron arches, with 116 columns, the spaces being filled
with masonry, thus forming the outer walls. All t
columns reach down into the basement, which cons
of two vaults, communicating one with another, a
provided with gratings over the whole surface. Ea
column carries the iron joists which sustain the arch
masonry of the ground-floor. There is, therefore, qu
a network of joists and girders connected, metal
metal, with the rest of the iron-work of the building, a
with the gratings above mentioned. Each of the colum
rests on a strong limestone flag, bedded on a squ
masonry foundation, which in turn rests on a layer
concrete laid on the natural surface of the soil, the sp
between the concrete and the brick floor of the baseme
being filled in with earth. On the ground-floor, as w
as on the basement, a large number of cast-iron wast
water, gas and water pipes complete this extensi
metallic network. The whole quantity of wrought a
cast iron, is about 2,460 tons in weight, all the differe
portions being connected by more than 100,000 bolts a
nuts; there are probably, therefore, as many points
contact.

It must be admitted that an edifice would be protect
from lightning if the iron of the ridge were continu
without break to the earth. If, then, in the case of t
Halles Centrales the whole is in perfect metallic conta
and if, besides, the soil on which it rests is sufficient
damp to act as a good conductor of electricity, it may
said that the building constitutes a protecting conductor
the highest degree, and that a flash of lightning whi
might strike that conductor of unusual section would
dispersed by the numberless channels, or would traver
the whole network with the greatest facility. This fa
was proved by (1) voltaic electricity from a battery, an
(2) by magnetic electricity from electrical machines an
a Rhumkoff's coil.

The author, with MM. Gibbs and Banneux, tel
graphic engineers, conducted some experiments with
small Daniel battery of three cells, one pole of whi
they connected by a copper wire rope of three strands
the iron ridge of the building, which pointed S.; t
electric current then passed freely into a Siemens' rhe
stat and a galvanometer, or differential rheometer, su
as is employed in connection with telegraphs. Th
second wire rope, sufficiently long to reach the l
column and the ridge on the opposite side, was connect
with the other pole, and allowed the circuit to be made
will by touching any of the parts of the building. In t
first place, the circuit was completed by placing the wi
rope on the layer of asphalte on the market floor, whe
there was no deflection, whence it follows that to t
buyers and sellers in the market the floor is a comple
insulator. On taking up some of the asphalte a
making contact with the concrete of the vaults, t
deflection rose to between 84 deg. and 85 deg.
the vaults are several cast-iron frames, some provid
with a grating and others with a plate of rough gla
On placing the wire in contact with the iron fram
which is connected to the concrete and the back of t
vault by a large surface, the deflection rose to 88 deg
The electric current can, therefore, pass almost freely
the girders, the columns, and the mortar of the vault
If the circuit was completed by placing the second wi
in contact with the columns of the nave, the out
columns, the gas pipes, the wrought-iron in the gallerie
the cast-iron waste-water spouts, or the columns whic

* This is translated from a paper by M. Melsens, member of th
Belgian Academy, in the *Moniteur Industriel Belge*. It is repro
duced here, as the subject is shortly to come before the Society in
paper, by Dr. Mann.

...the two wings, or touching, without in any way ...ing the former arrangements, the same parts in the ...gallery, columns, spouts, gallery, girders, &c., ...was no alteration in the deflection of the galvano-...; this showed that there was no sensible resist-..., for the instrument always stood at 90 degs., that is ...the needle at right angles to the current. These ...ments were repeated in the vaults, and the deflec-... was always the same, viz., 90 degs.; the case was also ...when contact was made in the street beyond ...footway, in the mud near the man-holes of the ...

...Halles Centrales are thus proved to constitute ...ent protecting conductor; but the question is, ...it is prudent to be content with this. The ...is of opinion that it is not, and advises that the ...conductor be completed near the soil, and that ...ridge be supplied with a row of copper points, so as to ...form the building into a lightning conductor both ...ing and preventing. In order to make the com-...tion with the soil thoroughly perfect, two wells ...ular section should be dug, one in the middle of ...of the wings. The sides should consist of a long ...of cast-iron, filled, if necessary, with sea sand ...alkaline by weak lime-wash. The capital of ...column should be in perfect contact, metal to metal, ...the cast and wrought-iron of the edifice, and with ...water and gas pipes beyond the meters, which often ...lead pipes offering sufficient resistance to become ...in the case of strong discharges of electricity.

...order to test the powers of conducting electricity ...by the Halles Centrales, a Holtz machine, ...with two insulated conductors terminating in ...spheres, was placed in the nave. One of the ...was put in contact, as in the former experiments, ...the other was kept in the hand, and held wherever ...was iron, on the ground floor, in the two wings, ...the vaults. Everywhere sparks were manifest; ...wrought-iron grating of a stall standing on the ...the spark showed itself more vivid than on the ...of the cellar. On the paved floor of the base-...the same thing occurred, and people who were ...ing on it received a violent shock. On the asphalte ...weaker, but still quite perceptible. It was less so ...the large plates of thick rough glass. On a shower ...occurring, the manifestations were more marked, ...crackling that was heard along the whole length ...wire proved that it lost a great deal of electricity. ...interior of a large Leyden jar, insulated on two ...and thick plates of rough glass, was put in con-...with one of the columns, and the exterior with the ...sphere of the second wire, when the jar became ...and gave out some very brilliant sparks. The ...led to the top of the edifice having been detached, ...the experimenters, holding in their hands the ...of the insulated wires, furnished with their metallic ...presented them to the columns. Sparks were mani-...even when the two experimenters were at a slight ...In fact, the thorough communication of the ...with the soil was completely established.

...some remarks on the lightning conductors of ...Hôtel de Ville, the Conservatoire Royale de Musique, ...the Bourse, all at Brussels, M. Melsens concludes ...observations and data relating to buildings ...large masses of wrought and cast iron are em-...It is best to place all masses of iron that are ...considerable size in direct communication with ...conductors. As a super-precautionary ...the author has thought well (the results of his ...being sometimes contradictory) to give a ...rule on this subject, that "all the metallic parts of ...considerable size should be placed in communica-...with the lightning conductors, so as to constitute ...metallic circuits, that is to say by two points, or ...conductors at least." But sometimes serious ...are encountered when the buildings are ...when their construction is far advanced. In the face of these difficulties, and keeping in view the slight degree to which electricity can manifest itself over several conductors of a considerable section altogether M. Melsens has determined for the present to leave all the metallic parts of the Hotel de Ville, Brussels, unconnected to the conductors, but to connect them when all the restorations shall be accomplished. On the contrary, all these difficulties vanish when the lightning conductor is designed and carried out with the building from its foundations.

CHILIAN INTERNATIONAL EXHIBITION.

The following letter appeared in the *Engineer* of December 19th:—

SIR,—The Chilian Government has fixed the 16th of September, 1875, for the opening of an exhibition at Santiago, to which, in addition to native products, raw and manufactured, those of all other American and European countries will be admitted, and the following information will be useful to intending exhibitors:—Packages containing goods intended for the exhibition must be marked "Esposicion de Chile," besides the exhibitor's private marks and numbers. The exhibition is constituted a bonded warehouse, in order that all packages may be forwarded to Santiago immediately after their landing in Valparaiso. Custom-house officers, appointed for the purpose, will receive and examine the goods on their arrival. In order to expedite the examination of the contents of the packages, exhibitors must produce a list of the contents of each package. Exhibitors will enjoy the following privileges:—(1.) A reduction of 50 per cent. on the tariff of the railway between Valparaiso and Santiago, and all other railways belonging to the State. (2.) The importation duty free of all goods comprised in sections I., II., and IV., and in the special group of public instruction. (3.) The directing commission will grant 40 dols. (about £8) for passage money of every person coming in charge of machinery for the exhibition. Workmen availing themselves of this advantage must be provided with a certificate from the Chilian consul at the port of their embarkation, stating that they expressly came for that purpose. The Pacific Steam Navigation Company have offered a reduction of 25 per cent. of freight on goods intended for the exhibition. Exhibitors of machinery in motion will be supplied with motive power free of expense, but must themselves provide any special motors that they may require. Steam and water will be provided free of expense. All articles must be ticketed with their prices, but these may be altered during the exhibition. The exhibition will be opened on the 16th of September, and closed on the 31st of December, 1875.

Goods belonging to sections I., II., and III., will be received on deposit in the exhibition stores from the 1st of March to the 15th of August, 1875, after which date no articles belonging to the above sections will be received. Articles belonging to section IV., and the special group, &c., will be received up to the 25th of August, 1875. JUAN E. WALKER.

Representative of English Exhibitors.

Santiago, Chili.

A commission, nominated by the Geographical Society of Paris, and composed of Admiral Fluriot de Langle, MM. Delesse, Charles Grad, H. Farry, and Jules Girard, has just published some instructions to navigators to aid in their study of the physical geography of the sea. These instructions, which the society sends gratuitously to everyone who is willing to turn to account, in the interest of science, his stay on board ship, point out, in a style sufficiently precise and elementary to come within the comprehension of all, the principal points on which observations should be made, and the best methods to be adopted for collecting useful particulars.

CORRESPONDENCE.

THE PUBLIC USUFRUCT OF PATENTS.

Sir,—Mr. Bramwell's excellent paper, and the discussion upon it, may be considered to have disposed of arguments like those which, forty years ago, were put forth under a title such as "The Policy of Piracy" against the registration of designs—arguments that have been used from time to time since, to the astonishment of many persons, against what the author of the paper well describes as "the recognition by the State of property in inventions." Having myself repeatedy urged the expediency of protection, for preventing loss of inventions that would otherwise be kept concealed, I can have no fault to find with the almost entire omission now of notice of the higher ground which might be taken by defenders of Patent-law, who retain views of morality supposed to regulate the conduct of individuals, and not to be disregarded in the behaviour of the aggregation called the State. Obviously there is no obligation, on the simple score of morality, binding or urging the State, or individual, to the purchase of anything where there is no use made or intended to be made of the article, invention, or what not. There can be no robbery without something taken. But it is expedient that usufruct of inventions should pass into the hands of the State, and it is the duty of the State-administration to make the best bargain it can for those whom it represents. The administration should take into account primarily, though without injustice, not the inventor but the community. The latter want the thing invented, but they are interested in rewarding the inventor solely because that course will conduce to the primary object, as well as to the demonstration of the inventive spirit in the future. The usufruct being what is wanted, it is the duty of the administration to pay no price such as a privilege allowing the inventor to prevent the use of his invention. The bargain should be: payment to the inventor—taking the form of the privilege *intended* by the present system of patents—and perfect realisation of the advantages of the invention for the public benefit. As to the latter the present law is most seriously defective.

The justification for granting a patent being that there is something to be gained in return for the price—which price is the monopoly conferred—the probability should always be considered as great that the inventor may have been but little in advance, in point of time, of some other inventor, and that each invention is very liable to be soon improved upon or superseded; whilst the price should not be the enabling an individual to stop the public and future inventors from using the thing.

The effect of the law as it is seems to have been not entirely unrecognised; but I fear that the extent of the evil referred to is known to few. It is the main object of this letter to state facts within my observation. During the Exhibition of 1862 I had the duty of supplying to a journal, with which I was then connected, a carefully-compiled series of notices of the stove-grates and kitchen-ranges in the Exhibition. Though not previously ignorant of such contrivances, I was surprised at the number of patented inventions that there were. Scarcely any kitchen-range was without several, and some ranges had five or six; but it was seldom that the same patents were used by different manufacturers. Wishing to know how a person wanting a range, the best that could be produced, could obtain that article, I called the attention of this and that manufacturer's agent to the omission in his exhibit of features that there were in ranges close at hand. The range manufactured by A. B. had not the patented oven and flues which, looking at C. D.'s range, seemed best; and the range of C. D. had not the patented latch of A. B.'s range. The reason given by A. agent for the omission in his range, and by C. representative for the like, was that the feature was property of the other manufacturer. Moreover, it see that, added to any obstruction on the part of a ri there was a conceit in each manufacturer about limi himself to his own patents. This feeling may be sidered by some persons as creditable pride in the m facturer, but when indulged in it helps to mak Patent-law injurious rather than serviceable to public, who, in allowing the monopoly, had clearl object but the obtaining the best form of range for fair price.

There cannot be a doubt that, unless this sta affairs be remedied by an amendment of the law, whe there shall be compulsory granting of licenses on payment, and whereby there shall be a right of people to demand that patents granted shall be use of on payment for the article embodying the us strongest possible argument will be placed in the h of those who wish for the abolition altogether of pa A thing patented should be what the term "pat implies, open to the public use. It should not be b "patent" shut away from that use, and shut out the application along with other patents.—I am, &

Edward Ha

6, Claverton-street, St. George's-square, S.W.,
17th December, 1874.

PATENT-LAWS.

Sir,—The paper read by Mr. Bramwell befor Society, on the "Expediency of Patents," wa haustive of that branch of the subject. This fact recognised by those engaged in the discussion, directed their remarks chiefly to the defects of patent system. The "merits and demerits" of Pa laws form a subject for consideration quite distinct the expediency of these laws, and Mr. Bramwell cised a wise discretion in limiting his paper to "expediency view," though he was compelled to ref his closing remarks, to some of the requisites of sirable system. Mr. Bramwell gave some reasons it was not expedient to introduce the American sy of examination, and in these views I concur, but anxious to learn what system of administration he recommend, as he intimates he has decided views what constitutes a good system. I would sugges Bramwell be invited by the Society to read an paper upon patent systems. The influence of a paper, and the discussion it is sure to elicit upon legislation would be most beneficial. I am credibl formed that an attempt will be made next sessi amend the patent system, and there is no subj little understood by legislators. The chief defect English patent system is the absence of the liberal that has always characterised the American patent lation, to which the wonderful results of the Am system are attributable. Whatever mode of adi tration may be adopted, "justice to inventors," than "expediency," must be the cardinal principle legislation on patents.

These views were regarded by Mr. Bramw "sentimental," but the learned chairman, Mr. Ste Q.C., stated that the inventor's right to his inv was even more perfect than the right to most other of property. In considering the "expediency" of P laws there is danger that legislators will not giv weight to the rights of invention; and they shou reminded that the title to patent, as well as othe perty, rests on a higher and more stable foundation "expediency." A patent system just to inventor hardly fail to be expedient to the nation. The op above expressed in regard to the American examin system is founded upon a long and intimate acquain with the working of that system. The introducti strict examination, with power to the examiners to r

ments, could hardly fail to be detrimental alike to the interests of inventors and the public. This system has been tried in America under the most favourable circumstances for success, and the most we can say is that it has not proved disastrous; while in Prussia it has been tried under less favourable conditions, and has nullified the Patent-laws, which is a result we may fairly anticipate by its introduction into this country. The assimilation of the patent systems of all nations is most desirable in every respect, but we cannot afford to introduce that reform by adopting the American system, as suggested by many reformers. Let us have more public discussion to prepare the way for the promised legislation.—I am, &c.,

GEORGE HASELTINE.

4, Southampton-buildings, London,
December 30th, 1874.

LIFE-BOAT BRIDGES FOR SAVING LIFE.

SIR,—I cannot refrain from addressing you on the loss of life at sea, suggested by the recent foundering of the *La Plata* in the Bay of Biscay, and of the sad loss of the brave captain, officers, seamen, and scientific men who went down in the ill-fated vessel.

My object in writing is not for personal benefit, or to give publicity to the invention known and patented as "Hirn and White's Life-boat Bridge," which has been before the Admiralty, the public, and various scientific societies for some years past, but in the hope that it may be adopted as being in my opinion the only efficient plan for saving life in cases of emergency, such as the *Birkenhead* in 1852, and numberless other, ending with the *La Plata*, which is now so painfully before the public.

This plan is open to be adopted by any and every one. I must however state with much satisfaction that the Lords of the Admiralty have decided to adopt it for their troop-ships, and I have recently received an order for H.M.T.S. *Orontes*, now being lengthened at Liverpool, with one of my life-boat bridges and boats.

The principle of the invention is founded, first, upon the method of carrying and launching large and heavy life-boats, capable of holding from 150 to 200 men; they are carried athwart the ship, resting on launching ways, supported at either end by upright shores, which can be knocked away at a moment's notice, the boat being immediately launched into the sea, from either side of the ship, and with a hawser attached, can be veered under the lee quarter of the ship, where she would ride in safety until required for use.

The first idea of the life-boat bridge was the so converting it into a raft that it might float off in case of the ship's foundering, but this plan was open to the dangerous possibility of its being entangled in the rigging and carried down by the ship. Upon further consideration the idea matured itself into the converting the bridge into the launching ways, upon which was placed a life-boat on Lamb and White's principle, which could be launched from any height of side, as she would readily relieve herself of any water she might ship, by valves in the bottom, fitted for the express purpose.

The principle can be most successfully applied in emigrant and passenger, as well troop-ships, as two or more of those bridges can be fitted according to the number of souls carried on board.

In urging the merits of this particular invention for saving life at sea, I do not underrate others, nor the carrying boats in davits, these being necessary for the ship's work.

Being fully persuaded of the practicability of my method, I take this means of bringing it before the public, in the hope that it may be largely adopted were practicable.

The danger of carrying life-boats hanging in davits outside the ship and exposed to the sea must be obvious, as proved by the disasters we daily read of in the public papers, from ships losing their boats.

While on the subject I cannot help mentioning Captain Hurst's Life Rafts, which are lashed to the bulwarks, outside the ship, ready to be cut away at a moment's notice. These are a valuable addition to the ship's life-boats in any form, and however carried.—I am, &c.,

JOHN WHITE.

Medina Docks, West Cowes, Isle of Wight.

NOTES ON BOOKS.

Scientific London. By B. H. Becker. (*H. S. King and Co.*)

In this volume Mr. Becker has given a popular account of the various scientific societies and institutions of London. Those included are:—The Royal Society, the Royal Institution, the Society of Arts, the Institution of Civil Engineers, the Chemical Society, the Department of Science and Art, the London Institution, the Birkbeck Institute, the Gresham Lectures, the Society of Telegraph Engineers, the Museum of Practical Geology, the British Association, the Statistical Society, and the Royal Geographical Society; fourteen in all. In each case a brief sketch of the foundation and origin of the institution, as well as of its present condition, is given, and the intention of the book is, as its author states, to provide members of our various societies with some information about the history of that one to which they belong, and its standing among the rest. The chapter devoted to the Society of Arts, after narrating the circumstances connected with the foundation of the Society, goes on to describe some of the varied and numerous undertakings with which it was connected in the early periods of its history. Its association with the first Exhibition scheme is, of course, noticed at some length, and its present action is last of all described. Without in any way committing this *Journal* to an endorsement of Mr. Becker's views, it may fairly be said that his book gives a very kindly and sufficiently accurate account of the different institutions he criticises. Inasmuch as the whole space at his disposal only amounts to 340 small octavo pages, minute detail or lengthened historical narrative in each separate case would be impossible.

Plants, their Natural Growth and Ornamental Treatment. By F. E. Hulme, F.L.S., &c. (*Marcus Ward and Co.*)

The object of this book is to offer to the ornamentist a guide in his treatment of those natural forms which form the chief subject matter of his labours. The principal part of the work consists of plates, illustrating the various plants described in their natural forms, and giving, in many instances, examples of the conventional treatment they have undergone, when transferred to the flat surface of the decorator. Of these plates there are forty-four, all printed in the natural colours. To each plate is appended a short descriptive article, dealing with the flowers and leaves in regard to their artistic capabilities.

History and Practice of the Fine Arts. By W. B. Scott. (Longmans, Green, and Co.)

Mr. Scott's "Half-hour Lectures on the History and Practice of the Fine and Ornamental Arts" is now republished in a third edition. In a series of nineteen short chapters or lectures, the author traces the rise and progress of the various departments. In the first thirteen chapters decorative and ornamental art is mainly considered. Then follow three chapters on the history and on the various methods of painting. The last three are devoted to explanations of general terms in art.

Sun and Earth as Great Forces in Chemistry. By Thomas W. Hall, M.D. (Trubner and Co.)

Dr. Hall appears to wish to resolve all chemistry into the action of heat. He regards the sun "as our highest chemist," and the earth as a vast and active chemical, and aspires to found an entirely new chemical philosophy, based on certain peculiar views of the functions of solar heat in its relations to matter. By means of this philosophy he undertakes the explanation "of chemical affinity and attraction of the elementary forms of chemicals, of the causes, nature, and results of combinations, of combustion, and of decomposition, and also of many of the phenomena of the galvanic battery and of electricity." Readers who wish to study this new theory must be referred to the treatise itself.

GENERAL NOTES.

Production of Champagne in France.—The Chamber of Commerce of Rheims has lately published the following particulars relative to the production of this wine in the department of the Marne, where 16,500 hectares of vineyards (40,755 acres) are cultivated for that purpose, of which 2,465 hectares are situated in the district of Vetry-le-Francois; 555 hectares in that of Chalons; 700 in that of Sainte Manehould; 7,624 in that of Rheims; and 5,587 in the Epernay district, where the finest qualities of champagne are grown. The value of this wine, produced annually in these districts, exceeds 60,000,000 francs (1½ million sterling). During the last thirty years, the value of these vineyards has increased fourfold.

Exhibition of Agricultural Machines and Implements at Paris in 1875.—On the request of a large number of manufacturers, the French Minister of Agriculture and Commerce has decided that an exhibition of agricultural implements and machines shall be held in connection with the general show of fat beasts, poultry both live and dead, cereals and roots for seed, &c., which will take place at the Palais de l'Industrie on the 25th of next month. Forms of application for space may be obtained at the office, 60, Rue Saint-Dominique, or will be sent to those who apply fer them at the office of the Minister of Agriculture and Commerce.

Gresham Lectures.—The Mercers' Company have given notice that in the approaching Hilary Term the lectures founded by Sir Thomas Gresham will be read to the public gratuitously in the theatre of Gresham College, Basinghall-street, in the following order:—Astronomy (the Rev. Joseph Pullen), January 11th, 12th, and 13th; Physic (Dr. Symes Thompson), 14th, and 15th; Rhetoric (Rev. Charlton Lane), 16th, and 18th; Geometry (the Dean of Manchester), 19th and 20th; Divinity (the Rev. J. W. Burgon), 21st, 22nd, and 23rd; Law (Dr. J. T. Abdy), 25th, 26th, and 27th; Music (Dr. Henry Wylde), January 28th and 29th, and February 1st. Each lecture, with the exception of those on Music, is delivered, according to the will of the founder, first of all in Latin at six o'clock in the evening, and afterwards in English at seven o'clock. The music lectures begin at seven.

Indian Coal Fields.—The coal-fields of India may be divided into four groups:—1. Those of Bengal, including the coals of the Rajmahal Hills and those of the valley of the Damudo. 2. These of Rewah, Sirguja, Bilaspur, Chutia, Naspur, and the tributary mehals of Orissa. 3. Those of the Nerbudda valley and the hills to the south of it. 4. Those of Chanda and the Godavery. The principal field is that of Raniganj, beginning about 120 miles north-west of Calcutta and extending northward about 18 miles. This field supplies about half a million tons a year, ten times the yield of all the other fields put together. The seams which are mined vary in thickness from 4½ feet to 35 feet and are individually variable. Eighteen distinct coal-bearing areas are enumerated in the several groups. In all the basins the coals are mostly concentrated in one bed of great thickness, consisting of alternations of coal and shale, and the beds thin out rapidly to the west. In the Raniganj field, where the formation attains its maximum thickness, the upper group is 5,000 feet thick, the lower 2,000 feet, each containing several seams of coal. To the west the upper group is replaced by rocks containing no coal, while the lower diminishes greatly in thickness.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

The Church Builder for 1874. Presented by the Publishers, Messrs. Rivingtons.

A Tract on Musical Statics, by John Curwen. Presented by the Author.

Wave Lines, by Dr. J. Collis Browne. Presented by the Author.

Researches on the Atomic Weight of Thallium, by William Crookes, F.R.S.

De Wereld-tentoonstelling te Weenen, by J. W. De Campo.

Report by Dr. M. C. Cooke on the Gums, Resins, Oleo-resins, and Resinous Products in the India Museum, or produced in India.

Statistics of the Colony of Victoria for 1873—General Report—and the Report of the Minister of Public Instruction. Presented by the Agent-General.

Du principe essentiel de l'Harmonie, par Alexandre Marchand. Presented by the Author.

Report of the Commissioner of Education (Washington, U.S.) for the year 1873.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...Institute of Surveyors, 12, Great George-street, S.W., ... p.m. Mr. J. E. Knollys, "The Landlord and Tenant Question."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. M... J. E. Howard, "The Early Dawn of Civilisation, considered in the Light of Scripture."
London Institution, Finsbury-circus, E.C., 5 p.m.

TUES. ...Royal Institution, Albemarle-street, W., 3 p.m. Pr... Gladstone on "The Voltaic Battery. The History ... the Battery in its various Forms." (Juvenile Lecture.)
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m. Annual Meeting.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m.

WED. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 3 p.m. Professor Macleod on the "Food and Work of the I... Horse." (Juvenile Lecture.)
Microscopical, King's College, W.C., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m. Annual Meeting.

THUR....Royal, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C. 7 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Pr... Gladstone on "The Voltaic Battery. Electrotyping, &c." (Juvenile Lecture.)

FRI.......Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m.
Astronomical, Burlington House, W.C., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m. Annual Meeting.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.

SAT.......Royal Institution, Albemarle-street, W., 3 p.m. Pr... Gladstone on "The Voltaic Battery. The Elec... Telegraph." (Juvenile Lecture.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,155. VOL. XXIII.

FRIDAY, JANUARY 8, 1875.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The Council have passed a resolution to the effect that in their opinion it is desirable that the Cantor Lectures Programme be from time to time, as far as may be found practicable, arranged to further the scheme of the Society's Technological Examinations, and that steps be taken for getting such lectures published in a special form as guide books.

CANTOR LECTURES.

The second lecture of the course of Cantor Lectures on "Alcohol, its Action and its Uses," by BENJAMIN W. RICHARDSON, M.D., F.R.S., F.R.C.P., was delivered on Monday, December 14th, 1874, as follows:—

LECTURE II.

The Alcohol Group of Organic Bodies—Actions of different Alcohols.

If before a chemist of a hundred years ago you could have placed a specimen of spirit of wine or alcohol, and could have asked him of what it was composed, he would have told you that it was the element of water combined with elementary fire, to which elementary fire he would give the name of phlogiston, a name derived from a Greek word, signifying to burn or inflame. He would tell you that all bodies that burned were phlogisticated, and that bodies that would not burn were dephlogisticated. The substance that was left behind was, he would probably add, the element with which the elementary fire had previously been combined. Were you to ask him whence he derived this knowledge, he would say, "from the greatest chemist who had ever lived before his time, George Ernest Stahl, Professor of Medicine, Anatomy, and Chemistry in the University of Halle, who had died in Berlin, whither he had gone to as physician to the King of Prussia—forty years ago."

As proof that alcohol was elementary water combined with phlogiston, our ancient chemist would probably show you this experiment:—He would place a portion of the spirit in a cup, would set fire to the spirit, and would invert over the fire a glass vessel, shaped almost like a [illegible] globe, which he would call a cucurbit, into which he would allow the flame to ascend. He would indicate that within the glass vessel a vapour, derived from the burning fluid, formed and condensed, as you see forming and condensing now. Collecting this fluid he would prove to you that it was water, which water he could prove to be nothing else but one indivisible thing, therefore an element. Thus his demonstration would be complete. The element, while it existed as spirit, yielded fire on burning; it was fire water. The fire was condensed with the water; nothing could be plainer, according to his light of science.

If you had inquired of the chemist whether he had any symbol by which to denote elementary water or spirit he would give you, as a symbol for water, a sign something like the letter **V**, with two wavy lines following the letters; and for spirit of wine, a sign like the letter **V** with the letter **S** in the centre, as I put it on the black board; and if once more you questioned him as to whether his laboratory contained any similar chemical substance he would answer—none. Spirit of wine stood by itself, a pure substance, possessing single and special virtues.

If, passing over the intervening hundred years, you asked the chemist of to-day, "What is alcohol?" he would tell you that it was an organic radical called ethyl, combined with the elements of water. He would explain that water was no longer considered to be an element, but to be composed of two elements, called hydrogen and oxygen, two equivalents of hydrogen being combined in it with one equivalent of oxygen. He would inform you that the radical he had called ethyl was a compound of carbon and hydrogen, and he would add that this radical in alcohol took the place of one of the equivalents of hydrogen of water. He thereupon would give you a symbol for water and alcohol, but symbols of a very different kind to those presented by his learned predecessor. He would express the names of the elements composing the water and spirit by the first letters of their names, and add their equivalents, or parts, by figures attached to the letters. Thus his symbol for water would be H_2O; for the radical ethyl, C_2H_5; and for alcohol $(C_2H_5)HO$ or C_2H_6O.

Were you interested about the theory of phlogiston, invented by the illustrious George Ernest Stahl, your modern guide would instruct you that the theory had long since been discarded, and that towards the latter part of the last century the very books of its discoverer had been burned in derision by a priestess of science in one of the temples of science in Paris. Then through what a wonderful history of discovery during the hundred years he would, if he liked, lead you. Into this cucurbit in which I burned the alcohol, and which you will observe I closed by placing it with its mouth downwards upon the table, he would pour clear lime water as I do now; he would shake the water round the sides of the cucurbit and see, as he did it, the water would become milky white. This phenomenon he would indicate was due to the presence of a gas which the old chemist had actually collected but had overlooked. That gas is carbonic acid. It, as well as the water, was the product of the combustion of the spirit, and it now, in combination with the lime water, has united with the lime, forming carbonate of lime or chalk. Following the history of this gas, called once fixed air, because it could thus be fixed by lime and other substances, he would show how it had been proved to consist of carbon and oxygen; how it is given off from the burning of bodies containing carbon; and how a French chemist of the last century, named Lavoisier, traced out by analysis how, in fermentation, the juice of grapes is changed from being sweet and full of sugar into a vinous liquor, which no longer contained any sugar, the inflammable liquor known as spirit of wine. Thence it would be shown that the same illustrious chemist, making an analysis of sugar and studying the effects of yeast in causing fermentation of sugar, collected and weighed the elements produced, determined the elementary composition of spirit as consisting of carbon, hydrogen, and oxygen, and from his research announced the new principle in chemistry, that in all the operations in art and nature nothing is created; that an equal quantity of matte

exists both before and after the experiment; that the quality and quantity of the elements remain precisely the same; that nothing takes place beyond changes and modifications in the combinations of the elements; and that in every chemical experiment an exact equality must be supposed between the elements of the body examined, and those of the products of its analysis. Finally, on this head, he would state the theory of Lavoisier, that *must* consists of alcohol combined with carbonic acid, and that the effects of vinous fermentation upon sugar are reduced to the mere separation of the elements of sugar into two portions; one portion oxygenated at the expense of the other, so as to form carbonic acid; the other disoxygenated to form alcohol. So that were it possible to reunite alcohol and carbonic acid the product would be sugar. Bringing you down to a later period, the modern chemist would describe a theory current about between thirty and forty years ago that alcohol is a compound of olefiant gas and water, and that in a state of vapour it consists of equal volumes of these. Or, again, that it was a hydrate of ether; or, again, according to a still later view, that it was a hydrated oxyde of ethyl. Thus he would bring you to the latest theory as to composition which I have already supplied.

Lastly, if for the sake of further comparison you asked the chemist of to-day whether alcohol had any ally or congener, he would reply, many. He would give you, for instance, this spirit, which he would call methylic alcohol, and which he would tell you was got also by distillation, only that the distillation was dry, and that the substance distilled was wood; or he would give you this specimen, which he would call amylic alcohol, and which he would tell you was got by distillation, not of wood, but of potato. Again he would show you other specimens, to which he would give different names as indicated in the following table:—

Table 1.—Alcohols.

	Elementary composition.		
Methylic Protylic (wood spirit)	C	H_3	HO
Ethylic Deutylic (common alcohol..	C_2	H_5	HO
Propylic Trilylic	C_3	H_7	HO
Butylic Tetrylic..................	C_4	H_9	HO
Amylic Pentylic (potato spirit, fusil oil)	C_5	H_{11}	HO
Hexylic	C_6	H_{13}	HO
Hextylic Œnanthic	C_7	H_{15}	HO
Octylic........................	C_8	H_{17}	HO
Decatylic......................	C_{10}	H_{21}	HO
Cetylic........................	C_{16}	H_{33}	HO
Melylic	C_{30}	H_{61}	HO

Directing your attention to the composition of these alcohols, the chemist would beg you to observe that their chemical construction is throughout the same, that is to say, in all cases, a radical composed of carbon and hydrogen has replaced one of the equivalents of hydrogen of water. The radicals, however, vary in respect to the equivalents of the elements of which they are composed, and to distinguish them they have different names. Essentially each radical, though it is composed of more than one element, acts as if it were one, and is called a base, because it is a root or origin upon which other structures rest. Thus, in the present case, the radicals, as they vary in amount of carbon and hydrogen which they contain, produce, in each case of their combination with water, an alcohol possessing a different property or different properties from the other alcohols. The table No. 2 will give you an illustration of the increase of carbon or hydrogen in the radicals of the series.

Table II.—Radicals of Alcohols.

Composition.		Old name.	New name.
C	H_3	Methyl	Protylen.
C_2	H_5	Ethyl	Deutylen.
C_3	H_7	Propyl	Tritylen.
C_4	H_9	Butyl	Tetrylen.
C_5	H_{11}	Amyl	Pentylen.
C_6	H_{13}	Hexyl	Hexylen.
C_7	H_{15}	Heptyl	Heptylen.
C_8	H_{17}	Octyl	Octylen.
C_{10}	H_{21}	Decatyl	—
C_{16}	H_{33}	Cetyl	—
C_{30}	H_{61}	Melyl	—

In the first of these radicals, methyl, you will se that the radical is composed of one of carbon and thre of hydrogen. The radical ethyl of two of carbo and five of hydrogen. The radical propyl of thre of carbon and seven of hydrogen, and so on, the in crease in the equivalents of the elements being af a given rule in the whole series, the carbon increasin one, and the hydrogen two with each progressiv step. So, as the alcohols progressively change fro the first of the series, the methylic, they grow riche in carbon and hydrogen, and proportionately, and the grow heavier, less soluble, and less volatile.

A very simple experiment suffices to show the in crease of carbon in these series. If I take a piece cotton wool, place it in a glass cup, pour upon it a littl methylic alcohol (in which alcohol you will notice fro the table there is the smallest amount of carbon) s fire to it and hold a white plate over the flame, th plate remains white because the air that reaches th flame is sufficient to consume all the carbon. If I the same experiment with ethylic alcohol, although th carbon is a little greater, yet the result remains th same. If I move two steps higher, viz., to butyl alcohol, in which there are four equivalents of carbo the combustion is not quite complete, and therefor shade or stain of carbon is left on the plate; and going one step further in the series I use amyl alcohol, then the combustion is rendered so imperfe that a thick layer of carbon, derived from the alcohol, the destruction of it by the burning, is left upon t white surface.

I may digress here for a moment to state—if the pr tical fact about to be told be considered a digression that this simple mode of testing common alcohol w serve roughly to detect adulteration of it with the heav alcohol—fusil oil, some of which I last burnt. T heavier alcohol is used in adulteration, and as you w learn when you hear of its effects, it is a danger adulterant. I was dining a few months ago with s friends, one of whom produced a small flask of prec liquor he had had presented to him, and which said to be an unusually choice hollands. On examini it I felt sure it was a gin treated with fusil oil, and burning a little of it, this suspicion was confirmed b deposit of carbon upon a white dish. I warned friends forthwith of the danger of drinking this hea though certainly pleasant spirit, and the majority t the warning. Two, less prudent, indulged, to su for the next two or three succeeding days to an ext that convinced them there was no mistake in scientific and friendly admonition they had received.

The physical distinctions between the various alco now before us are marked by other signs. For ample, as we move from the methylic alcohol upwar we discover that their vapours increase in weight, t as fluids they grow heavier, and that their boiling p that is to say the temperature required to make th boil, has to be increased. In Table No. 3 these fa

are presented in relation to the four alcohols of the series:—

TABLE III.—ALCOHOLS.

NAME.		Chemical comp.	Vapour density.	Specific gravity.	Boiling Point.	
Old.	New.		$H_2 = 1$	Water 1,000.	Cen.	Fah.
Methylic..	Protylic...	$C. H_4 O$	16	814 at 0° C	60	140
Ethylic ...	Deutylic...	$C_2 H_6 O$	23	792 „	78	172
Butylic....	Tetrylic ...	$C_4 H_{10} O$	37	803 „	110	230
Amylic....	Pentylic...	$C_5 H_{12} O$	44	811 „	132	270

Thus you will see that the vapour density of methylic alcohol is 16 when compared with hydrogen gas as a standard; of ethylic alcohol, 23; of butylic, 37; and of amylic, 44. In respect to the specific gravity of the fluids, that is to say of the weights of the fluids themselves, compared with water reckoned as a thousand, the same rule extends, with the one remarkable exception, viz., that the methylic alcohol appears heavier than the ethylic, after which the weights increase, so that amylic alcohol stands as 811 to 792, the weight of ethylic. Again, as to the boiling points, the lightest alcohol boils at 140, that is 72° below the boiling point of water; ethylic at 172; propylic at 205; butylic at 230, or 18° above the boiling point of water; and amylic at 270, or 58° above the boiling point of water, on Fahrenheit's scale.

The analogies between these various alcohols are sustained throughout by other chemical changes relating to them. If we expose diluted common alcohol to the atmosphere under fitting conditions it becomes acidified; in other words, it is converted into vinegar. This is due to its oxydation, in which process there are two steps; one by which the spirit is converted into a substance called aldehyde (dehydrated alcohol—al-de-hyd), and then into acetic acid, or vinegar. In the formation of the aldehyde two atoms of the hydrogen are oxydised, by which water is produced, and the aldehyde has therefore the composition of C_2H_4O. In the formation of the acetic acid another atom of oxygen is added, and the acetic acid has therefore the composition of $C_2H_4O_2$. This same series of changes extends through all the alcohols, as will be seen from the next table.

TABLE IV.

Alcohols.		Aldehydes.		Acids.	
Mythylic..............	$C H_4 O$	Formaldeyde	$C H_2 O$	Formic	$C H_2 O_2$
Ethylic	$C_2 H_6 O$	Aldehyde	$C_2 H_4 O$	Acetic	$C_2 H_4 O_2$
Propylic..............	$C_3 H_8 O$	Propionaldehyde......	$C_3 H_6 O$	Proponic	$C_3 H_6 O_2$
Butylic	$C_4 H_{10} O$	Butylaldehyde	$C_4 H_8 O$	Butyric..............	$C_4 H_8 O_2$
Amylic	$C_5 H_{12} O$	Valeraldehyde........	$C_5 H_{10} O$	Valerianic	$C_5 H_{10} O_2$

I said, in the first lecture, that from common or ethylic alcohol a new compound can be obtained by heating it with sulphuric acid, to which compound the name of ether is applied. In like manner, an ether can be obtained from the other alcohols.

TABLE V.—ETHERS.

Name.	Composition.	Form.	Boiling Point.
Methyl	$C_2 H_6 O$	Gas	..
Ethyl	$C_4 H_{10} O$	Fluid	94°Fah.
Propyl..........	$C_6 H_{14} O$	„	153°Fah.
Butyl	$C_8 H_{18} O$	„	219°Fah.
Amyl	$C_{10} H_{22} O$	„	348°Fah.

If chlorine be brought to bear upon ethylic alcohol, the elements of water are removed; that is to say, the oxygen and the hydrogen, and are replaced by chlorine, and there is formed chloride of ethyl. This change can be extended to all the other alcohols, the properties of the products being modified by the base, as will be seen by reference to the tables subjoined.

TABLE VI.—CHLORIDES.

NAME.		Chemical comp.	Vapour density.	Specific gravity.	Boiling Point.	
Old.	New.		$H_2 = 1.$	Water 1,000.	Cen.	Fah.
Methyl ..	Protyl ..	$C H_3 Cl$	25	Gas	...	...
Ethyl	Deutly ...	$C_2 H_5 Cl$	32	921 at 0° C.	11	52
Butyl	Tetryl	$C_4 H_9 Cl$	46	880 „	70	158
Amyl	Pentyl ...	$C_5 H_{11} Cl$	53	...	102	216

The same rule extends to the action of iodine on the alcohols, as is shown in the next table:—

TABLE VII.—IODIDES.

NAME.		Chemical comp.	Vapour density.	Specific gravity.	Boiling Point.		Per cent. of Iodine.
Old.	New.		$H_2 = 1.$	Water 1,000.	Cen.	Fah.	
Methyl	Protyl.	$C H_3. I.$	71	2240	42	108	89·4
Ethyl..	Deutyl	$C_2 H_5. I.$	78	1946	72	162	81·4
Butyl..	Tetryl.	$C_4 H_9. I.$	92	1604	120	248	69·0
Amyl..	Pentyl	$C_5 H . I$	99	1511	146	295	64·1

Once more the rule extends to the action of nitrous acid, as indicated in the following:—

TABLE VIII.—NITRITES.

NAME.		Chemical comp.	Vapour density.	Specific gravity.	Boiling Point.	
Old.	New.		$H_2 = 1$	Water 1,000.	Cen.	Fah.
Methyl ..	Protyl ...	$C H_3 No. 2$	30	...	Gas	Gas
Ethyl.....	Deutyl ..	$C_2H_5 No. 2$	37	0·917	18	64
Butyl	Tetryl ...	$C_4H_9 No. 2$	51	...	64	147
Amyl......	Pentyl ...	$C_5H_{11} No. 2$	58	0·877	96	205

These illustrations could be largely extended, but they are sufficient for our purpose. I have brought for those who are curious to see them, twelve specimens of these different compounds formed on the alcohols. Six of these belong to the ethyl, or common alcohol series, six to the amyl, and they include respectively specimens of the alcohols, of the acids of the alcohols, of the ethers, of the chlorides, of the iodides, and of the nitrites. One of these specimens, I mean the nitrite of amyl, has within these last few years obtained a remarkable importance owing to its extraordinary action upon the body. A distinguished chemist, Professor Guthrie, while distilling over nitrite of amyl from amylic alcohol, observed that

the vapour, when inhaled, quickened his circulation, and made him feel as if he had been running. There was flushing of his face, rapid action of his heart, and breathlessness. In 1861-2, I made a careful and prolonged study of the action of this singular body, and discovered that it produced its effect by causing an extreme relaxation, first, of the blood vessels, and afterwards of the muscular fibres of the body. To such an extent did this agent thus relax, I found it would even overcome the tetanic spasm produced by strychnia, and having thus discovered its action, I ventured to propose its use for removing the spasm in some of the extremest spasmodic diseases. The results have more than realised my expectations. Under the influence of this agent, one of the most agonising of known human maladies, called *Angina pectoris*, has been brought under such control that the paroxysms have been regularly prevented, and in one instance, at least, altogether removed. Even tetanus, or lock-jaw has been subdued by it, and in two instances, of an extreme kind, so effectively as to warrant the credit of what may be truly called a cure. I notice this action of nitrite of amyl because it will be referred to again in explanation of certain of the effects of alcohol.

I should have liked, if there had been time, to have dwelt at greater length on many other interesting points bearing on these different alcohols and their derivatives. I should have been pleased to have presented to you a more extended account of the progress of discovery during the past century leading to these modern facts; and I should much have liked to have rendered more complete the description of the alcohol series of bodies, by explaining the differences of what are called monatomic, diatomic, and triatomic alcohols; but I must desist for two reasons; first, because the study would lead me into too great detail, and secondly because it would introduce to notice a series of compounds, the physiological action of which are not so well understood as are those to which I shall soon direct your attention, and the study of which is more than enough for the time that is at our disposal. It must be considered sufficient, therefore, if I have succeeded in showing that the common alcohol is but one of a group of a series of chemical compounds, and that its superior claim to our notice rests upon its antiquity as a discovered substance, and on its enormous distribution in civilised communities, rather than on its special or distinctive properties as a chemical agent.

One other series of facts I would, however, briefly describe before leaving this part of my subject. If into this ethylic alcohol I throw a portion of the metal sodium, a brisk action immediately begins to take place; as you will see, a gas escapes which I easily collect in a glass tube, which burns, and if mixed with air, explodes, as you hear. The gas is hydrogen. A change of substitution has occurred in this experiment. The hydrogen belonging to the water of the alcohol has been replaced by the metal and what is called sodium alcohol. If potassium had been used, the result would have been the same.

By acting on common alcohol with strong potash, then with sulphuretted hydrogen, and afterwards with iodide of ethyl, a new alcohol is produced called mercaptan. In this fluid the oxygen of the alcohol is replaced by sulphur, so that the formula for it is (C_2H_5) HS. It is a fluid, whitish in colour, and of so offensive and penetrating an odour that it can hardly be approached until it is largely diluted with common alcohol. It is nearly insoluble in water, but imparts to it its peculiar odour; its specific gravity is 832, compared with water as 1,000; it is thirty-one times heavier than hydrogen, and it boils at 135° Fahrenheit.

Sulphur alcohol is very rarely seen, but there is a diluted specimen here which has been prepared with very great care. There is only five per cent. of it in the solution, and yet its odour is as much as can well be borne.

From this point I proceed to dwell on the action of certain of the alcohols which have been brought before us up to the present time, excluding on this occasion the alcohol best known, I mean the common alcohol of commerce, or, as we now know it chemically, ethylic alcohol. The point I shall aim at will be to show the influence of these alcohols upon animal life, and thereby to lead up to the action of ethylic alcohol pure and simple. The subject is one entirely new, and is limited to a very few bodies of the alcohol group, viz., to methylic alcohol, butylic, amylic, the potassium and sodium alcohols, and sulphur alcohol or mercaptan.

ACTION OF METHYLIC ALCOHOL.

Methylic alcohol, pyroxylic spirit or wood spirit, as it has been differently called, the spirit contained in the liquid got by distilling wood, has been known for about 62 years. It was discovered by Mr. Philip Taylor, in 1812, and was soon applied for lamps and for other purposes as a spirit. It was probably first made commercially by Messrs. Turnbull and Ramsay, of Glasgow. Its properties were investigated and reported upon by Sir Robert Kane, of Dublin, in 1836, and it was also analysed by Messrs. Dumas and Peligot, who determined that it contained 37·5 per cent. of carbon, 12·5 per cent. of hydrogen, and 50 per cent of oxygen. When it is pure it remains clear in the atmosphere. It has an aromatic smell, with a slight acidity. The specimen I have used for my research had a specific weight of 810, water being 1,000, and it boiled at 140° Fahr.

The spirit has been much used in the arts in the place of alcohol for making varnishes. Having a lower boiling point it is more volatile than common alcohol. It is now also largely used in museums for preserving purposes, and it yields on oxydation a very powerful preservative vinegar. For the sake of economy it is often employed in the manufacture of other compounds called methylated.

Owing to the volatile nature of this alcohol it may be exhibited freely by inhalation in the same manner that chloroform is administered. It then enters the blood by being carried with the air that is inspired into the pulmonary tract, and thus into the air vesicles. Here it is absorbed into the circulation by the minute bloodvessels which make their way from the heart over the lungs, and which ramify upon the vesicles. By administrating the vapour of methylic alcohol in this way its effects are rapidly developed, for it condenses quickly in the blood, is carried rapidly into the left side of the heart, and thence is distributed by the arteries over the whole body as quickly as it is condensed and absorbed.

The alcohol may be administered in the same way, that is to say, in combination with water, hot or cold. In this way it is not unpleasant to the taste, and in one instance, as I am informed by a veteran member of my profession, this alcohol was invariably drunk by a well-known physician, in preference to common alcohol. He was accustomed to make it into toddy, with water and sugar, and considered that while it was as pleasant to take as ordinary spirituous drinks it was less injurious than they are. I have myself, of late years, when compelled to allow the administration of alcohol in some form, recommended this methylic lighter spirit, and, I am satisfied, with better results than if the heavier or ethylic spirit had been employed. I have ventured also to suggest that in many instances other physicians might follow the same practice with advantage; for methylic alcohol is much more rapid in its action, and much less prolonged in its effects than is common alcohol, so that it produces its effects promptly, and what is of most importance, it demands the least possible ultimate expenditure of animal force for its elimination from the body. This latter fact, I repeat, is of great moment; for, in the end, all these alcoholic fluids are depressants, and although at first, by their calling vigorously into play the natural forces, they seem to excite, and are therefore called stimulants, they themselves supply no force at any time, but cause expenditure of force, by which means they get away out of the body and there

will lead to exhaustion and paralysis of motion. In other words, the animal force which should be expended in the nutrition and sensation of the body, is in part expended on the alcohol, an entirely foreign expenditure. The lighter the alcohol therefore, *cæteris paribus*, the less injurious its action, and so we may put down methylic alcohol as the safest of the series of bodies to which it belongs. But it is not without potency of effect, and the phenomena it produces are sufficiently demonstrative. Its effects are developed in four distinct stages.

The first stage is that of excitement of the nervous organisation; the pulse is quickened, the breathing is quickened, the surface of the body is flushed, and the pupil is dilated. After a little time there is sense of languor, the muscles falling into a state of prostration and the muscular movements becoming irregular. Thereupon the second stage follows, if the administration be continued. In this second stage the muscular prostration is increased, the breathing is laboured, and is attended by deep sighing movements at intervals of about four or five seconds, followed by further prostration, rolling over of the body upon the side, and distinct signs of intoxication. From this condition the subject passes into the third stage, which is that of entire intoxication, complete insensibility to pain, with unconsciousness of all external objects, and with inability to exert any voluntary muscular power. The breathing now becomes embarrassed and blowing, with what is technically called "bronchial rale," or rattle, due to the passage of air through fluid that has accumulated in the finer bronchial passages. The heart and lungs, however, even in this stage, retain their functions, and therefore recovery will take place if the conditions for it be favourable. Also, if the body be touched or irritated in parts, there will be response of motion, not from any knowledge or consciousness, but from what we physiologists call "reflex action;" that is to say, the impression we have made by irritation upon the surface of the body has travelled by its usual route through the nerves, to its nervous centre in the brain, and uncontrolled there by the consciousness has rolled back again, stimulating in its course some muscular fibre to motion. Probably the reason why the heart, which is a muscle, and the breathing muscles, continue to beat while all the other portions are at rest is due to this fact, that the blood which the heart drives to the brain and other nervous centres conveys to the centres which supply the heart a wave of motion that rolls back upon these vital muscles, and sustains them still in their rhythmical motion.

During all these stages there is no violent convulsive action from this alcohol, and no distinct tremor; but one phenomenon has been step by step more marked, and that phenomenon is a reduction of the animal temperature. Even though the body of the subject be exposed to a temperature of 84°, that is summer heat, it will begin to cool, from the first, and continually decline through all the stages, so that at last the loss of heat will become actually dangerous; for the body cannot throw off water freely, and therefore fluid collects in the lungs, and there is risk of what may be plainly considered suffocation like as from drowning. I have seen this decline of temperature from methylic alcohol, in animals narcotised by it, proceed to the loss of eight degrees of heat on Fahrenheit's scale when the insensibility was at its extreme point.

Presuming that the administration of the methylic spirit be continued when the third degree has been reached, there is a last stage, which is that of death. The two remaining nervous centres which feed the heart and respiration cease simultaneously to act, and the motion is over. After the death the blood throughout the body is found charged with the alcohol. The circulation of blood over the lungs has continued to the last, and so the lungs are found containing blood in both sides of the heart; the vessels of the brain are engorged with blood, as are the other vascular organs. The blood itself is not materially changed in physical quality, but coagulates or forms into clot, rather more slowly than usual.

If at the third stage of insensibility the administration of methylic spirit be stopped, recovery from the insensibility and prostration will invariably take place on one condition, that the body be kept dry and warm. From four to five hours, however, are necessary before the recovery is complete, and under the best conditions the restoration of the animal temperature is not perfect under a period of seven hours.

Happily we have no data to guide us that will show the effects on the animal body of the long continued use of methylic alcohol, for men have not as yet steadily plied themselves with it as a drink to induce phenomena of chronic intoxication from it. The above-named facts, however, drawn from careful observations, in which the effects of the agent were seen on the inferior animals, and in one instance where the fluid was taken by accident by the human subject, show that methylic alcohol, though it may be less potent than its allies, is sufficiently potent, and the inference is fair, indeed irresistible, that if the use of it were persevered in for long periods of time, it would lead to structural change in the body, just as all other chemical agents do that modify and pervert the natural mechanism. An agent that causes congestion of the brain cannot be employed many times without destroying the delicate organisation of the vascular structure of the brain, neither can it influence the other vascular organs in the same way without prejudice to their structure; neither can it destroy the function of the nerves, of the muscles, and of the organs of the senses, without prejudice to their functions. In many respects this, the highest and least injurious of the alcohols, resembles chloroform in the ultimate action it produces on the body. It still more closely resembles ether, although recovery from the effects of both these agents is very much more rapid than from the spirit. It may consequently, as a chemical agent possessing a specific power of action over the living organism, be fairly classified with these agents. It is quite as artificial as they are, it is quite as dangerous in the long run, and its effects are more prolonged.

ACTION OF BUTYLIC ALCOHOL.

I pass over the second alcohol of our series, viz., ethylic alcohol, the common alcohol of wines and spirits, because that will of itself engage our attention for the remaining part of the course, after this lecture is concluded. I pass over propylic also for the reason that it is not easily separated as an alcohol, and is less perfectly studied than the other members of the group before us. Thus I am brought to what is called butylic alcohol.

With this spirit we arrive at one of the heavier bodies of the group in which, as our table shows, there is an increased proportion of carbon and hydrogen over those that are placed above it in the scale. Compared with common alcohol the weight of its vapour is as 37 to 23. Its weight, as a fluid, is 803 to 792, and its boiling point 230 Fahr. to 172. It is a heavier fluid; it mixes indifferently with water, but it is not unpleasant to take when diluted and sweetened. Applied to the lips and tongue when in a pure state it creates a sensation of burning, in the same way as common spirit, but with more intensity, and there is this remarkable fact connected with the sensation, that after the burning effect has passed away an extreme numbness of the part, where the fluid was applied, remains. I made this observation originally in 1869, and I have since often applied the knowledge with effect, in relieving, by the application of the agent, local pain. Toothache, for instance, is very quickly soothed by it.

The alcohol is not obtained by special process of distillation; it is produced with other alcohols in the process of fermentation, and is obtained by what is called fractional distillation, that is, by distillation of it, at certain

fixed temperatures, from fusil oil, or from the oil of beetroot, or from molasses after distillation of ethylic spirit.

The action of butylic alcohol on the animal body is divisible into four stages, the same as we have seen in respect to methylic spirit, but the period required for producing the different stages is greatly prolonged; and when the third stage, that of complete insensibility, is reached, there is added a new phenomenon which does not belong to any of the lighter alcohols. In this third degree, after the temperature of the body is depressed to the minimum by the butylic spirit, distinct tremors occur throughout the whole of the muscular system. These come on at regular intervals spontaneously, but they can be excited by a touch at any time, and in the intervals where they are absent there is frequent twitching of the muscles. The tremors themselves are not positively muscular contractions, but are rather vibrations or wave-like motions through the muscles, and are attended with an extreme deficiency of true contractile power in the muscular fibre. An electrical current passed through the muscles, which would, in health, throw them into rigid contraction, will now excite the tremors and keep them proceeding, but will not excite complete contraction. So long as the tremors are present the temperature of the body is depressed, falling even half a degree; but when they cease the temperature rises again, not to the natural standard, but to or near that which existed before the tremors were excited. After the tremors are once established, they continue without further administration of the alcohol for ten and twelve hours, and so slowly do they decline, they may remain in a slight degree even for thirty-six hours. They subside by remission of intensity and prolongation of interval of recurrence. One fact of singular significance attaches itself to these muscular tremors. They are the tremors which occur in man during the stage of alcoholic disease, when there is set up that malady to which we give the name of *delirium tremens*. An ordinary intoxication with a lighter alcohol is insufficient to produce this extreme perversion of nervous and muscular power, but the introduction of one of these heavier alcohols, or it may be the excessive saturation of the body with a lighter spirit, for on this point I am not sure, is sufficient to cause the tremulous motion. What the nature of the muscular movement is, what unnatural relationships exist between the nervous system, the muscles and the blood, to lead to them are questions still unsolved. Involuntary, developed even against the will, excited by any external touch, attended with great reduction of temperature, and remaining as long as the temperature is reduced, they indicate an extreme depression of animal force; a condition in which all the force of life that remains has to be expended on the mere organic acts of life, on the support of the motions of the heart, the muscles of respiration, and the functions of the secreting glands. The voluntary systems of nerve and muscle are indeed well-nigh dead, and recovery rests entirely on the maintenance of the organic nervous power. Still recovery will take place if the body be sustained by external heat and by internal nourishment.

In the extreme stage of intoxication from butylic alcohol the red blood in the arteries loses its rich colour, and the blood, which flows with difficulty from the veins, is of a dirty hue. The blood coagulates readily, but the clot is loose, and the fibrine of which it is composed separates in a coarse network or mesh. The little corpuscles of the blood run into each other, forming rolls or columns. Indeed it is wonderful how the blood circulates through the structures it should nourish. The vascular membranes of the brain are found charged with this tarry blood; the brain structure is softened, and gives the odour of the poison, and the muscles, when divided by the knife, cut without firmness, yielding from numerous points the same tar-like blood. The vascular organs—spleen, liver, lungs, kidneys—are equally changed, and in a similar manner. Their fine structures are infiltrated with the deteriorated vascular fluid which was intended for their maintenance, and even the secretions and cavities of the body are perverted by being charged with fluid derived from the unnatural blood. This is the state of the body of one who dies insensible after the delirium and tremors which mark even the human malady, self-inflicted and terrible, known as *delirium tremens*.

Action of Amylic Alcohol.

Amylic alcohol, the next of our series, is obtained by the fermentation of potato starch, or starch of grain, and when pure is a colourless fluid. Its weight compared with water as 1,000 is 818, and it boils at 270° Fahr. It is from this alcohol that the active substance, nitrite of amyl, to which I have before referred, is derived. The odour of amylic alcohol is sweet, nauseous, and heavy. The sensation of its presence remains long. In taste it is burning and acrid, and it is itself practically insoluble in water. When it is diluted with common alcohol it dissolves freely in water, and gives a soft and rather unctuous flavour, I may call it a fruity flavour, something like that of ripe pears. From the quantities of it imported into this country it is believed to be employed largely in the adulteration of wines and spirits.

Amylic alcohol, when it is introduced as an adulterant is an extremely dangerous addition to ordinary alcohol in whatever form it is presented, whether as wine or spirit. Its action on the body is the same as that of butylic alcohol. It produces three stages of insensibility ending in the profoundest narcotism, or coma, followed by reduction of temperature and by muscular tremors. These tremors recur with the most perfect regularity of themselves, but they can be excited at any moment by touching the body, or blowing upon it, or even by a sharp noise, such as the snap of the finger. In all other respects the phenomena induced are the same as are observed from butylic alcohol, except that they are much more prolonged, from two to three days being sometimes required for the complete restoration of the animal temperature. The reason of this prolongation of action lies in the greater weight and the greater insolubility of this spirit, that is to say, the force required to decompose it, or mechanically to lift it out of the body when it has once entered it, is so much greater than is required for the lighter spirits, which can diffuse readily through the secretions, volatilise by the breath and possibly undergo rapid decomposition. The odour of the substance remains for many hours in the animal tissues. Amylic alcohol acts upon some resins and resinous substances, I believe, dissolving certain of them more easily than the lighter spirits, but its peculiar odour prevents its application on a large scale.

Action of Sodium and Potassium Alcohols.

The action of the sodium and potassium alcohols is exceedingly interesting in a physiological point of view and in this I think only, except in respect to their varied uses as chemical re-agents. They act on the living animal tissues as caustics, and will one day be considered of great service to the surgeon. Brought into contact with blood in solution, there is produced by them an almost instant crystallisation of needle-like crystals spread out in beautiful arborescent filaments. This arborescent appearance is identical with a crystallisation which can be induced in the alcohols themselves, but there are also formed smaller radiant crystals due to the crystallisation of the crystalloidal matter of the blood-cells, and singularly like the forms which, since the time of Dr. Richard Mead, have been described as occurring in the blood after infection by the poison of the viper.

These metallic alcohols are powerful antiseptics, like common alcohol, over which they have an advantage in that they more thoroughly harden soft structures. I have taken advantage of this action to employ them for the preservation of nervous matter, which is rapidly prone to decomposition.

I should add that, by some chemists these alcohols are called ethylates of sodium or potassium, a term which is thought to define more correctly their chemical construction.

ACTION OF MERCAPTAN OR SULPHUR ALCOHOL.

I have already referred briefly to this most curious body of the alcohol series, describing it as an alcohol in which oxygen is replaced by sulphur. In experimenting with it a solution containing 5 per cent. is sufficient, and the vapour of it may be inhaled in order to produce its effects. These are most remarkable.

I found, by direct experiment, that the vapour is not irritating to breathe, but that its influence on the system is speedily pronounced. There is a desire for sleep, and a strange, unhappy sensation, as if some actual or impending trouble were at hand. This is succeeded by an easy but extreme sensation of muscular fatigue; the limbs feel too heavy to be lifted, and rest is absolutely necessary. There is, at the same time, no insensibility to pain, and no intoxication. The pulse is rendered feeble and slow, and remains so for one or two hours, but, in time, all the effects pass off, and active motion in the air helps quickly to dispose of them.

On the inferior animals the action of mercaptan is equally peculiar. Frogs exposed to its vapour fall asleep, and seem to pass into actual death, except that the eye remains bright. They may be left in this apparently lifeless state for half an hour, then, removed into the air, in the course of an hour and a half or two hours they commence to breathe again, and gradually recover, precisely as if they were awaking from sleep. The action of this alcohol on the animal body, though it produces these extreme effects, is less injurious than that of the other alcohols. It escapes mainly by the breath, and in some new form, as a sulphur compound. It thus communicates to the breath an odour which is by no means uncommon in persons who indulge to a great extent in the use of ordinary alcohol. This observation suggests a most important explanation of certain phenomena connected with the action of common alcohol. It appears to me that in some states there is actually produced in the living organism, by the vital chemistry, sulphur compounds, derived probably from the bile, a substance rich in sulphur, which compounds, distributed by the blood to the nervous matter, create the phenomena similar to those I have described as following upon the inhalation of mercaptan. Thus, under unnatural states of life, the body actually makes its own poisons, and the doctor is often asked to remove what the patient, if he were a better chemist and a wiser man, would never produce for the exercise of the doctor's skill.

JUVENILE LECTURES.

On Wednesday last, the 6th inst., the first of a course of two lectures, specially adapted to a juvenile audience, was delivered by Mr. Herbert M'Leod, professor of experimental science at the Royal Indian Civil Engineering College. The subject was, "The Food and Work of the Iron Horse":—

The lecturer, in tracing the history of science from the beginning of the world, pointed out that in the earliest ages man did his own work; then he got his wife to assist him, if not to do all the work; then the wind and the force of streams of water were brought to his assistance, but as these were very inconstant and uncertain, animals were brought into play. Lastly steam was pressed into the service. At first it was used to pump water; then to turn machines; and lastly to draw loads; and this was the origin of the steam-engine. He then proceeded to describe the action of the chemical laws of combustion, and the ultimate result in the production of motion. He said that he proposed to do all that he could to instruct his audience as far as possible, without leading them deeply into scientific matters. He supposed that every one of them had been in a train, and had had the curiosity to look at the locomotive. They had seen a quantity of white cloud escaping from the funnel, which was commonly called steam, and at the back they had seen a man with perhaps not the cleanest of hands or face, shovelling coals or coke into the furnace. Now they had to find out how that process of shovelling in the coke ultimately produced the motion of the engine. The air consisted, roughly speaking, of one volume of oxygen and four of nitrogen, the former of which supported combustion, the latter preventing it. Mr. M'Leod then proceeded to show by experiments how flame was extinguished in nitrogen and was increased in power by oxygen, and explained the effects of the mixture of the two gases in atmospheric air. Going into the subject of heat, he said that they did not know so much about heat as they would like to, but he showed some of the effects of heat in experiments. Its effect was to make things larger, and this was illustrated both in the case of gases and metals by experiments, in one of which a piece of cast-iron was snapped in two by the contractile force of a cooling bar of iron. The subject of fuel and its composition was next treated, and the lecturer brought the first portion of his remarks to a close by saying that they had found that combustion was produced by the union of the constituents of fuel and the oxygen of the air; the oxygen being a gas that supported combustion, while the nitrogen kept it in check. They had found that heat enlarged bodies, whether solid, liquid, or gaseous. They had found also that heat altered the state of bodies, converting solid bodies into liquids and liquids into gases, and they had found that fuel consisted in great part of carbon, and that carbon when burnt produced carbonic acid gas. Next Wednesday they would study the properties of hydrogen, and pass on to the steam boiler and the working of the steam engine.

Mr. Seymour Teulon occupied the chair.

MISCELLANEOUS.

THE AMERICAN INTERNATIONAL EXHIBITION.

The American Correspondent of the *Times* gives the following account of the preparations for the International Exhibition at Philadelphia in 1876:—

"The Hon. A. T. Goshorn, the Director-General of the Exposition, has just transmitted to the President a report upon the progress of the work, in which he describes it in detail. The Commissioners of Fairmount-park, Philadelphia, have set apart for the uses of the Exposition 450 acres of land, eligibly situated and well adapted for the purpose. The Exhibition buildings have been located, much of the grading completed, and the general arrangement of the grounds adopted. Railway communications directly to the grounds, from all parts of the country, have been established, affording facilities for the conveyance of passengers and goods. It has been found necessary to change the plans for the main Exhibition building, in order that the cost of construction might be brought within the means at the command of the Centennial Commission, and the buildings now being erected, while answering the demands of the Exhibition in all important particulars, will cost much less than the original estimate. Construction began in July last, and the progress made ensures timely completion on a scale and in a manner answering the requirements of the Exhibition. The grading and foundations for the main building are completed

and the placing of the superstructure, which is now being prepared, will begin early in the spring of 1875. The Art Gallery and Memorial hall, for which the State of Pennsylvania and the City of Philadelphia have made liberal and sufficient appropriation, are in process of construction, the work being far advanced. This and the main building will be in readiness before the opening in April, 1876. The plans for auxiliary buildings—the machinery hall, agricultural hall, and horticultural hall—have been adopted, and contracts for their erection will this month be made. The buildings contemplated cover a space exceeding 40 acres, with facilities for increasing their capacity as demand may require. Applications for space in the American department have been numerously made; great interest has been shown in the matter throughout the country, and it is evident that the industries of the United States will be fully represented, and in a manner reflecting credit upon us. Several State Governments are making arrangements for complete exhibitions of the resources of their respective States; and a board has been appointed by the President, representing the various departments of the general Government, for the purpose of preparing a collective exhibition illustrating the functions of the Federal Government. This is expected to be an interesting and instructive feature.

"The display of the resources of the entire American continent will be very comprehensive and instructive. The interest manifested in the Exhibition in European and Oriental countries, he continues, gives abundant assurance that the representation of the leading nations of the world will be unusually large. The arrangements for the reception and accommodation of foreign articles are being made on a scale that will answer all demands which can be reasonably anticipated. He concludes with the statement that the Centennial Commission are confident that the great national undertaking committed to their care 'will be crowned in 1876 with a success that will be creditable to the Government. The Commission have realised from the beginning that the honour of the nation is involved in the enterprise, and the aim, therefore, has been to render it eminently the great illustrative feature of the celebration, representing fully the political and industrial growth of the country during the century.'

"The apportionment of the space in the main Exhibition building among the various nations to be represented has now been made, the plan adopted being that of the Paris Exposition of 1867. The main building has 485,090 square feet of available space, and this is divided as follows:—Siam, 3,946 square feet; Persia, Egypt, and Turkey, each 7,776; Russia, 10,044; Sweden and Norway, 10,044; Austria, 23,328; the German Empire, 27,264; Denmark and the Netherlands, 7,776; Switzerland, 6,156; Italy, 11,664; Spain and her colonies, 15,552; France, Algeria, and other colonies, 27,264; Great Britain, India, Canada, Australia, and other British colonies, 46,748; the United States, 123,160; Mexico, 11,664; Honduras, 3,888; Guatemala and Venezuela, each 5,508; San Salvador and Nicaragua, each 4,536; Ecuador, Hayti, and the Sandwich Islands, each 3,888; the United States of Columbia, 7,776; Peru, 11,664; Chili, 9,744; Brazil, 17,529; the Argentine Republic, 15,552; Liberia, 2,268; Japan and China, each 7,290 square feet. Thirty-four nations and their colonies are thus provided for, and there is a space of 21,408 square feet reserved for contingencies. Although it is yet nearly seventeen months to the opening of the Exhibition there are already applications from American exhibitors for 180,000 square feet, although the space allotted to this country is but 123,160 square feet. The applications for space in the portions allotted to other nations go directly to the Commissioners appointed by those nations, so that the officials here have no direct knowledge of the amount asked for. The German Empire has already had for its space 700 applications made, as is learnt from authentic private sources. Fairmount-park, where the construction of the Exhibition buildings is going on, under the direction of Richard J. Dobbins, the general contractor for the work, has for several months been a busy hive of industry."

MELBOURNE BOTANIC GARDENS.

The report of Baron Mueller, the Government Botanist, Melbourne, for the financial year ending June last, has recently been received here. Among other matters, some portion of the report is devoted to an account of the industrial researches in connection with indigenous and foreign plants, which have been carried on of late under Baron Mueller's superintendence. The results of some of these researches have already appeared in London at the International Exhibition. Among the exhibits were samples of tar-oils from *Eucalyptus globulus*, all distinct in their specific gravity, boiling point, colour, solvent power, odour, and other physical properties, also pure alcohol from the sawdust of Eucalyptus wood, from which also paper-paste and oxalic acid, together with other products, may be obtained, potash from the Eucalyptus, various fibres, including those of common rushes and grasses, the material for superior paper to supplement the supply of rags, &c., as well as many other native products. The percentage of tar (all of more or less distinct characters) obtainable from a series of various Victorian woods, is given in a table annexed to the report, as is also the proportionate yield of medicinal aloe from several species of aloe; saponin from the root and bark of *Acacia lophantha* and *A. decurrens*; caoutchouc from *Ficus macrophylla*; potash from Eucalyptus and Fern-tree ashes; tannic acid from the catechu of *Acacia decurrens*. Among the experiments carried on, the acids of the *Casuarinas* (in this instance of *C. quadrivalvis*) were subjected to analysis, and the presence of citric acid, accompanied by two other organic acids, was shown in the foliage of these trees. As usual, numerous investigations of these kinds gave negative results. The percentage of the volatile oil in the foliage of *Melaleuca hypericifolia*, *M. decussata*, *Callistemon rigidus*, *C. rugulosus*, *Agonis flexuosa*, *Eucalyptus cornuta*, *E. colossea*, *E. populnea*, *E. calophylla*, *E. nutans*, was obtained. As experiments on new substances, some are mentioned on the dye principles of three species of native Droseras or sundew herbs, and among the indigenous products are enumerated fibres, paper material, fixed and distilled oils, native potash, soda, dyes, tars, acetic wood acid, wood alcohol, bromine, iodine, and many other substances from native material, still lying latent, though extant in boundless quantity.

It was ascertained by experiments on rabbits, that *Burchardia umbellata* and *Anguillaria australis*, although belonging to the melanthaceous and therefore partly poisonous tribe of *Liliaceæ*, contain no noxious principles in their tuberous roots. In the search for salep in the tubers of terrestrial *Orchidæ* the common *Microstis porrifolia* gave the best results. In drying, the roots of this species evolve a slight violet odour, and ten grains of the dry powder were found to produce one ounce of good pale mucilage, free of bitterness. The tubers of *Thelymitra aristata*, although still richer in mucilage, proved slightly bitter and of brownish tinge. As yet but few of the numerous Orchids of Victoria have been examined in this respect, but the few kinds of *Pterostylis* tubers experimented on proved inferior to those of *Microstis*.

The production of *Eucalyptus* oil has now, Baron Mueller states, attained the rank of a flourishing industry, mainly through the exertions of Mr. Bosisto, of Richmond. He also alludes to the efforts which have been made to acclimatise the *Eucalyptus* in such temperate climates as suit it, where there is neither excessive heat nor severe frost.

Some pages of the report are devoted to an account of the recent botanical publications issued under the authority of the department. Chief among them is the sixth volume of the "Flora of Australia," the joint work

of Baron Mueller and Mr. Bentham. The seventh volume of this work is promised in 1875, and it is stated that two more volumes will be required to complete the series. The eighth volume of the "Fragmenta Phytographiæ Australiæ" had so far advanced as to render its conclusion possible by the end of last year. As originally designed, this work has been reserved for the promulgation of absolutely new observations.

Following this, the report gives some details of the most botanical explorations, of the issue of botanical educational collections to about one hundred public institutions, involving the drying of more than ten thousand specimens. Throughout the whole the writer complains somewhat bitterly of the want of funds at his disposal for the various purposes of botanical expedition, scientific investigations, and the expansion of the museum. A great want here is stated to be a complete collection of plants foreign to Australia. As regards indigenous plants, the collection appears to be very complete. In an appendix to the report are published the seventh systematic index of the plants indigenous to the colony of Victoria, additions to the genera of plants of Australia since the issue of the last report, fossil genera hitherto undefined, and a list of the vegetable products sent to the last London exhibition.

TESTIMONIAL TO MR. E. C. TUFNELL.

On the occasion of the recent retirement of Mr. Edward Carleton Tufnell from the office of Inspector of Schools under the Local Government Board, a meeting was held at Exeter-hall of head-masters of elementary training colleges and schools—chiefly of the larger metropolitan district schools—to consider the subject of expressing some recognition of the services Mr. Tufnell had rendered to the cause of education in this country. Mr. Edwin Chadwick, C.B., took the chair, and gave a short sketch of Mr. Tufnell's labours. He had served on the Poor-law Commission of Inquiry in 1832; on the Factory Commission of Inquiry under which the half-time school system was devised for the protection of children; and on the Poor-law Executive Commission. Mr. Tufnell served also as an inspector under the Committee of Education at the Privy Council, when he inspected the reformatory schools, and on the Commission of Inquiry into the Employment of Young Children. He had been charged with the task of improving the condition of the Greenwich Hospital School for the children of sailors, and he raised it to the condition of a model half-time school. For 40 years his services had been devoted with zeal, intelligence, and benevolence to retrieving the condition of orphans and outcasts, the lowest and most dangerous classes of the community. Mr. Tufnell had a foremost influence in laying the foundation of an improved elementary education in England by the institution of training colleges for the teachers of elementary schools. At a time when there was no general conception of the need of training for elementary school teaching, Mr. Tufnell, then an Assistant Poor-law Commissioner, induced Mr. Nicholls, one of the Poor-law Commissioners, and Dr. Kay (now Sir James Kay-Shuttleworth), an Assistant Poor-law Commissioner, to visit Holland, Switzerland, and Germany, and examine the institutions for training teachers. On their return Mr. Tufnell and Dr. Kay established the training school at Battersea, and with the approval of the Poor-law Board, gave themselves to its organisation. To meet the expenses of the establishment Mr. Tufnell gave three years of his salary. This was the first Normal school in England.

A general committee was formed of those present, and an executive committee appointed. Mr. John Hammond, head master of the Lambeth Schools, Lower Norwood, consented to act as honorary secretary, and Mr. Thomas Bain, of the South Metropolitan Schools, as treasurer, to collect subscriptions for a testimonial to Mr. Tufnell from schoolmasters and others.

FOG-SIGNALLING APPARATUS.

The following communication has been forwarded by Mr. O. Cullis, a signalman on the S.E.R. :—

"I beg respectfully to introduce this apparatus to your notice, as being the most useful invention yet produced for signalling trains in foggy weather, for three reasons.

"1stly. That the object of this invention is to provide a simple and efficient apparatus by which fog-signals may in foggy weather be automatically placed on to, and taken off from the rails of the various railways by the working of the ordinary signal (visible) apparatus. For this purpose I connect to the ordinary wires used for working the signals another wire, which I carry forward for any desired distance beyond the signal, and at the spot at which it is desired to place the fog-signals on to the rail. I attach the wire to slides, which carry a clip in which the stem of the fog-signals may be held. The wire which is carried forward to the slides is slack, and the slides are pressed forward by a spring, or springs, so as to bring the fog-signals carried by them over one of the rails, but when the signal is lowered, indicating the line is clear for the train to proceed, the slides are drawn back by the wire, and the fog-signals are removed from the rails into the boxes. The apparatus is so small that it can readily be fixed by screws or otherwise in foggy weather to any of the sleepers prepared for the purpose, and may be removed therefrom at such times as not required for use.

"2ndly. It is not an apparatus to do away with fog-signalmen altogether, but to protect them from danger whilst performing those hazardous duties, as in my humble opinion (and I speak from nine years' experience as a signalman) it would be a great mistake for railway companies to trust entirely to any kind of machinery, more especially in the 'London Districts,' where the trains run so frequently, and where there is such a complication of signals, for which places this apparatus is specially adopted. The simplicity of its construction secures economy to railway companies, and safety to the public combined, as it is so contrived as to be under the control of the signalman, being worked in conjunction with the signal now in use, and thereby preventing the accidents and delays that occur under the present system of fog-signalling. By employing an apparatus such as the one I describe to place fog-signals on to and to take them off from the rails, these signals will only be exploded when the ordinary signals are at danger; whereas at the present time, when the fog-signals are placed on to and taken off from the rails by hand, they are frequently left remaining on the rails after the ordinary signals have been lowered to "all right" simply because the fogmen have not time to remove them, without running the risk of losing their lives, or being maimed for life whilst so doing; and by this means not only are a great number of fog-signals exploded uselesly, but the drivers of the trains are confused by reason of the fog-signals not being in accordance with the ordinary signals, hence the real cause of so many accidents during the foggy weather.

"3rdly. Under the present system of fog-signalling not only are trains delayed and accidents caused to them as before mentioned, but our railways are little better than death-traps to the men who have to perform the duties of fog-signalmen. Every season there are from twenty to thirty killed, besides a great number injured, whilst performing those duties, in the 'London Districts' alone. I may remark that the fog-signalmen have to place the detonating signals on to the rails at least 200 yards away from the ordinary signals, and it is whilst travelling from the signal to the place where the detonators are, to remove or replace as the case may be, that they run the risk of being knocked down by an approaching train. Some gentlemen may be aware a train cannot be heard so distinctly in foggy as in clear weather.* By the use

* This statement is entirely opposed to Professor Tyndall's recent experiments on the effect of weather on sounds.—Ed.

of this apparatus, it being under the control of the signalman, the detonators will always be taken off the metals the instant the signals are lowered to "all right," so that the fogmen will only be required to substitute fresh detonators, as the old ones become exploded, and that they will be able to do immediately a train has passed by them, and they will have ample time to get out of the way before another train arrives. The cost of fitting this apparatus will not exceed 30s. for each signal, and it will save each railway company from £200 to £300 annually in fog-signals alone, as none will be used unless actually required as a danger signal."

WARMING OF PASSENGER TRAINS.

M. Belleroche, engineer to the Grand Central Belgian Railway, recently read before the Liège Association of Engineers a paper on his system of warming passenger trains, which is as follows:—

Foot-warmers or coils are placed at the bottom of the carriages, and a current of water, continually being re-heated, is made to flow through them, the circulation being increased by means of a pump that may be worked by the engine; all the coils of the train are united to each other, and the circuit is completed by a return pipe. Another method may be adopted, which consists of cooling the water in the return pipe by making it pass through the tank, in which case the pump would be replaced by a small injector, for driving the water into the re-heater. The re-heating apparatus consists of a casing which forms a reservoir round the chimney, and of re-heating tubes fixed to the bottom of this reservoir, and descending into the smoke-box. The reservoir round the chimney is surrounded by a double casing, and the annular space formed by this casing and the exterior surface of the reservoir is in communication with the smoke-box, and is therefore filled by the hot gases. One of the locomotive injectors is arranged so as to serve the boiler or the heaters at will. Half an hour before departure the locomotive is coupled, the feed-water having been previously heated, and the coils fed.

The first experiment for the purpose of testing the calorific power of the apparatus was made last year on the Grand Central Belgian Railway, with a train composed of twelve carriages, the locomotive only having been prepared for the purpose. The cubic content of the reservoir was more than 300 litres ($10\frac{1}{2}$ cubic feet), the speed 60 kilos. (about 37 miles) per hour, and the pressure of steam in the boiler 5 atmospheres. The heating surface of the apparatus was 2·27 square metres in the smoke-box (24·4 square feet), and 2·6 square metres (28 square feet) in the chimney, the outer double casing not being in communication with the smoke-box. The following are the results obtained:—While the engine was standing or shunting about Louvain terminus, the temperature of the water was maintained at 95 degs. Centigrade (203 Fahr.) for two hours; and while running that temperature rose one-third of a degree per minute. On the water being renewed, and the temperature consequently being lowered to 62 degs. Centigrade (143·6 Fahr.), it rose again while running to 2·25 Centigrade (36 Fahr.) per minute; and from 83 degs. Centigrade (181·4 Fahr.) the increase was 1 deg. Centigrade (33·8 Fahr.) per minute.

The absorption of caloric increased therefore with the lowering of the initial temperature, as might have been expected. As the cold water will constantly cool the apparatus while running, a maximum rise in temperature of 2 degs. Centigrade (35·6 Fahr.) per minute may be reckoned upon. This absorption of heat corresponds to 36,000 calories (142,859 English units of heat) per hour, which, spread over a quantity of 700 litres (154 gallons) in a train of ten carriages, holds out the hope of heating to 50 degs. Centigrade (122 degs. Fahr.) per hour.

CORRESPONDEN

PROTECTION FOR INVE

SIR,—I beg to offer a few observatio
of the notice, "Protection for Inventi
number.

Prussia ought properly to be class
granting patent countries, such as
Holland (if the latter will accept h
unlike them she professes to grant pat
does not. Let this reflection, howe
correspondent's justly wounded spirit;
alone, his case is the rule, the opposite

There is no Patent-law in Prussia.
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law coming.—I am, &c.,

General Patent-office, 4, South-street, F
London, January, 1875.

PROTECTION FOR INVENTIONS.

Sir,—Mr. Bramwell's paper and the discussion upon it, while pointing out with great clearness the evils of the present system, and showing to demonstration the necessity for protection, have not suggested any substantial amendments of the existing law of patents. It is true that during these discussions a deputation from the Inventors' Institute, and others, has submitted to the Lord Chancellor the plan of a preliminary examination of inventions, according to the system in operation in America; but it seems very doubtful whether the practical working of that plan has been really efficacious, owing to the fact that it involves an inquiry not only into the novelty but into the merit of every new invention.

The granting of Letters Patent for inventions is a prerogative of the Crown, but it nevertheless tends in its operation to foster the monopolies which pressed so heavily upon our forefathers, and it is chiefly on this latter ground that the abolitionists base their arguments. The protectionists of the Patent-laws, on the other hand, insist that the most trifling inventions should be encouraged, and their resulting benefits secured to the inventors.

The right course lies probably between the two extremes, and, acting upon this hypothesis, I am about to lay before you a scheme, which, while it is intended to remove the objections of the abolitionists, has also for its object that of satisfying the views of the advocates of protection. Without further preface I proceed to disclose my scheme, and I commence it by enunciating the following propositions by way of preamble:—

1. Letters Patent for inventions are mere grants of monopolies, and ought therefore to be discontinued.

2. Inventions are essential to the prosperity of the community at large, and ought therefore to be encouraged.

3. Inventors look for a pecuniary reward, and ought to be remunerated in proportion to the value of their discoveries, and such remuneration should be secured to them by operation of law.

4. Any system which shall effectuate the foregoing propositions is a desideratum, and, if accomplished, would be a national benefit.

Believing as I do in the truth of the above propositions, I proceed to explain my scheme—

1. Letters Patent for inventions to be henceforth discontinued, and in substitution thereof a certificate of invention to be issued to the inventor.

2. Such certificate to be founded on an examination of the invention, but only as regards its novelty.

3. Every application for a certificate to be accompanied by a specification in such form, and supported by such evidence and models as the Department may require.

4. The specification, if found on examination to be new, to be immediately published in the *Gazette*, or otherwise, so as to give the public an opportunity of stating valid objections within say one calendar month to the issue of the certificate.

5. The fees payable to the Department not to exceed five guineas.

6. Every invention when thus advertised to become the property of the Crown, in trust for the nation.

7. All persons making or using the invention to pay to the Department a royalty of say three per cent. on the price realised by its use or sale, two-thirds of which to belong to the inventor, and the remaining third (subject to the maintenance of the Department) to form an item of national revenue.

8. The royalty to be collected by means of stamps, and a properly organised Department of the Inland Revenue, and the usual penalties to attach to fraud, or evasion of royalty.

9. The right of the inventor to accrue from the date of his first application, and the certificates to be issued in numerical and chronological order.

10. The certificate to remain in force for a generation, or 30 years.

11. A patentee under the existing law may exchange his patent for a certificate, but the duration of such certificate to be less than 30 years by the time elapsed since the date of the patent.

12. Any certificated goods manufactured, or certificated process used, abroad to pay the same royalty on importation into the United Kingdom.

13. A Department to be constituted called the "Board of Inventions," to consist of the Lord Chancellor, the first Lord of the Treasury, a Chief Examiner, and a staff of Assistant Examiners, all properly salaried.

14. All the officers and business of the present Patent Commission to be transferred to the new Department.

15. The Board to have a common seal, and power to appoint districts.

16. In course of time a proper building to be provided as a depository for models.

It is conjectured that a royalty such as I have described must yield a very large revenue indeed, thus affording not only a fairly adequate and proportionate reward to inventors, but a considerable addition to the national resources, after providing ample means of maintaining the proposed Department.

Having thus roughly pourtrayed my scheme, I will now proceed to point out how it affects the views of the respective parties.

The advocates of the total abolition of the Patent-laws produce an array of no less than seven cardinal evils, which they say are attendant upon the existing system; and I think it will be found on consideration that my proposals extinguish them, one and all. These evils are:—

1. "Interference with the freedom of trade." My plan throws every invention open to the public, every individual member of which may use it upon condition of paying a royalty of 10 per cent. on the net profits.

2. "British manufacturers are placed at a disadvantage with those of countries where there is no Patent-law." I neutralise this objection by proposing an import royalty of three per cent. on all certificated productions.

3. "A patent for invention, by barring the road, stops further inventions." This is no doubt true to a great extent under the present system, but I neutralise the objection by throwing every invention freely and without stint into the hands of the public at large, so that all may use it.

4. "Patents are granted for useless things." If the foregoing second proposition be true, it seems to follow in natural sequence that facility should be afforded for the most trivial invention which the human mind is capable of conceiving, and that on the obvious ground that it is impossible to predict of what it may be the germ; and the only condition attached to the grant of a certificate should be that the invention is new. Even if it should turn out to be useless, the simple result would be that it will not be used, will yield no royalty, and therefore no reward to the inventor.

5. "Patents are granted for things which are old." The proposed preliminary examination as to novelty will check this practice; but the same reasons as are given in No. 4 afford an answer to this objection.

6. "Patents give rise to expensive and difficult legislation." It is confidently believed that the system now proposed will be production of no litigation to any appreciable extent as between individuals. Questions may occasionally arise between inventors and the official department, but these cases would be, I think, exceptional.

7. "Patentees are great losers by patents, and it would be a charity to protect them against themselves,"

This objection is most thoroughly answered and met by my scheme, supposing, as I believe will be the case, that a system such as I have propounded would be hailed by inventors as the one best calculated to secure to them, and that by a Government guarantee, and by the aid of official collectors, a true measure of pecuniary reward; while it would at the same time operate as a check upon the costly and suicidal proceedings of the mere visionary.

An ingenious and thinking man cannot help inventing; and, having succeeded in obtaining a certificate for one invention, he might contentedly await his hoped for reward, and employ his thoughts and energies in another channel, undisturbed by the necessity of self-protection, which now torments him. As there would be no secrecy, so there would be no fear of discovery or robbery so common under the present system. A poor man, too, would have as good a chance of reward as a rich one.

In conclusion, I have only to add that, if my proposal may be considered startling by its novelty and boldness, it is an entirely disinterested one. I put it forward with patriotic views, and can only hope that it may at all events be deliberately considered by all who have a real desire, as also by those who have the power, to promote the true interests involved in the important question of "Protection for Inventions."—I am, &c.,

JOHN MURRAY, *Treasurer Soc. of A.*

7, Whitehall place, 1st January, 1875.

GENERAL NOTES.

American Patent-office.—This office has just commenced the publication of a complete subject-matter index, from 1790 to 1873. The first volume (A to G) has appeared, and the remainder is in the printer's hands. Although the index has a somewhat meagre look, this really arises from the fact that the claims of an American patent are shorter and far more sharply defined than is the case under our own law, while no patent is allowed to cover more than a single item of invention. The whole is arranged in a tabular form so as to give every assistance to the eye.

Isinglass.—The manufacture of isinglass, says *Nature*, which is generally supposed to be confined to Russia and North America, or other countries where the sturgeon is found in abundance, is carried on to a considerable extent in India, principally from the air-vessels of several varieties of acanthopterygian fishes, and particularly, different kinds of perch, as well as from other fish. There is room for a great extension of the trade, as isinglass, the purest known form of animal jelly, has, in a measure, had its consumption checked by its high price, and substitutes are employed, such as gelatine, of which it is itself the purest form.

Registrations of Designs.—It is in contemplation to move the Designs-office from Whitehall to premises closely adjacent to those occupied by the Patent-office. This change of locality is expected to be followed by important alterations in the adminstration of the department, as it will be transferred to the control of the Commissioners of Patents instead of remaining under the Board of Trade. For this purpose a Bill will be brought in early next session, but the office itself is to be moved at once, without waiting for the necessary administrative changes, as the premises it now occupies are required for the Railway Commission. Suggestions have been made that the system under which designs are registered should be in many respects assimilated to that now in force as regards patents, and it is therefore most probable that the various descriptions of registered inventions and designs will be printed, as the specifications of patents now are. Another necessary improvement will be the preparation and printing of indexes, those at present existing being only manuscript, and very imperfect. The abolition of all fees for searches will be made at once.—*Times*.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are du should be forwarded by cheque or Po order, crossed "Coutts and Co.," and ma able to Mr. Samuel Thomas Davenport, officer.

JUVENILE LECTURES.

The second Juvenile Lecture by Prof. on "The Work and Food of the Iron will be delivered on Wednesday next, J 3 o'clock. Tickets have been distribute members by whom application was mad

SCIENTIFIC MEETINGS FOR THE ENSU

MON.... Royal Geographical, 1, Savile-row, W., 8½ St. Vincent Erskine, "A Journey to Um Africa." 2. Capt. F. Elton on "The Coas Delta of the Rufigi, East Africa."
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C.
Social Science Association, 1, Adam-street, 8 p.m. Mr. Rupert Kettle on "Police S Bail on First Convictions."

TUES. ...Royal Institution, Albemarle-street, W. E. Ray Lankester on "The Pedigree Kingdom."
Medical and Chirurgical, 53, Berners-street, W., 8½ p.m.
Civil Engineers, 25, Great George-stre S.W., 8 p.m. Mr. H. E. Jones, "Th Gas Works."
Photographic, 9, Conduit-street, W., 8 p.
Anthropological Institute, 4, St. Mart 1. Mr. Thomas J. Hutchinson on "T of Prehistoric Peru." 2. Mr. G. E. Andamans and Andamanese."

WED. ...SOCIETY OF ARTS, John-street, Adel Professor Macleod on the "Food and Horse." (Juvenile Lecture II.)
Geological, Burlington House, W., 8 F. Blake on "The Kimmeridge Clay A. J. Jukes-Browne on "The Cam Greensand." 3. J. Clifton Ward on of the Southern Part of the Lake-Glacial origin of the Lake-Basins of Westmoreland." Second Paper.
Graphic, University College, W.C., 8 p.
Royal Literary Fund, 10, John-stree 3 p.m.
Royal Society of Literature, 4, St. Ma 4½ p.m. Mr. Walter De Gray Birch tion of Manuscripts, chiefly in relat Catalogue in the British Museum."
Archæological Association, 32, Sackvill

THURS....Royal, Burlington House, W., 8½ p.m
Antiquaries, Burlington House, W.C.
London Institution, Finsbury-circus,
Chemical, Burlington House, W., 8 p.
Society for the Encouragement of the duit-street, W., 8 p.m. Conversazi
Royal Institution, Albemarle-street, P. M. Duncan on "The Grander Ph Geography."
Inventors' Institute, 4, St. Martin's-
Mathematical, 22, Albemarle-street,

FRI.......Royal Institution, Albemarle-street, Meeting, 9 p.m. Prof. Tyndall c Problems."
Civil and Mechanical Engineers, 7, W. S.W., 7½ p.m. Mr. A. T. Walm Bridges."
Philological, University College, W. on "Cursor Mundi."
Junior Philosophical Society, 6A, 7½ p.m. Mr. T. Engledue Prideau Theory and its relations to the F Organic Nature."

SAT......Royal Institution, Albemarle-stre Edward Dannreuther on "Moza

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,156. Vol. XXIII.

FRIDAY, JANUARY 15, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FIRES AT SEA.

The Council have decided to offer the Society's Fothergill Gold Medal for an effective means of extinguishing fire on board ship, and they have directed the Secretary to enter into communication with leading ship-owners, with the view of enlisting their aid in this important matter.

CANTOR LECTURES.

The third lecture of the course of Cantor Lectures on "Alcohol, its Action and its Uses," by Benjamin W. Richardson, M.D., F.R.S., F.R.C.P., was delivered on Monday, December 21st, 1874, as follows:—

Lecture III.

The Influence of Common or Ethylic Alcohol on Animal Life. The Primary Physiological Action of Alcohol.

I have to consider to-night the primary action of ethylic alcohol on animal life. This is the alcoholic spirit which enters into wines, beers, and ordinary spirituous liquors.

There are two modes in which this subject must be discussed. One relates to the mere physical action of alcohol upon the body, the other to its action as a food for the body. Of the varied substances which we take into our systems, some, like chloroform or opium, produce very marked physical effects, which we may call physiological, but which have nothing to do with the nourishment of the organism, nor with the sustainment of its vital power. Other substances act as foods, producing certain continuous phenomena of structural build and of vital function. Alcohol is peculiar in that we are obliged to consider it, at the present time, from each of these points of view, and to-night I take up the first, I mean the purely physical action of alcohol, reserving the question of its qualities as a food for a future lecture.

A very simple problem lies before us. The sum of £117,[illegible],000 of money is invested in this country on alcohol as a commercial substance. Where does the alcohol go? We know that the larger part of it goes in consumption by human beings. A little—I mean by comparison a little—is used for the purposes of art and science, but the greater portion of it, practically all but the whole of it, is consumed by human beings. Thus a question arises, we may almost say, of engineering and commerce, a question, therefore, particularly worthy of this Society, viz., What is the good of this invested capital, and of the substance which it supplies? It is not necessary for any of us to consider ourselves as physicians in studying this matter, but we may all consider ourselves as animal engineers, anxious to know the physical properties of agents which influence the animal life. To put it in a very practical way, suppose that there was no question involved in regard to the influence of alcohol upon the body, but that in the course of the invention of motive engines—common inanimate engines, which can be made to produce motive power by the application of heat to water—it had originally become the practice from some circumstance to put into the engines so much spirit with the water, and to work the engines with this mixture. Then suppose somebody said, "This is a very expensive process of working the engines; maybe they will work as well without the spirit." You would then naturally inquire, "Can such be the fact?" And you would seek an engineer to fill the place I now have the honour to occupy, to explain to you the mechanism of the engines. You would also beg him to explain and put before you facts which would bear upon the point, whether the admixture of spirit and water was useful or useless? Now, please, consider me to-night as an engineer, and the animal body as the engine I am to speak upon. I am not going to address a word to you as a physician; I am not going to offer advice. I simply mean to place before you, as far as I know them, the facts relating to the physical effects of this thing alcohol, when it is put into one of those millions of engines which we call men.

Alcohol will enter the body—the engine of which I am about to speak—by many channels. It can be introduced by injecting it under the skin or into a vein. Exalted by heat into the form of vapour, it may be inhaled by man or animal, when it will penetrate into the lungs, will diffuse through the bronchial tubes, will pass into these minute air vesicles which are so well defined in this diagram, will travel through the minute circulation with the blood that is going to the heart, will condense in that blood, will go direct to the left side of the heart, thence into the arterial canals, and will be carried throughout the body. Or, again, the spirit can be taken in by the more ordinary channel, the stomach. Through this channel it finds its way, by two routes, into the circulation. A certain portion of it—the greater portion of it—is absorbed directly by the veins of the alimentary surface, finds its way straight into the larger veins, which lead up to the heart, and so onwards with the course of the blood. Another portion is picked up by those small structures indicated on this diagram, which proceed from the mucous surface below the stomach, which are called *villi*, and from which originate a series of fine tubes that reach at last the lower portion of a common tube known as the thoracic duct. This tube ascending, as you will observe on the diagram, lying in front of the spinal column, terminates at the junction of two large veins on the left side of the body, at a point where the venous blood, returning from the left arm, joins with the returning blood from the left side of the head on its way to the heart.

Thus in whatever way the alcohol is introduced it enters the blood; the shortest way is that by inhalation, the longest and most ordinary way is by the stomach. Indeed, except for experimental purposes, the introduction is always by this latter and longest route, and we may, for our practical purposes, only think of alcohol as a fluid taken by the mouth into the stomach, and absorbed like a food or a drink from the surface of the alimentary canal.

Suppose then a certain measure of alcohol is taken into the stomach, it will be absorbed there; but, previous to absorption, it will have to undergo a proper degree of dilution with water, for there is this peculiarity respecting alcohol when it is separated by an animal membrane from a watery fluid like the blood, that it will not pass through the membrane until it has become charged, to a given point of dilution, with water. It is itself, in fact, so greedy for water, it will pick it up from watery textures, and deprive them of it until, by its saturation, its power of reception is exhausted, after which it will diffuse into the current of circulating fluid.

To illustrate this fact of dilution, I introduce a simple experiment. Here is a bladder, in which has been placed a mixture consisting of equal parts of alcohol and distilled water. Into the neck of the bladder a long glass tube is inserted and firmly tied. Then the bladder is immersed in a saline fluid representing an artificial serum of blood. The result is, that the alcohol in the bladder has absorbed water from the surrounding saline solution, and thereby a column of fluid has passed up into the glass tube. A second mixture of alcohol and water, in the proportion, this time, of one part of alcohol to two of water, has been put into another bladder immersed in like manner in an artificial serum. In this instance, a little fluid has also passed from the outside into the bladder, so that there is a rise of water in the tube, but less than in the previous instance. A third mixture, consisting of one part of alcohol with three parts of water, is placed in another little bladder, and is also suspended in the artificial serum. In this case there was for a time a small rise of fluid in the tube connected with the bladder; but after a time, owing to the dilution which took place, a current from within outwards set in, and the tube became empty. Thus each bladder charged originally with the same quantity of fluid contains now a different quantity. The first contains more than it did originally; the second a little more; the third a little less. From the third absorption is taking place, and if I keep changing and replacing the outer fluid which surrounds the bladder with fresh serum, I could in time, owing to the double current of water into the bladder through its coats, and of water and alcohol out of the bladder into the serum, remove all the alcohol. In this way it is removed from the stomach into the circulating blood when it has been swallowed. When we dilute alcohol with water before drinking it we quicken its absorption. If we do not dilute it sufficiently it is diluted in the stomach by transudation of water in the stomach until the required reduction for its absorption; the current then sets in towards the blood, and passes into the circulating canals by the veins.

If you direct your attention to this diagram showing the circulation, you will see that all the returning veins end in the large trunks which terminate in the central organ of the circulation—the heart. The heart, a moving muscular organ, has four cavities; two above called the auricles, two below called the ventricles. The cavities on the right side are called respectively the right auricle and right ventricle; the cavities on the left side are called respectively the left auricle and the left ventricle. The right auricle receives all the venous blood of the body, and transmits it to the right ventricle; the right ventricle drives the blood over the lungs where the blood is arterialised; the left auricle receives the blood from the lungs, and transmits it to the left ventricle, which drives it through these arterial tubes over the whole of the body, whence it returns again by the veins to the right side of the heart, and so on, in circulation. Alcohol, therefore, entering the veins, makes its way in the course I have described through the right heart, through the lungs, through the left heart, through the body at large by the arteries. This is the course of its travel in the organism; what does it do as it makes the round?

As it passes through the circulation of the lungs it is exposed to the air, and some little of it, raised into vapour by the natural heat, is thrown off in expiration. If the quantity of it be large this loss may be considerable, and the odour of the spirit may be detected in the expired breath. If the quantity be small the loss will be comparatively little, as the spirit will be held in solution by the water in the blood. After it has passed through the lungs, and has been driven by the left heart over the arterial circuit, it passes into what is called the minute circulation, or the structural circulation of the organism. The arteries extend into very small vessels, which are called arterioles, and from these infinitely small vessels spring the equally minute radicals or roots of th[e] which are ultimately to become the great rivers b[y] the blood back to the heart. In its passage throu[gh] minute circulation the alcohol finds its way to organ. To this brain, to these muscles, to these se[creting] or excreting organs, nay even into this bony st[ructure] itself, it moves with the blood. In some of the[se] which are not excreting, it remains for a time and in those parts where there is a large per-ce[ntage of] water it remains longer than in other parts. Fr[om] organs which have an open tube for conveyin[g] away, as the liver and kidneys, it is thrown eliminated, and in this way a portion of it is u[ltimately] removed from the body. The rest passing r[ound] round with the circulation, is probably decom[posed] carried off in new forms of matter; but concer[ning this] more on a future occasion.

When we know the course which the alcoh[ol takes in] its passage through the body, from the pe[riod of its] absorption to that of its elimination, we are able to judge what physical changes it indu[ces in the] different organs and structures with which i[t comes in] contact. It first reaches the blood, but, as quantity of it that enters is insufficient to p[roduce any] material effect in that fluid. If, however, th[e dose] be poisonous or semi-poisonous, then even rich as it is in water—and it contains sev[en hundred] and ninety parts in a thousand—is aff[ected. The] alcohol is diffused through this water, a[nd] comes in contact with the other constituen[ts—with] the fibrine, that plastic substance which, w[hen blood is] drawn, clots and coagulates, and which is p[resent in the] proportion of from two to three parts in with the albumen which exists in the seventy parts; with the salts which yie[ld] parts; with the fatty matters; and lastl[y with those] minute, round bodies which float in m[yriads in the] blood, which were discovered by the Dutc[h] Leuwenhock, as one of the first results of observation, about the middle of the sev[enteenth cen]tury, and which are called the blood glo[bules or cor]puscles. These little bodies are, in fac[t,] discs, when natural, have a smooth out[line, are] depressed in the centre, as I indicate on they are red in colour; the colour of the b[lood is] derived from them. We have discove[red of late] years that there exist other corpuscles blood in much smaller quantity, which a[re] cells. Here is a drawing, showing very these different cells float in the blood-str[eam in the] vessels. The red corpuscles, you will o[bserve, keep the] centre of the stream; the white lie ext[ernally at the] sides of the vessels, moving less quickly is mainly with the red corpuscles. Th[ey have the] most important functions in the econom[y; they take up,] in great part, the oxygen which we in[hale in breath]ing, and carry it to the extreme tissu[es, and] they absorb, in great part, the carboni[c acid which] is produced in the combustion of the [ex]treme tissues, and bring that gas back [to the lungs to] be exchanged for oxygen there; in sh[ort, they are the] vital instruments of the circulation.

With all these parts of the blood, with albumen, salts, fatty matter, and corp[uscles, alcohol] comes in contact when it enters the b[lood, and, if] in sufficient quantity, it produces dist[urbance. I] have watched this disturbance very blood corpuscles, for in some animals floating along during life, and we can from men who are under alcohol b[y a drop] of blood, and examining it with the action of the alcohol, when it is o[bserved.] It may cause the corpuscles to run t[ogether] and to adhere in rolls; it may modify th[e outline,] the clearly-defined smooth outer crenate, or even starlike as I defin[e;] it may change the round corpuscle

thus, or, in very extreme cases it may produce what I may call a truncated form of corpuscle, in which the change is so great that if we did not trace it through all its stages we should be puzzled to know whether the object looked at were indeed a blood-cell. All these changes are due to the action of the spirit upon the water contained in the corpuscles; upon the capacity of the spirit to extract water from them. During every stage of modification of corpuscle thus described, the function to absorb and fix gases is impaired, and when the aggregation of the cells, in masses, is great, other difficulties arise, for the cells united together pass less easily than they should through the minute vessels of the lungs and of the general circulation, and impede the current, by which local injury is produced.

A further action upon the blood instituted by alcohol in excess, is upon the fibrine or the plastic colloidal matter. On this the spirit may act in two different ways, according to the degree in which it affects the water that holds the fibrine in solution. It may fix the water with the fibrine, and thus destroy the power of coagulation; or it may extract the water so determinately as to produce coagulation. These facts bear on a new and refined subject of research with which I must not trouble you further, except to add that the inquiry explains why in acute cases of poisoning by alcohol the blood is sometimes found quite fluid, at other times firmly coagulated in the vessels.

These are the only points I have time to touch upon in respect to the physical action of alcohol upon blood. I must pass next to blood vessels, and trace out the action upon those fine ramifications of the larger vessels which we call the minute circulation. Upon these parts the spirit exerts a singular influence, from which arise a series of phenomena, characteristic of action when even a moderate quantity of spirit is taken into the body. That we may follow out this position clearly, it is essential I should for a few minutes put alcohol out of sight altogether and describe the mechanism and governance of this minute circulating system.

If any of you ever visited the Royal College of Physicians you would find there a system of blood vessels dissected and traced out by the immortal discoverer of the circulation of the blood himself, William Harvey; and I think it would strike you, as you looked on, that all the organs of the body, which constitute the body in its entirety, are built upon these minute vessels. It is as though Harvey had suggested the thought that the vascular system was the primary part of the animal organisation, and that upon it were planted and developed all the structures. I have here had constructed a diagram illustrative of what I mean. The arteries are all shown branching out into their extreme divisions and giving the outline of the limbs, of the brain, of the visceral parts, and of the other organs. The veins are seen springing or continuing from these extreme arterial parts, as rivers may be said to spring, and to form at last trunks of large and larger size by which they bring back the blood to the centre of the circulation to be vivified there, and carried on again.

From this distribution of blood in these minute vessels the structures of organs derive their constituent parts; through these vessels brain matter, muscle, gland, membrane is given out from the blood by a refined process of selection of material, which up to this time is only so far understood as to enable us to say that it exists.

These minute vessels are therefore more intimately connected than any other part with the construction and with the function of the living matter of which the body is composed. Think you that this mechanism is left uncontrolled? No; the vessels, small as they are, are under distinct control. Infinitely refined in structure, they nevertheless have the power of contraction and dilatation, which power is governed by nervous action of a special kind. If we pass to the lower class of animals, we find running along the body, in addition to its vascular system, a series of points of nervous matter, consisting of what are called ganglia. These ganglia are connected together in chain, and from them filaments of nerves emanate, which are distributed to all the active moving parts of the body. Here is a large diagram showing this nervous system in the grasshopper. In such lower animals the nervous system thus described stands alone, and when we rise in the scale and come even to man we find still the same primitive nervous chain. But we find also now another and more highly developed nervous system, the centres of which are locked up in the brain and spinal column, from which centres nerves of special sense go into the organs of sense, nerves of sensibility or common sensation go to the skin and other sensitive surfaces, and nerves of voluntary motion go to the muscles, all combining to perform their respective functions in the animal economy.

Thus man has two nervous systems: the primary nervous chain and the added centres, with their fibres. The two systems are connected by their fibres in different parts, but they are still distinct, both anatomically and functionally. The primary nervous system is called the system of the organic vegetative or animal life; it governs all those motions which are purely involuntary, and its centres are believed by some, and I think with perfect correctness, to be the seats of those faculties which we call emotional and instinctive. The centres of the brain and spinal chord, with their parts, are the centres of the volitional and of the reasoning powers of all those faculties, that is to say, which are directly under the influence of the will.

Keep in mind, if you please, the two nervous systems, and add to the remembrance this one additional fact, that all those minute blood-vessels at the extremities of the circulation are under the control of the primary or organic nervous supply. Branches of nerves from those organic centres accompany every arterial vessel throughout the body to its termination, and without direction from our will regulate the contraction and dilatation of the blood-vessels to their most refined distribution. This fact was suspected by the older anatomists, but it remained for modern research to make it a demonstration. Thus it has now been proved that if the organic nervous supply of a part of the minute circulation be cut off by division of the organic nerve feeding that part, the vessels become paralysed, as these flexor muscles of my hand, which now grasp so firmly, would be paralysed were their voluntary nervous supply divided.

It will be clear at once that an important advancement of knowledge respecting the course of the blood through the minute circulation has been gained; but our knowledge does not rest at this point. When certain simple physical impressions are made upon the organic nerves, the disturbance of their supply is indicated by distant phenomena, and the blush which mantles, or the pallor which overspreads the cheek, under the influence of mental emotion or shock, are phenomena of this order.

I can bring to your notice an experiment, showing the production of paralysis, and of all the phenomena above quoted by the mere action of cold upon the organic nervous fibre. By evaporating ether from the back of my hand quickly, I freeze the skin, and thereby produce paralysis. I take the ether away, and now into the paralysed vessels, which are capable of offering no efficient resistance, the blood rushes, distending the vessels, remaining for a moment stagnant in them, and giving a brilliant red colour or crimson blush over the part. I feel in this part the glow commonly called hot-ache; it is the blush which occurrs on the cheek, and it is from the same physiological condition.

Still further in advance, and with the mention of the fact I am brought back to the subject proper of my lecture, we have learned that certain chemical agents can so influence the organic nervous chain as to disturb its functions, after the manner of a pure physical act. When this peculiar fluid, the nitrite of amyl, to which I have

before called your attention, came before me for investigation, I divined, from the symptoms it produced, that it influenced the organic nervous fibre precisely after the manner of a division of that fibre. I dipped a spill of paper into the liquid, brought that near to my nose, as I do now, inhaled the vapour, and immediately felt my face in a red glow, as you see it again at this moment, and felt my heart beating rapidly, as I feel it beating at the present time. I reasoned, naturally, and as events proved, correctly, that this fluid, by its action on the organic nerves, paralysed the vessels of the minute circulation, and finding this to obtain with one chemical agent I traced it in others, and found a class of chemical substances, all of which have this same property of relaxing the blood-vessels at their extreme parts. The whole series of the nitrites possess this power; ether possesses it; but the great point I want to bring forth from this description is, that the substance we are specially dealing with, alcohol, possesses the self-same power. By this influence it produces all those peculiar effects which in every-day life are so frequently illustrated. It paralyses the minute blood-vessels, and allows them to become dilated with the flowing blood.

If you attend a large dinner party, you will observe after the first few courses, when the wine is beginning to circulate, a progressive change in some of those about you who have taken wine. The face begins to get flushed, the eye brightens, and the murmur of conversation becomes loud. What is the reason of that flushing of the countenance? It is the same as the flush from blushing, or from the re-action of cold, or from the nitrite of amyl. It is the dilatation of vessels following upon the reduction of nervous control, which reduction has been induced by the alcohol. In a word, the first stage, the stage of vascular excitement from alcohol, has been established.

The action of the alcohol extending so far does not stop there. With the disturbance of power in the extreme vessels, more disturbance is set up in other organs, and the first organ that shares in it is the heart. With each beat of the heart a certain degree of resistance is offered by the vessels when their nervous supply is perfect, and the stroke of the heart is moderated in respect both to tension and to time. But when the vessels are rendered relaxed, and resistance is removed, the heart begins to run quicker, like a watch from which the pallets have been removed, and the heart-stroke, losing nothing in force, is greatly increased in frequency, with a weakened recoil stroke. It is easy to account in this manner for the quickened heart and pulse which accompany the first stage of deranged action from alcohol, and you will be interested to know to what extent this increase of vascular action proceeds. The information on this point is exceedingly curious and important. After I had observed the effect of alcohol on the circulation generally, I attempted to calculate the rate at which it expedited the rate of circulation by observing its effect on the beat of the heart in the pigeon. Alcohol may be administered to this bird quite painlessly, and, as the animal quickly goes to sleep under the influence, and is therefore perfectly quiet, the beatings of its heart can be calculated with precision. I traced in these observations an increase of beats of the heart amounting in the course of two hours to one-fourth beyond what was natural. Then I essayed to make researches on myself, but many circumstances intervened, connected with the persistent labour and anxiety of professional life, which prevented me conducting the necessary operations so correctly as I desired, and as I might perhaps at another time have done. Fortunately, the information has been far more ably supplied by the researches of Dr. Parkes, of Netly, and the late Count Wollowicz. The researches of these distinguished inquirers are so valuable, I make no apology for giving them in detail. The observers conducted their inquiries on the young and healthy adult man. They counted the beats of the heart, first at regular intervals, during what were called water periods, that is to say, periods when the under observation drank nothing but water; a taking still the same subject, they counted the the heart during successive periods in which alc taken in increasing quantities. Thus step by st measured the precise action of alcohol on the h thereby the precise primary influence induced by Their results were as follows:—

"The average number of beats of the heart i (as calculated from eight observations made in during the first, or water period, was 106,00 alcoholic period it was 127,000, or about 21,0 and in the brandy period it was 131,000, or 25,

"The highest of the daily means of the puls during the first or water period was 77·5; b day two observations are deficient. The ne daily mean was 77 beats.

"If, instead of the mean of the eight days we compare the mean of this one day, viz., 7 minute, with the alcoholic days, so as to be s over-estimate the action of the alcohol, we fi

"On the 9th day, with one fluid ounce of heart beat 430 times more.

"On the 10th day, with two fluid ounces, more.

"On the 11th day, with four fluid ou times more.

"On the 12th day, with six fluid ounces, more.

"On the 13th day, with eight fluid ou times more.

"On the 14th day, with eight fluid ou times more.

"But as there was ephemeral fever on it is right to make a deduction, and to number of beats in that day as midway 11th and 13th days, or 18,432. Adopting daily excess of beats during the alcoh 14,492, or an increase of rather more tha

"The first day of alcohol gave an excess and the last of 23 per cent.; and the mea gives almost the same percentage of exces of the six days.

"Admitting that each beat of the heart during the alcoholic period as in the wat it was really more powerful), the heart c days of alcohol was doing one-fifth more

"Adopting the lowest estimate which of the daily work of the heart, viz., as eq lifted one foot, the heart during the a did daily work in excess equal to liftin foot, and in the last two days did ext amount of 24 tons lifted as far.

"The period of rest for the heart though, perhaps, not to such an extent ferred from the number of beats, for was sooner over. The heart, on the fift after alcohol was left off, and apparen when the last traces of alcohol were eli in the sphygmographic tracings signs o ness; and, perhaps, in consequence of brandy quickened the heart again, the a more rapid contraction of the ventricl than in the alcoholic period. The fact, on a heart whose nutrition had r restored."

It will seem at first sight almost in an excess of work could be put upon t perfectly credible when all the facts heart of an adult man makes, as 73·57 strokes per minute. This num sixty for the hour, and again by twe the entire day, would give nearly 106, of strokes per day. There is, howe stroke produced by assuming the recu by sleep, so that for simplicity's sal

the 4,000 strokes, and speaking generally may put the average at 100,000 in the entire day. With each of these strokes the two ventricles of the heart, as they contract, lift up into their respective vessels three ounces of blood each, that is to say, six ounces with the combined stroke, or 600,000 in the twenty-four hours. The equivalent of work rendered by this simpler calculation would be 116 foot tons; and if we estimate the increase of work induced by alcohol we shall find that four ounces of spirit increase it one-eighth part; six ounces, one-sixth part; and eight ounces, a fourth part.

The stage of primary excitement of the circulation thus induced lasts for a considerable time, but at length the heart flags from its over action, and requires the stimulus of more spirit to carry it on in its work. Let us take what we may call a moderate amount of alcohol, say two ounces by volume, in form of wine, or beer, or spirits. What is called strong sherry or port may contain as much as twenty-five per cent. by volume. Brandy over fifty, gin thirty-eight; rum, forty-eight; whisky, forty-three; vin ordinaire, eight; strong ale, [illegible]; champagne, ten to eleven; it matters not which, if the quantity of alcohol be regulated by the amount present in the liquor imbibed. When we reach the two ounces, a distinct physiological effect follows, bringing on to that first stage of excitement with which we are now conversant. The reception of the spirit arrested at this point, there need be no important mischief done to the organism; but, if the quantity imbibed be increased, further changes quickly occur. We have seen that all the organs of the body are built upon the vascular structures, and therefore it follows that a prolonged paralysis of the minute circulation must of necessity lead to disturbance in other organs than the heart.

By common observation the flush seen on the cheek during the first stage of alcoholic excitation is presumed to extend merely to the parts actually exposed to view. I cannot, however, be too forcibly impressed that the condition is universal in the body. If the lungs could be seen, they too would be found with their vessels injected; if the brain and spinal cord could be laid open to view, they would be discovered in the same condition; if the stomach, the liver, the spleen, the kidneys, or any other vascular organs or parts could be exposed the vascular enlargement would be equally manifest. In the lower animals I have been able to witness this extreme vascular condition in the lungs, and there are here presented to you two drawings from nature, showing, one the lungs in a natural state of an animal killed by a sudden blow, the other the lungs of an animal killed equally suddenly, but at a time when it was under the influence of alcohol. You will see, as if you were looking at the structures themselves, how different they are in respect to the blood which they contained, how intensely charged with blood is the lung in which the vessels had been paralysed by the alcoholic spirit.

I have had the unusual, though unhappy opportunity of observing the same phenomenon in the brain-structure of a man who, in a paroxysm of alcoholic excitement, precipitated himself under the wheel of a railway carriage, and whose brain was instantaneously evolved from the skull by the crash. The brain itself, entire, was before me within three minutes after the death. It exhaled the odour of spirit most distinctly, and its membranes and minute structure were vascular in the extreme. It looked as if it had been recently injected with vermilion. The white matter of the cerebrum, studded with red points, could scarcely be distinguished, when it was incised, by the natural whiteness; and the pia mater, or internal vascular membrane covering the brain, resembled a delicate web of coagulated red blood, so tensely were its fine vessels engorged.

I should add that this condition extended through both the larger and the smaller brain, the cerebrum and cerebellum, but was not so marked in the medulla or commencing portion of the spinal cord.

The action of alcohol continued beyond the first stage, the function of the spinal cord is influenced. Through this part of the nervous system we are accustomed, in health, to perform automatic acts of a mechanical kind, which proceed systematically even when we are thinking or speaking on other subjects. Thus a skilled workman will continue his mechanical work perfectly, while his mind is bent on some other subject; and thus we all perform various acts in a purely automatic way, without calling in the aid of the higher centres, except something more than ordinary occurs to demand their service, upon which we think before we perform. Under alcohol, as the spinal centres become influenced, these pure automatic acts cease to be correctly carried on. That the hand may reach any object, or the foot be correctly planted, the higher intellectual centre must be invoked to make the proceeding secure. There follows quickly upon this a deficient power of co-ordination of muscular movement. The nervous control of certain of the muscles is lost, and the nervous stimulus is more or less enfeebled. The muscles of the lower lip in the human subject usually fail first of all, then the muscles of the lower limbs, and it is worthy of remark that the extensor muscles give way earlier than the flexors. The muscles themselves by this time are also failing in power; they respond more feebly than is natural to the galvanic stimulus; they, too, are coming under the depressing influence of the paralysing agent, their structure is temporarily deranged, and their contractile power reduced.

This modification of the animal functions under alcohol marks the second degree of its action. In young subjects there is now, usually, vomiting with faintness, and gradual relief from the burden of the poison.

The alcoholic spirit carried yet a further degree, the cerebral or brain centres become influenced; they are reduced in power, and the controlling influences of will and of judgment are lost. As these centres are unbalanced and thrown into chaos, the rational part of the nature of the man gives way before the emotional, passional, or organic part. The reason is now off duty, or is fooling with duty, and all the mere animal instincts and sentiments are laid atrociously bare. The coward shows up more craven, the braggart more boastful, the cruel more merciless, the untruthful more false, the carnal more degraded. "*In vino veritas*" expresses even indeed to physiological accuracy, the true condition. The reason the emotions, the instincts, are all in a state of carnival, and in chaotic feebleness.

Finally, the action of the alcohol still extending, the superior brain centres are overpowered; the senses are beclouded, the voluntary muscular prostration is perfected, sensibility is lost, and the body lies a mere log, dead by all but two-thirds, on which alone its life hangs. The heart still remains true to its duty, and while it just lives it feeds the breathing power. And so the circulation and the respiration, in the otherwise inert mass, keeps the mass within the bare domain of life until the poison begins to pass away and the nervous centres to revive again. It is happy for the inebriate that, as a rule, the brain fails so long before the heart that he has neither the power nor the sense to continue his process of destruction up to the act of death of his circulation. Therefore he lives to die another day.

Thus there are four stages of alcoholic action in the primary form:—(*a*) A stage of vascular excitement and exhaustion; (*b*) a stage of excitement and exhaustion of the spinal cord, with muscular perturbation; (*c*) a stage of unbalanced reasoning power and of volition; (*d*) a stage of complete collapse of nervous function.

Such is an outline of the primary action of alcohol on those who may be said to be unaccustomed to it, or who have not yet fallen into a fixed habit of taking it. For a long time the organism will bear these perversions of its functions without apparent injury, but if the experiment be repeated too often and too long, if it be continued after the term of life when

the body is fully developed, when the elasticity of the membranes and of the blood vessels is lessened, and when the tone of the muscular fibre is reduced, then organic series of structural changes, so characteristic of the persistent effects of spirit, become prominent and permanent. Then the external surface becomes darkened and congested, its vessels in parts visibly large; the skin becomes blotched, the proverbial red nose is defined, and those other striking vascular changes which disfigure many who may probably be called moderate alcoholics, are developed. These changes, belonging as they do to external parts, come under direct observation; they are accompanied with certain other changes in the internal organs, which we shall perhaps discover in a future lecture, to be more destructive.

ECONOMY OF FUEL.

The following communications have been addressed to the Council on the subject of the recent stove competition:—

Gas Apparatus Manufactory,
5, Chandos-street, Charing-cross, W.C.,
London, 17th Dec., 1874.

GENTLEMEN,—I was one of the competitors at the late trial of stoves at the London International Exhibition, 1874.

I have to acknowledge, with thanks, the receipt of your communication, giving me the decision of the Council in that competition, and though I am neither surprised nor disappointed by it, I cannot but regret that so much time, labour, and expense has been incurred both by committee and competitors, for so unsatisfactory a result.

I should be glad to learn the relative values of the gas-warming stoves tried, if the committee think it consistent with their peace of mind to furnish a list of them in their order of merit.

But my special reason for now addressing you is not to open vials of wrath on the lame conclusion of the trials, or to cavil at the method of testing, but to suggest a plan I think likely to promote the attainment of that improvement in apparatus for the "economic use of coal for domestic purposes," which the anonymous donor of £500 seeks by help of the Society of Arts.

The late competition was, though duly notified, and, as far as I could see, very carefully conducted—an isolated effort; and the time for sending in stoves was just the busy part of a busy season. If the trials could be made annually, the articles entered at a stated time, in June or July, and the decisions made known in September, the attention of makers could more fully be given at such season, and the awards would be issued early enough in the year to be a timely indication to intending purchasers of such goods, and to enable manufacturers of successful stoves to prepare a stock in anticipation of a demand that would be likely to follow that success.

No other prize than a certificate showing the figure of merit would be needed.

Any sums, like the £500, given for the encouragement of improvements, could be devoted to carrying out these trials.

A certificate could be given to every stove tried, whether good, bad, or indifferent; and the value of the figure of merit being clearly explained, the maker could use his own discretion as to publishing it.

The competition being annual, each exhibitor would aim at excelling the best production of the last year, and in time the perfection desired would be more nearly approached.

The points of excellence in the best production of its kind each year should be clearly stated and conspicuously displayed on the article when exhibited, as a guide to both purchasers and manufacturers.

An agreement could probably be made, if desired, wi the Crystal Palace managers, or others, for setting ap a space in their building to be called the Society of A Competition Court.

The competitors individually could pay an agreed r for the space occupied by their goods, but an indispensal condition of admission to this court should be a c spicuous display of the Society's figure of merit.

Such an arrangement could be adapted to all various matters in which the Society of Arts from t to time interests itself, and would before long be gre appreciated by the public.

I am, yours truly,
FRANCIS HARMON

To the Council of the Society of Arts,
John-street, Adelphi.

Birmingham, Dec. 17th, 18

DEAR MR. FOSTER,—The result arrived at by Stove Committee, that "while giving full credit to invention and efforts of the competitors, for the care labour which they have bestowed upon their c trivances, the Council are unable to award any pri appears to me to support the opinion, that in orde most effectually promote economy in the use of coal domestic purposes, we require to discover new truth the science of heat. Discovery is the foundation invention; and the fact comes up again and again, t the greatest of modern inventions are based u modern discoveries of new knowledge; for insta the electric telegraph, electro-plating, &c. The ap cability of our present stock of knowledge in the sci of heat, is in my opinion, largely exhausted for purposes of invention until we obtain new knowledg combine with it.

If plenty of discoveries were made, then inven would have plenty of material (as I may call it) making new inventions. We have at present sufficient power of discovery in this country comp with that of invention.

Want of new knowledge appears to me to be "dead-lock" which prevents much progress in in tion at present, and hence we should provide remuneration for pure scientific research.

If you can communicate these ideas to your Cou and Society I shall be glad.

Yours very truly,
GEORGE GOR

P. Le Neve Foster, Esq.,
Secretary Society of Arts.

JUVENILE LECTURES.

On Wednesday last, the 13th inst., the secon a course of two lectures, specially adapted t juvenile audience, was delivered by Mr. Her M'Leod, professor of experimental science at Royal Indian Engineering College. The sub was, "The Food and Work of the Iron Horse

The lecturer began by illustrating the principle volved in the combustion of hydrogen both in a spheric air and in oxygen, and showed how water produced by combustion. Going on from these ele tary principles, he proceeded to their application i steam-engine. He showed how water and solid ma were incompressible, but that nevertheless the l would transmit pressure, and when a sufficient am of elasticity was produced by compression, gas, what they had specially to deal with—steam, w exert a force tending to move any portion of the taining vessel which was moveable. Thus a cork driven from a tube by the force of air compress means of a piston working therein. It was on principle that the steam-engine was constructed. S

was admitted to a cylinder in which was a moveable plug or piston, and immediately on its admission it drove this piston as far as it could along the cylinder. When the piston had reached its furthest point the jet of steam was cut off, and another was admitted on the opposite side of the piston, which was thus continually driven backwards and forwards from end to end of the cylinder. The motion thus obtained was transmitted through suitable rods and apparatus to turn a wheel, or do other work required. The various portions of the engine were then commented on, particularly the means for producing draught in the furnaces of locomotives by means of a steam-blast. The action of this was explained and illustrated by experiment.

At the conclusion of the lecture a vote of thanks to Professor McLeod was proposed by the **Secretary**, and carried unanimously.

MISCELLANEOUS.

THE PROPOSED ALTERATIONS IN THE RAILWAY SYSTEM OF THE GERMAN EMPIRE.

SIR,—The Constitution of the German Empire has recently opened up the question of the amalgamation of the railways belonging to the several States of which the Empire is composed. The question involves administrative and legislative principles which are of European and cosmopolitan interest, as affecting not only the internal, but also the international transit of goods and persons across the continent of Europe; that Great Britain, with her thirty-six millions of exports to the German Empire, perhaps more than any other. The importance of the subject is not lessened by its neglect hitherto by the diplomacy of our own and other governments. The position of the question, as now propounded by the German Government, is stated in a recent pamphlet by Herr Moritz Mohl, member of the Imperial and Würtemberg Parliaments, to whose exertions is mainly due the brilliant example set to Germany by Würtemberg in railway administration. The following is an abstract of the pamphlet, omitting the references to the principles adopted by the Society of Arts on the Postal Telegraph question, the discussion of which he quotes in support of his views on the present system of railway administration in Germany.

I may mention here that in June, 1873, an Imperial Railway Department was added to the other departments of the German Administration. This department proposes next session to lay before the German Parliament the Railway Bill, which Herr Mohl discussses as follows.—I am, &c.,

EDWIN CHADWICK.

East Sheen, Mortlake, Surrey.

The Imperial Railway Department has just presented to the public a measure for the regulation of the railways throughout the German Empire; in order, according to a statement made in the German Parliament, to give an opportunity to all whom it may concern, of expressing their wishes or objection as regards the proposed Bill. The *Algemeine Zeitung* has also contained a number of articles following closely the onward steps indicated by the "motives" of this measure. I say, "the onward steps," because the "motives" (or explanatory exposition of principle attached to the Bill) evidently point to a much greater extension of the powers in the hands of the railway department than is assigned to it in the Bill itself, though even these powers, as there defined, despite their apparent limits, are capable of an almost unlimited extension.

Before proceeding, however, it may be as well to look at the history of this movement, which concerns so deeply the rights and interests of all the German States; and thus enable readers to form an independent judgment upon this important question.

The Constitution of the North German Confederation of 1867 contained the same provisions for the regulation of railways, roads, canals, &c., as the present German Constitution, with the exception of the clauses relating to Bavaria. Under the head of "Objects for the Supervision and Legislation of the Federal Government" were included—"The railway organisation and the establishment of means of communication by land and by water in the public interest, and for the national defence." But by this it was undoubtedly not understood that the whole railway, canal, and river system was to be placed under the exclusive control of the Imperial Government, the proof of which is, that the Imperial Government has never before claimed any such powers. The Constitution expressed, however, clearly enough the points on which the Imperial Government was entitled to interfere in the railway management; and a special article of the Imperial German Constitution was devoted to defining these points. As the question is one of such importance to the whole German nation, it may not be out of place to give here an extract from this part of the Constitution of the German Empire, to show how contrary its provisions are to the spirit of the new Railway Bill:—

"Article 41. The Imperial Government is entitled, if sanctioned by a Bill passed through the German Parliament, to establish at its own expense, or by concessions granted to private companies, such railways as may be deemed necessary for the nation, defence, or public traffic, notwithstanding the opposition of those members of the Federal Council through whose territory the railway must pass.

"Every existing railway administration is bound to allow new lines to be connected with its own, at the cost of the administration of the new lines.

"All laws investing existing railway administrations with the right of protesting against the establishment of competing lines are hereby repealed throughout the whole Empire, excepting in so far as existing rights are concerned; such privileges cannot be accorded in any future concessions."

"Article 44. The railway administrations are bound to facilitate, as much as possible, the through traffic, and all changes of passengers and goods from one line to another."

"Article 45. The Imperial Government reserves to itself the control over the tariffs. This control will be exercised with the following objects in view:—

"1. The establishment of uniform regulations throughout all the German lines.

"2. The establishment, as far as possible, of uniform and moderate fares throughout the empire, especially for transport of coals, wood, iron, &c., at as low a rate as is rendered practicable by the requirements and capabilities of different localities.

"Article 46. In cases of famine, or any great rise in the price of food, the railways are bound to transport flour, vegetables, and potatoes, at a lower rate, which shall be fixed by the Emperor by the advice of a Special Committee, appointed for the investigation of the circumstances.

"The above regulations, as well as those contained in Articles 42 to 45, are not applicable to Bavaria.

"The Government is, however, entitled to establish narrow gauges, &c., for the construction of the lines important for public defence.

"When required for the purpose of national defence, all railway administrations are bound to submit implicitly to the decrees of the Imperial Government, and to transport soldiers and war material at a fixed and uniform tariff."

These are accordingly the points on which the Imperial Government is entitled to control the administra-

ion of the railways, according to the German constitution, which does not, however, in anyway interfere with the rights of individual States to construct and manage their own State railways, and to grant concessions to companies for the construction of private lines. Only in the case of such lines as are deemed necessary for national defence or general traffic is the Imperial Government allowed to step in, and by the authority of a special Bill passed for the occasion, construct the line either at the expense of the Empire or by granting concessions to a private company, even without the consent of the States through which they pass. Such a case, however, would of course not occur if the States expressed their willingness to construct the line themselves. Bavaria consented to this article, which would certainly not have been the case had its rights of railway construction or management been in any way limited thereby.

It appears, therefore, that by the constitution the authority of the Imperial Government over the railways is limited to the following points:—

1. To ensure such uniformity of gauges and construction as shall facilitate a through traffic. This has been effected by a police regulation of December 29th, 1870, which, after some slight alteration, was approved by the Federal Council, and promulgated by the Imperial Chancellor. In Würtemburg this regulation has been already carried into effect as far as local circumstances permitted.

2. The establishment of uniform regulations for the management of the lines, the rights and duties of the officials, &c. This was carried out in the "Railway Management Regulations" approved by the Federal Council, and published by the Imperial Chancellery on 22nd December, 1871. This also was put into practice in Würtemburg, but has been superseded by a recent regulation of July 1st, 1874, uniform with those which are in operation in Austria.

3. The control (not the absolute authority) over the tariffs with a view to establishment of the greatest possible uniformity and reduction of the same. This article certainly gives considerable power to the Imperial Government, but this power is unquestionably rather that of arbitration than of administration, which the great diversities of soil, industry, local circumstances, &c., render very desirable.

The regulations in Article 44, by which the different railway administrations are bound to facilitate in every way the transfer of passengers and goods from one line to another, have been practically carried out all along, by agreement between the different companies and States. As regards the national defence, we believe that the military authorities are consulted before any new Imperial line is approved by the Government. The regulations concerning the use of the lines for the national defence (contained in Article 47) were in full force in North and South Germany even before the South German States joined the Imperial Confederation. The German railways were thus not quite in such a chaotic state bfore the establishment of the Imperial Railway Department as a perusal of the articles of even the Imperial Constitution regarding the railways might lead one to believe. Indeed, it may be doubted whether, after the establishment of a railway department, there was any occasion for any further legislative measures, and whether it would not have been better to rest contented with the efficient carrying out of the regulations of the Imperial Constitution on the subject, instead of depriving (as this Bill will do) the individual States of their constitutional right of granting concessions to companies, and placing the entire power in the hands of the Imperial Government.

Everyone knows what confusion and ruin has been caused by railway speculation in Berlin as well as in Vienna, North America, and London. Herr Lasker has covered himself with honour in the eyes of all honest men by exposing this evil in the Prussian Parliament,

and moving the formation of a Royal Commis
inquiry into the cause and means of preventing i
noble exertions have not been fruitless, though t
ruption he has combatted so energetically and
will and must always reappear—in spite of all the
ment can do—as long as concessions are granted
private companies; for speculators, as a rule, a
for such concessions with the object of self-enri
and impossible as it has hitherto proved to c
reckless gambling on the exchange, it is still
possible to prevent it in all which concern
speculation. What little can be done in th
must be done by the individual States, by
Governments and representatives. These a
the right to decide whether, and under what
they will allow the most important means of p
munication to be worked for the benefit
individuals. These alone possess the requisite
of the circumstances and requirements of
countries. The Imperial Parliament, th
Council, and the Imperial Government cann
knowledge or understanding of what is to the
of each individual State. Supposing th
Government to favour private railways, all t
States would be at once at the mercy of Ber
tors, who would have far greater facilities th
pushing their schemes throughout the wh
They were chiefly Berlin speculators, wh
schemes of private railways, to drive in the
the wedge for the destruction of the State ra
in the Central German States; and it i
Governments and representatives of thes
such projects were frustrated, to the great
the lands concerned, whilst in Berlin spe
reigned paramount. Even looking at th
way companies from the most favourable
the defeat of the speculator was a legiti
rejoicing, for a higher principle was at st
merely financial consideration, namely, th
by keeping in its hands the profitable lin
to extend even the less profitable lines, an
out the country and promote commerce
throughout the land. Thus only the State
function it is to provide the land with
munication, can effectually decide whethe
extent, and at what times and places the
shall be spread over the country, and wh
what condition concessions should be gra
individuals.

The control therefore of the system
cession ought, properly speaking, not to
functions of the Imperial Railway Depar

Although a measure was passed in the
Parliament (April 20th, 1870) calling u
cellor "To introduce a Bill for the purpo
uniformity in the concessions, constructi
ment of the railways, as well as for en
41 to 47 of the Constitution, as regards
the Government over the railways," an
measure was confirmed by the German
ment (June 14th, 1871), yet the latter t
sary not only to withdraw what had
concerning the concessions, but also
tional reassurance on this point in th
Bill for the creation of an Imperial
ment.

Herr Elben, who brought forward th
Imperial Parliament, said (May 17th,

"The promoters of this Bill believe
now come for taking vigorous steps to
tion of the seventh chapter of the Co
have thought it advisable to confine th
within the limits of the right granted b
Accordingly they have renounced the
into effect the first clause of the measu
the North German and Imperial P
believe the most effectual steps will b

Department under whose authority all further extensions of the railway system may be carried out. They have therefore laid aside all consideration of the question of concessions, as the German Constitution only deals with the compulsory concessions of Art. 41, and we wish to confine ourselves strictly within the constitutional powers of the Imperial Parliament."

And he was contradicted by no one, not even by the Chancellor, though the latter indicated a further extension of his powers in the speech of May 28, 1873, where he spoke to this effect:—"It is the control over the administration that concerns us rather than over the concessions; the gist of the whole Bill lies in Article 3, which gives to the Imperial authorities—though to a very modest degree—a certain amount of executive power, and—in so far as the separate States already possess it—of penal authority, referring to the constitution of North German Confederation in the case of the State railways, a very cumbrous piece of machinery. But I should thankfully accept even this small allowance in the hopes of your future co-operation in the further development of the question, as it may seem necessary. I only beg of you, in the interests of the Imperial dignity and Constitution, not to leave the authorities in their present state of powerlessness. They have now the power to issue decrees, but no legal means of enforcing them."

In the sitting of May 17, 1873, Prince Bismark had assigned this last point as one of the reasons for the creation of an Imperial Railway Department when, in answer to Herr Eckhard's complaint of the administration of the Elsass-Lothringen Railways, he said:—"I trust that the possible necessity of extending this measure at some future time will not prevent its supporters from taking the first steps and commencement . . . . I shall be thankful . . . . if we only bring it so far that the Imperial authority over the traffic becomes a reality; it can be further developed and enforced where it has hitherto not been established."

This powerlessness and need of fresh authority were each apparent to everyone in the Parliament, but the Bill for the creation of a Railway Department was carried by a majority of 130 votes, for although every South German and Saxon member felt very doubtful as to its advisability, yet the warm advocacy of the Chancellor would not fail to secure a majority. The Liberal Council was also amenable, and so the Bill became law on June 27, 1873.

Herr Scheele, formerly member of the Discount Company and director of the Berlin-Anhalt Railway Company, was appointed head of the department.

We must now see how the Railway Department proposes to deal with the question of private versus State railways in the Bill now before our notice.

Distinction must be drawn between the Bill itself and the "motives," or preliminary exposition of principles, which indicate the direction in which the measure tends, and the further development of the question which may be expected to result therefrom.

Article 1 of the Bill runs as follows:—

"The supervision over the construction, management, and goods and passengers traffic of all the railways in the German Empire to be vested in the Imperial Railway Department.

"The State Governments will retain the supervision over the management and construction of the railways in such points as are not specially placed by this Bill under Imperial control, or may hereafter be placed under the same."

The following articles explain more fully what is included by this measure:—

"Article 72. Besides the cases specially enumerated in the Bill, the Imperial Railway Department will exercise an authority in the following points:—

"1. In the general supervision over the estates and private railways.

"2. It will act as a Court of Appeal for and against the railways."

"Article 73. It will be the functions of the Imperial Railway Department—

"1. To enforce the execution of this and all other regulations of the railway system.

"2. To abolish any abuses and evils which may creep into the railway administration.

"3. The department is entitled at its discretion to take any branch of the railway system under its exclusive control."

Thus the authority of the Imperial Railway Department would be practically quite unlimited. It is as though a clause were added to a constituted definition of the rights of kings, stating "that the monarch is furthermore entitled to take all other administrative powers under his exclusive control."

The Bill goes on as follows in its definition of the powers of the Railway Department:—

"Article 2. The construction of lines at the expense of the separate States, the right of granting concessions to railway companies, and the supervision over the companies in their character as joint-stock companies, remain in the hands of the separate States within the limits specified in this Bill.

"Until the conditions of railway concessions have been fixed by the Imperial authorities, each State is entitled to regulate the conditions on which it will grant railway concessions, on the understanding that all such railways shall be subject to future Imperial legislation.

"The Railway Department is bound to see that the Imperial interests are not affected injuriously by the conditions of such concessions, and that a due hearing is given to all reasonable complaints of the conditions attached to the concessions, or the construction of new lines.

"The final decision is in the hands of the Federal Council.

"To ensure the above-mentioned objects all plans for concessions or railway contracts between different States, or between one German State and any foreign State, are to be submitted to the Imperial Railway Department.

"Every German State is bound to permit any line commenced or projected in a neighbouring State to be continued in or through its territory, if the Federal Council or the representation of the Railway Department shall deem it advisable for the national defence or general traffic."

According to the Imperial Constitution this could only be done when considered necessary, and then only when authorised by a Bill passed specially through the German Parliament.

"In such cases the State in question is entitled to build the lines itself, or grant a concession to private contractors.

"In case of the Railway Department failing to gain the consent of the Government concerned, the construction of the line can only be carried out according to Article 41 of the Imperial Constitution."

It is evident how much would be left to the German States of their important constitutional right of granting concessions. The Imperial Railway Department might at any time take the whole power into its own hands. But even this step would not be necessary. Everyone whose application for a concession had been rejected, or granted under burdensome conditions, need only appeal to the Railway Department, whose function it is to "consider all reasonable complaints," or in other words which holds the decision in its hands. The State Government in question might, it is true, appeal to the Federal Council, but such a representation must be made through the Railway Department, and moreover, a State possessing but few votes would be entirely dependent for the maintenance of its rights and privileges on the opinion of outsiders. This is surely not

"possessing the exclusive right of granting concessions." We shall see, moreover, with what disastrous consequences to the middle German States the compulsory continuation of lines commenced in neighbouring States would be brought.

In Art. 4 of the Bill stands as follows:—"As regards the right of opposition to a rival or parallel line of railway, Article 41 of the Imperial Constitution will hold good."

But this clause bears quite a different and most disastrous signification for a country whose Government has lost the right of granting the concessions; it, in fact, endows certain railways with a monopoly of the line; for, according to Article 44 of the Constitution, all established rights are left untouched by this regulation. For example, the Prussian law of November 3rd, 1838, Article 45, forbids any second line constructed by different parties connecting the same localities, and passing through the same principal localities as any existing line, to be constructed for a period of 30 years after the establishment of the first line. And this law, though nullified by the Article 41 of the North German Constitution, remains still in force for such private lines whose period of 30 years has not yet expired. It is true that in the case of many Prussian lines this period has expired, but in many cases it has not, whilst the Article 41 would be brought to bear with full force on all the State railways as soon as the States had lost the power of refusing or granting concessions to private companies.

I must now turn to the "motives," or preliminary exposit of the Bill, which are so conclusive as to the spirit in which it has been drawn up that a few extracts will not be out of place here:—

"The network of German railways bears the traces of the former divided state of the Empire; but it has its light as well as its shady side. To compare it with the example so often held up to us; whilst in France Paris was taken as the centre, and connected by direct lines with the principal political and strategic points, thus leaving out many very important provincial localities, in Germany the opposite course has been pursued. The main points in each land having been connected without much regard to the direct lines between the chief centres of traffic, the country has been covered by a network of lines opening out many places which would have remained closed had a uniform system of centralisation prevailed from the beginning. The great diversities of railway administrations have had another good result, namely, that of endowing Germany with a mixed system of State and private railways, a combination which is far preferable to either an exclusively private or Government system; for whilst the former is too often at variance with the true interests of the country, and the latter is apt to fetter the march of commerce by bureaucratic routine and restriction, a healthy development of the railway system can only be secured by the existence side by side on all main lines of State as well as private railways; for whilst the State supervision and series will regulate the private lines, the private lines will by their competition exercise a stimulating influence on the State railways."

(*To be continued.*)

A few weeks ago 450 tons of Egyptian sugar were brought to Boston by the steamer *Ontario*, from Liverpool. This sugar is used extensively in Europe, but it is said it has been imported into the United States before.

The *Academy* notes that the Russian expedition which is about to explore Western China has reached Shanghai, *via* Kiachta and Peking, after procuring the necessary passports at the latter place. The party consists of two military officers, a doctor, a photographer, three Cossacks, and two interpreters. They were to leave at once by steamer for Hankow, whence they will proceed in native boats up the river Han in a westerly direction.

PUBLIC MUSEUMS AND LIBRARIES AID BY PARLIAMENTARY VOTES.

Number of visitors for the months of November December, 1874. When they are counted by sight words "by sight" are used, when by turnstile the w "machine":—

	Voted in 1874.	Number of Visitors. Nov.	Dec.	How co
1. British Museum ...	£102,442	return refused.		
2. National Gallery...	6,346*	60,782	52,740	(by sight
3. Kew Gardens and Museum.........	17,862	7,667	3,424	(by sigh
4. South Kensington Museum...	38,024†	50,619	61,898	(by mach
5. Bethnal-green‡......	5,810	31,230	37,520	(by mach
6. National Portrait Gallery	1,748	...	...	
7. Geological Museum, Jermyn-street	8,998	2,727	3,030	(by mac
8. Patent Office Museum§	1,490	16,588	24,400	(by mac
9. Edinburgh National Gallery‖	2,100	...	6,406	(by mac
10. Edinburgh Museum of Antiquities‖	...	..	5,978	(by mac
11. Edinburgh Museum of Science and Art** ...	9,824	32,543	19,400	(by mac
12. Edinburgh Botanic Gardens	1,750	...	...	
13. Royal Dublin Society	1,823	...	...	
14. Dublin Museum of Natural History	1,672	...	4,322	(by mac
15. Glasneven Botanic Gardens and Museum...	2,148	...	7,278	(by mac
16. Dublin National Gallery	2,380	No return.		
17. Geological Society, Dublin	500	"		
18. Museum of Royal Irish Academy, Dublin	2,084	"		
19. Zoological Gardens, Dublin...	...	5,751	2,945	
20. Tower of London††	2,236	6,310	8,253	(by sig
21. Royal Naval College, including Greenwich Painted Hall ...	1,416	16,721	13,637	
22. Royal Naval Museum	...	3,411	1,800	

* Exclusive of special purchases. Total number of visit the year, 807.304. The Gallery was closed from Monday, S to Monday, Nov. 2.

† These expenses may be treated as local to the Museum: for purchases, circulation, travelling, carriage, &c., for 120 S of Art, amount to £51,859, and a portion, say £15,000, sho added to the above. The returns of the number of visitors to Kensington Museum for the year 1874 were as follows:—M (six days of seven hours) 531,903; evening (three days o hours), 270,495; students (daily), 111,729; total, 914,127—be increase of 55,090 over the numbers in 1873. The total n since the opening in 1856 has been 13,940,228.

‡ Number of visitors for the year, 530,676.

§ Number of visitors for the year, 263,794; since the ope the Museum free daily (12th May, 1858), 3,082,964.

‖ Closed for month of November.

** Total number of visitors for the year, 337,036.

†† Total number of visitors for the year, 146,580, being crease of 6,755 over 1873, and of 86,671 over 1863, the being progressive. The total number visiting the Tower si above period was 1,218,090.

The number of patents applied for durin year ending December 31, 1874, was 4,492, which is crease of 198 on the previous year (4,294).

The total number of vessels of different cl launched on the Clyde during the year 1874 amoun 187, with a gross tonnage of 244,467. This as com with 1873 shows an increase of 17 in the number, and crease in the tonnage of 2,375. In the class of sailing v there is an increase in number of 29, with an incre tonnage of 33,710. Paddle steamers have decreased in ber by 4, and in tonnage by 8,651. The number of steamers was one less than that of the previous year, the tonnage shows a decrease of 29,229.

EXHIBITION OF APPLIANCES FOR THE ECONOMY OF LABOUR.

An exhibition of certain classes of implements, machines, and appliances for the economising of labour will be held in Manchester, in 1875, by the Society for the Promotion of Scientific Industry. It will consist of two divisions, classified as follows:—

DIVISION I.—ENGINEERS AND MECHANICS' TOOLS, AND APPLIANCES IN THE WORKING OF METALS, WOOD, AND STONE.

Class 1. Engineers' hand and machine tools, lathes, drills, planing and shaping machines, slotting and screwing machines, iron founders' moulding machines, file-cutting machines, grinding machines, &c.

Class 2. Boiler makers' tools, punching, riveting, drilling, plate-planing, and welding machinery, &c.

Class 3. Nail and rivet making machines.

Class 4. Steam hammers, and machines applicable to forge and general smith-work, &c.

Class 5. Lifting appliances, hydraulic and other cranes, winches, screw jacks, &c.

Class 6. Machine and hand tools, used by carpenters and joiners, planing, morticing, and moulding machines, saws, cask-making machines, &c.

Class 7. Stone-dressing and cutting machines, drills, rock-boring machines, coal-cutting machines, &c.

DIVISION II.—DOMESTIC APPLIANCES.

The special object of this division will be to encourage the development and production of appliances having for their aim the lessening of the labour of the household, the saving of fuel, the improved preparation of food, and the increased healthiness of the home.

Class 1. Labour-saving machines and appliances of all descriptions, comprising washing, wringing, mangling and drying machines and apparatus; ironing, crimping, and goffering machines; sewing machines (with or without motive power), knitting and embroidering machines; knife cleaners, shoe brushers, fire lighters, sweepers, mincers, choppers, beaters, potato cleaners, peelers; coffee and other grinding mills; butter and cheese making apparatus; food manufacturing machines and apparatus; boot and shoe stitching machines.

Class 2. Cooking stoves, ovens and ranges using coal, gas, or other fuel; culinary implements and utensils of all descriptions; filters, refrigerators, safes for perishable articles, pyrogenes, grates for fire-places, and other appliances and apparatus for warming rooms or houses. Artificial fuels. Gas and other lamps, chandeliers, gas burners and lighting apparatus of all descriptions. Safety matches, &c.

Class 3. Sanitary apparatus, including baths, lavatories, water-closets, cisterns, sinks, pipes, taps, drainage and sewage arrangements; ventilating apparatus and appliances; disinfectants of all kinds.

Class 4. Mechanical and scientific toys, and apparatus for the instruction and employment of children.

Class 5. Miscellaneous appliances for reducing manual labour in copying writing, in carrying, in transmitting messages, &c.

The Exhibition will open in May, and remain open during the months of May, June, and July.

The ninth quarterly report of the Sub-Wealden Exploration has just been issued. It would appear that very little has been done for some time past, owing to the obstructions in the boring-hole not having been removed. The contractors, however, have promised that this shall be done as soon as possible.

At Paysandu, a little town on the Uruguay, during the last season, 1874, about 150,000 ox tongues were packed in hermetically-sealed tins, and shipped to this country. The saladeros in the neighbourhood carry on their slaughtering operations upon a large scale, and, in addition to providing the Paysandu tongues, are also large exporters of hides.

GENERAL NOTES.

Architectural Museum.—The Art-Workmen's Evening Drawing and Modelling Classes are now at work in this museum, at seven o'clock, every Monday, Wednesday, and Friday evening. These classes have been established to give art-workmen the opportunity for self-improvement in their several branches of manufacture. The museum is opened free of charge during the day to art-workmen attending these classes. The museum is also open specially on the above-named evenings from seven to nine. The drawings and models for the prizes offered by the Goldsmiths' Company for designs for plate, are now being exhibited in this museum.

Colouring Matter from the Cockchafer.—*The Bulletin des Sciences et Arts*, of Poligny (Jura) gives particulars of a curious discovery by Dr. Auguste Chevreuse. He has found that on decapitating living cockchafers an hour after they have been feeding they yield four or five drops of a colouring substance, which varies with the nature of the leaves on which they have been feeding, and he has already obtained fourteen different shades. M. Nichlés, professor of chemistry, M. Préclaire, professor of drawing, and M. Chatelain, architect, have found that this substance may be employed either in mono-tinted drawings, like Indian ink, sepia, &c., or mixed with water-colours, and that it does not change on exposure to the light. The colouring substance may be collected on glass or in shells, in which it may be left to dry, and when required for use it is sufficient to dissolve it in water. When applied in a thick coat it presents the effect of varnish. Two or three cockchafers suffice for a small water-colour drawing.

Oak Timber.—Oak timber is rapidly disappearing from Europe, although half of the area of Sweden, one-fourth that of Norway, one-sixth that of Switzerland, and 780,000 square miles in European Russia are said to be yet in forest. The consumption of oak in France has doubled during the last 50 years; she requires 15,000,000 cubic feet yearly for wine casks alone, 750,000 cubic feet for building purposes, 600,000 cubic feet for her fleet, and 150,000 cubic feet for railway cars. £800,000 worth of staves were imported in 1826; £5,000,000 worth are now needed. Since losing Alsace and Lorraine, France contains 150,000,000 acres; 20,000,000 of this surface is covered with forest. In Norway the Administration of Forests declares that it is necessary to stop the cutting of timber. Holland and Belgium are nearly denuded of timber, and are large importers. North Germany is rich in forest, but within half a century has begun to cut down young trees. Austria has sold her forests since railways have been introduced. In Italy no forests remain. Spain and Greece are almost absolutely woodless. The southern coasts of the Mediterranean are almost forestless. Wood, for all purposes of construction, is becoming scarcer and dearer in all parts of the United States, yearly. In the Dominion of Canada it is yet abundant, though rather farther to seek.

Dimensions of the Earth.—Two German scientific men, Messrs. Behum and Wagner, have recently published the results of some very accurate measurements that they have made respecting the dimensions of the earth. From these it appears that the length of the polar axis is 12,712,136 metres, that of the minimum equatorial diameter which is situated 103 deg. 14 min. east of the meridian of Paris, or 76 deg. 46 min. west, is 12,752,701 metres, whilst the maximum diameter at 13 deg. 14 min. east, and 166 deg. 46 min. west, is 12,756,588 metres. They estimate the total surface of the globe at 509,940,000 square kilometres, whilst its volume is equal to 1,082,860,000,000 cubic kilometres. The circumference of the globe on its shortest meridian is 40,000,098 metres, whilst that of the longest is 40,069,903 metres. The oceans and glaciers occupy 375,127,950 square kilometres. The total number of inhabitants of the earth is estimated at 1,391,000,000; viz., 300,530,000 in Europe, 798,000,000 in Asia, 203,300,000 in Africa, whilst the population of America is 84,542,000, and that of Oceana 4,438,000. The population of the towns and cities exceeding 50,000 inhabitants is 69,378,500, or about one-twentieth part of the total population of the globe, leaving nineteen-twentieths of the inhabitants for the villages and smaller towns.

Lighting Gas from Excrementitious Matter.—M. Albert Sindermann has lately made known to the municipal authorities of Breslau the fact that he manufactures lighting gas from excrementitious matter and mud on one of his estates situated outside the town. According to the *Gazette* of Silesia, the process is as follows:—The apparatus, placed in a vault, consists of a reservoir, which collects the matters and distributes them by a sluice into a retort situated at a lower level. From this retort the gases escape into a tar-well, and then into the condenser. The purifying is accomplished by means of lime-water, and lastly the gases are made to pass over pure water, when they are collected in the gasometer. The gas thus obtained burns with a purer and softer flame than coal gas; its odour is slightly acid, and is not disagreeable. The *residuum*, such as coke, tar, and grease, is inodorous, and readily turned to account. The necessary works are not more costly than ordinary gas works; and, on the other hand, the gas obtained is cheaper than coal gas, while no disagreeable smell is noticed in the neighbourhood of the works.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

Jan. 20.—"The Graphic Method of Teaching," by B. Waterhouse Hawkins, Esq., F.G.S.

Jan. 27.—"The Mercantile Marine of Great Britain," by Capt. Bedford Pim, R.N., M.P.

Feb. 3.—"The Sandblast and its Adaptation to Industrial Purposes," by Wm. Newton, Esq.

Feb. 10.—"Meat Preservation," by G. W. Phibbs, Esq.

Feb. 17.—"Description of M. Kastner's New Musical Instrument, the Pyrophone," by M. Dunant. The instrument will be exhibited.

Feb. 24.—"The Art of Illustration as applied to the Printing Press," by Henry Blackburne, Esq.

Chemical Section.

The date of the first meeting of this Section is unavoidably altered. Instead of being held on Friday, January 29th, as announced, it will now be held on Tuesday next, Jan. 19th, at 8 o'clock p.m.

January 19.—"Appliances for Enabling Persons to Breathe in Dense Smoke or Poisonous Vapours," by Capt. Shaw, Chief Officer of the Metropolitan Fire Brigade. Prof. Tyndall, D.C.L., F.R.S., will preside.

The other dates will remain as previously announced, and the list of papers to be read will be published shortly.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

January 26.—"The Niger Expedition," by Capt. Knowles, R.N.

Indian Section.

Friday Evenings, at 8 o'clock. The following arrangements have been made:—

January 22.—Opening Address, on "The Objects to which Effort might Properly be Directed," by Sir George Campbell, D.C.L., K.C.S.I.

February 12.—"The Possibility of Adapting the Roman Alphabet for the Languages of India," by Frederick Drew, Esq.

ISSUE OF MEMBERS' TICKETS.

Tickets for the Indian and Chemical S[...] during the Session 1874-5 are issued wi[...] *Journal*. Members have the privilege of ad[...] two friends to each Sectional Meeting, [...] tickets can be filled in for one or two pe[...] required. In no case can more than two [...] be invited to one lecture. The dates [...] meetings will be duly announced in the [...] and members are particularly requested [...] the dates when issuing the tickets. Corre[...] tickets for the African Section will be [...] next week.

SCIENTIFIC MEETINGS FOR THE ENSUI[...]

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, [...] (Cantor Lectures.) Dr. B. W. Richardso[...] its Action and its Use." (Lecture IV.)
Royal United Service Institution, Whitehall [...] 1. Mr. G. B. Rennie, "The comparat[...] Simple and Compound Engines." 2. M[...] man, "Apparatus for Protection against [...] the Ventilation of Ships."
Institute of Surveyors, 12, Great George-[...] p.m. Adjourned discussion on the Pape[...] Knollys, entitled "The Landlord and [...] tion," will be resumed.
British Architects, 9, Conduit-street, W., [...]
Medical, 11, Chandos-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 8, Adelphi-terrace, W.[...] G. Henslow, "Observations on some [...] Theology and Morality" by Professor T[...]
London Institution, Finsbury-circus, E.C.[...]

Tues. ...SOCIETY OF ARTS, John-street, Adelp[...] (Chemical Section.) Captain Shaw, "[...] enabling Persons to Breathe in Dense S[...] ous Vapours."
Royal Institution, Albemarle-street, W., [...] Ray Lankester, "The Pedigree of the A[...]
Civil Engineers, 25, Great George-stre[...] S.W., 8 p.m. Discussion "On the Co[...] Works."
Statistical, Somerset House-terrace, W.[...] Dawson Burns, "The Consumption [...] Liquors, as affected at various period[...] Duty imposed upon them."
Pathological, 53, Berners-street, Oxford [...]
Zoological, 11, Hanover-square, W., 8½ [...]
Royal Colonial (at the Rooms of the [...] Adelphi-terrace, W.C.), 8 p.m. 1. [...] liere, "The Permanent Unity of [...] Adjourned Discussion on the late M[...] the same subject.

Wed. ...SOCIETY OF ARTS, John-street, Ad[...] Mr. B. Waterhouse Hawkins, "Th[...] of Teaching."
Meteorological, 52, Great George-st[...] Annual Meeting.
Royal Horticultural, South Kensingto[...]

Thurs....Royal, Burlington House, W., 8½ p.m[...]
Antiquaries, Burlington House, W. 8½[...]
Linnean, Burlington House, W., 8 p[...] "The Pathology of Oak-galls, [...] Powell, "The Nature of several A[...] Pacific." 3. "Papers on the Botany [...] the Challenger."
London Institution, Finsbury-circus, [...]
Society for the Encouragement of th[...] duit-street, W., 8 p.m. Mr. Wyl[...] of the Supernatural in Art, or Seei[...]
Royal Institution, Albemarle-street [...] P. M. Duncan, on "The Grander Ph[...] Geography."
Zoological, 11, Hanover-square, W., [...]
Numismatic, 13, Gate-street, W.C., [...]
Royal Society Club, Willis's Room[...] 6. p.m.

Fri. ... SOCIETY OF ARTS, John-street, [...] (Indian Section), Opening Add[...] Campbell, K.C.S.I.
Royal Institution, Albemarle-street. [...] Meeting, 9 p.m. Sir John Lu[...] "Wild Flowers and Insects."
Quekett Club, University College, [...]
Clinical, 53, Berners-street, W., 8½ p[...]

Sat......Royal Institution, Albemarle-stre[...] Edward Dannreuther, on "Beeth[...] Illustrations.
Royal Botanic, Inner Circle, Regent[...]

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FRIDAY, JANUARY 22, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FIRES AT SEA.

The Council have decided to offer the Society's Fothergill Gold Medal for an effective means of extinguishing fire on board ship, and they have directed the Secretary to enter into communication with leading ship-owners, with the view of enlisting their aid in this important matter.

DRILL IN SCHOOLS.

The following correspondence has taken place between Captain O'Hea and Mr. E. Carleton Tufnell, on the subject of Drill in District Industrial Schools;—

Whitehall-yard, London, S.W., 4th November, 1872.

SIR,—In the report on the drill of the Industrial District Schools, which I had the honour to lay before the Council of the Society of Arts last July, I avoided, for obvious reasons, offering suggestions or remarks not bearing directly on the subject of that report.

However, as army re-organisation and drill appear just now to occupy the particular attention of the authorities and the public, I trust the following ideas on the means of utilising the drill and general training of the establishments above referred to, for the benefit of her Majesty's service, may not be deemed out of place or unworthy of consideration.

It is my conviction that if the military training of the Industrial Schools were placed on a proper footing, and carried out according to regulation under careful supervision, such a system would produce a class of young soldiers and non-commissioned officers at present unrivalled in the British army.

It is well known to those who have served in the regiments of the line that the education of the junior non-commissioned ranks, and indeed up to the grade of colour-sergeant, is very defective. This may readily be proved by an inspection of the spelling, the diction, and the writing (notwithstanding the fact that candidates for promotion to the non-commissioned rank have to send in specimens of writing, &c., for approval) in the company order books in line regiments, even of the best class.

This state of things arises, in the first place, from deficiency of education in the class from which the army is usually recruited. A recruiting sergeant is not supposed to judge of the education of his recruit; he has to see only to his physical qualifications, age, appearance, &c.

Secondly. From the fact that when a young soldier joins his regiment or depôt, his duties, even after he has been dismissed drill, render it most improbable that, in the limited time afforded him for attendance at school, he can profit much by his interrupted teaching.

Lastly. From the fact that when made lance-corporal, or corporal, his increasing duties still further interfere with his education. Moreover the age at which the soldier of the present day must have arrived when selected for promotion, makes it very unlikely that he will profit much by the fragmentary instruction afforded him in the regimental school.

I would respectfully suggest that if in the several district schools lads selected for good conduct, proficiency in drill, and physique, were permitted to volunteer for the army, and these were subsequently drafted for a certain period into one central establishment where the military training and education, such as the keeping of military books, &c., could be perfected, they could be enlisted into the service, drilled, disciplined, and well qualified to fill the important position of non-commissioned officer with credit to themselves and benefit to the service.

Another opening would thus be afforded to the deserving children of the poor to advance their condition in life, and at the same time to repay the country that gave them an education, by rendering valuable service in a sphere where such must be of importance.

Further, I feel convinced that the sound moral training inculcated in these schools, (which would, before the young soldier joined the service, have time to become fixed in his character), must not only command the respect of all with whom he may be brought in daily contact, but would tend by example to materially lessen crime in the service, and consequently expense to the country.

I remain, Sir,
Your obedient servant,
JOHN B. O'HEA,
Late Captain 25th Foot.

E. C. Tufnell, Esq.

26, Lowndes-square, London, S.W.,
20th November, 1872.

DEAR SIR,—I have perused and considered your proposal to found a military school with drafts from the district schools with great attention, and am fully convinced of the great importance such an institution would be in improving the composition of the army. I have accordingly sent it, with an approving comment, to the President of the Local Government Board, and pressed it on his favourable consideration. I have reason to believe that he laid it before Mr. Cardwell. I, however, think that such an establishment could never be arranged by the managers of these schools. The military authorities alone could undertake to manage it, and it appears to me that such an institution would have precisely the same affect in improving the standard of the army that the institution of training ships has had on the navy.

Believe me,
Yours sincerely,
E. CARLETON TUFNELL.

CANTOR LECTURES.

The fourth lecture of the course of Cantor Lectures on "Alcohol, its Action and its Uses," by BENJAMIN W. RICHARDSON, M.D., F.R.S., F.R.C.P., was delivered on Monday, January 18th, 1875, as follows:—

LECTURE IV.

The position of Alcohol as a food. Its effects on the animal temperature. Hygienic considerations.

The question that lies before us for discussion to-night is short and definite. It is included in the three words: Is alcohol food?

We have studied in the previous lecture the purely

physical action of alcohol on the animal body, that which stands apart from the action of food, and we have learned from the study that over the nervous system and over the vascular supply this spirit exerts a specific influence. We now inquire whether the influence ends there, or whether there may be, in addition, either a sustaining, and constructing, or a heat-giving power—that is to say, a force-giving quality in it. If there be, then the simple physical effects are perchance tolerable, or at all events are not sufficient to militate against the advantages which lie on the food side of the question.

It may be well to rest for a moment to consider the position of men and animals upon the earth in relation to the means given to them for their support as living, moving, and, in the higher animals, thinking structures. This position is well defined. The theory that man was made originally out of the dust of the earth is, after all, the most scientific theory that has ever been advanced as to his primeval origin, if the word *dust* be only extended so as to include the actual compound substance of the earth. For in the earth are to be found not only all the elements out of which he is constructed, but even certain of the elements in the same kind of combination as we find them in him. In the earth, water, salts, and organic matter are found; in man the same are found. The man is in many respects of motion a reflex of the motion of the earth, presenting periodicities of movements, and of movements in a circle in like mode. As if to complete the analogy, this remains true, that the earth yields spontaneously to man, either from herself directly or from the vegetable kingdom which lies between her and man, all the requirements for his existence. Whatever, therefore, man invents, though it may seem to be a great necessity, is not a necessity except to those who, being trained to its use, have been led artificially to believe it essential. Thus nature has produced water and milk for man to drink, and they are, in truth, all the fluids that are essential. This lesson, which nature teaches by her rule of provision for the necessities of animal life, is supplemented by many other facts, each equally authoritative. There is ever before us the great experiment that all classes of living beings beneath man require as drink none other fluids except those I have named. We see the most useful of these animals performing laborious tasks, undergoing extremes of fatigue, bearing vicissitudes of heat and of cold, and enduring work, fatigue, and vicissitude for long series of years, sustained by their solid food, with no other fluid than simple water. We see again whole nations and races of men who labour hard, endure fatigue and exposure, and who live to the end of a long and healthy life, taking with their solid sustenance water only as a beverage.

When we turn to the physiological construction either of man or of a lower animal, we discover nothing that can lead us to conceive the necessity for any other fluid than that which nature has supplied. The mass of the blood is composed of water, the mass of the nervous system is composed of water, the mass of all the active vital organs is made up of the same fluid; the secretions are watery fluids, and if in any of these parts any other agent than water should replace it, the result is instant disturbance of function that is injurious in proportion to the displacement.

When we turn therefore to the use of such a fluid as alcohol under any of its disguises,—as spirit, as wine, as beer, as cider, as perry, as liqueur,—we are driven *à priori* to look upon it as something superadded to the necessities of life; to look upon it, in a word, as a luxury. In such sense it has always been received amongst those nations which have most indulged in it. It is something added to the ordinary life; something unnecessary, but agreeable. Wine, added to the meal, transforms the meal into a feast; it is supposed to make glad the heart, but it is never supposed that if the wine were not possessed the life would be shortened. When now we offer wine, it is, by the effect of habit and education, an offering of a thing that is super-necessitous, and in such wise a co[m]pliment, an indication of desire or of willingness t[o be] exceedingly hospitable.

All the evidence of a general kind which can [be] gathered from these observations points to the useless[ness], for man, of so artificial an agent as alcohol. But, a[fter] all, an assumption so derived may be false. We [have] already seen that when alcoholic spirit is taken [into] the animal body it produces in it exceedingly ma[rked] effects; it may therefore, by accident, I might almost [say], play in some manner the part of a food and supple[ment] water. Indeed, it is a form of water in which a c[om]pound of carbon and hydrogen has replaced hydro[gen]. Let us, then, ask the question: Can alcohol be in [any] sense accepted as performing any other part in the [body] save that physical part which we have considered? [Can] it have happened that man, by his invention, has ad[ded] to nature, a food? And let us answer the questio[n as] candidly as the facts of experiment and experience permit.

Constructive Materials of the Body.

The living animal body is constructed out of [a few] simple forms of matter which possess, during lif[e, the] power of motion. It is, in its living state, a noun [and a] verb. Whatever helps to maintain it in perfect [state] of construction, whatever enables it to move of it[s] mere will and motion, may be considered as a [food]. The one help gives matter, and mass, the other [gives] force or spirit to the mass. With the progre[ss of] organic chemistry, after the discovery of the [methods of] organic analysis, it soon became evident that wh[at are] called foods are divisible into two great classes; [those] which supply material or tissue, and those [which] supply heat or other variety of force. Gradua[lly it] was detected that the building foods all contai[n the] element nitrogen as an essential part, and tha[t the] force-supplying foods are free of nitrogen, are h[ydro]carbons, substances that will undergo combusti[on or] oxydation, and thus liberate force for the motive [power] of the economy. So, foods have for a long time [been] sharply classified as nitrogenous or tissue-feeding [and] as respiratory or heat-producing. At the pr[esent] moment this long accepted view is undergoing [some] modification. It is being elicited that the nitrog[enous] foods are to a certain degree heat-producing. [I] need not at this stage enter on the nice questio[n in]volved. I may safely, for the practical purpos[es I] have in view, let the division of the classes of [food] remain as described above.

The nitrogenous foods exist in the animal body [in the] form of what is called colloidal matter, the word co[lloid] being a term signifying a jelly-like substance. [The] purest form of this matter is found in the blood [as a] white, elastic, plastic matter, called fibrine. By re[peated] washings of a portion of this substance I have [pre]pared here, from the blood of the ox, a beautiful [speci]men of this colloid of the blood. Of a similar co[lloidal] substance the moving muscles are formed. In a [fluid] state, and permanently fluid at the temperature [of the] living body, the colloid called albumen forms p[art of] organic structure. Under the names of gelatin[e and] chondrine, a nitrogenous colloidal substance for[ms the] organic matter of the skeleton, of the cartilages, [of the] sheaths of muscles, of the tendons. The eye-b[all is] constructed out of a series of colloidal tissues. A[ll the] membranes which envelope the visceral organs, and [which] possess elasticity, are colloidal. The outer cover[ing or] skin is colloidal, the nails are the same. Ev[en in] the brain and nervous matter there is distribu[ted] colloid. Thus, if we sum up the various parts [of the] body we may say that all the active masses of [its struc]ture are nitrogenous and colloidal.

In combination with this active matter there are, [how]ever, two other material ingredients, viz., wat[er and] saline substance. Upon its combination with wat[er the] activity of the colloid depends. Upon the saline

the various kinds of combination of the colloid with the water. In bone the gelatine is combined with a salt, called phosphate of lime, with carbonate of lime, and other salts, in much larger proportion than itself. In fibrine the colloidal substance is nearly divested of saline; but in all parts these three material compounds make up the animal structures.

Lying outside these structures in the natural state, but really as an adventitious formation, is one other animal product, viz., fat; a substance detrimental to the function of the active parts when present in excess, but at the same time capable of combustion, and of yielding heat by the process.

We have now before us the constructive or building parts of the animal body. Excepting the water, the salts and the fat, they all contain nitrogen, and they take their specific quality from that specific fact. We know that the source of them is the vegetable kingdom, that they are formed by nature in that kingdom, are transferred from the vegetable to the animal, are not made by any natural process within the animal, have not yet been made by any artificial process known to the chemist, and can therefore only be supplied from the one natural supply.

Alcohol contains no nitrogen, it has none of the qualities of these structure-building foods; it is incapable of being transformed into any of them; it is therefore not a food in the sense of its being a constructive agent in the building up of the body.

In respect to this view there is, I believe, now no difference of opinion amongst those who have most carefully observed the action of alcohol. There is, however, a difference in relation to its action as a fat-forming food. It appears to be on evidence that men and animals beginning, while in a perfect state of health, to take in excess certain fluids containing alcohol become fattened. Notoriously, ale and beer fatten; and in some parts of the country certain animals—calves for instance—are rapidly fattened by the process of feeding them with a mixture of barley flour and gin. But through all these apparent evidences there may run an error. The fattening may not be due to the alcohol itself, but to the sugar or the starchy material that is taken with it. As a matter of general experience on which I have tried to arrive at the truth with as much accuracy as can be obtained, I am led to the conclusion that pure spirit drinkers among men, I mean those who do not take sugar with the spirit, and who dislike spirit which is artificially sweetened, are not fattened by the spirit they take. This tallies also with the observations on the action of absolute alcohol on inferior animals, for they certainly, under that influence, if they are allowed liberty to move freely, do not fatten.

The question of the effect of alcohol in fattening presents still another difficulty. Alcohol, when it is largely taken, unless the will of the imbiber be very powerful, is wont to induce desire for undue sleep, or at least desire for physical repose. Under such conditions there is an interference with the ordinary nutritive processes. The wasted products of oxidation are imperfectly eliminated, the respiration becomes slower and less effective, and there is set up a series of changes leading, independently of the alcohol as a direct producer of fat, to development and to deposit of fatty tissue in the body. All these circumstances militate against the hypothesis of the origin of fatty material direct from alcohol, nor is there any obvious chemical fact that supports the hypothesis. We understand chemically the transformation of starchy matter into one form of sugar, and we infer that in the animal body sugar is transmutable into fat. We know also that we can transmute sugar into alcohol, but as yet we see no way back from alcohol into sugar; if we did, the difficulty of tracing alcohol into fat would probably be over.

Physiological argument nevertheless lends some countenance to the view that alcohol may, by an unknown process, be transferable into fat. It is true that some confirmed alcoholics who do not wax fat in the ordinary sense of the term, that is to say, who do not fill out with fat, from the separation of fatty matter in their cellular tissue outside the vital organs, do, in certain instances, undergo a process of fatty change within their organic structures. Their muscles, including the heart, become the centres of the degeneration called "fatty," and by the interposition of cells of fat in the minute muscular elements, the activity of the fabric is destroyed, sometimes to a fatal destruction. The same degenerative change may extend also to other organs, to the brain and to such active glands as the liver and the kidney.

At first view it occurs to the mind that here is evidence of effect upon cause. At the same time it is not so clear that the effect is direct from the cause; for when we proceed to examine into all the data that lie before us, we discover such an absence of uniformity in differing examples of the fatty change that we lose alcohol as the clue to discovery. Some alcoholics truly present the fatty modification of tissue, other alcoholics do not present it, so that alcohol may be in active operation and may neither be promoting the production of fat from other material nor yielding it. Lastly, the fatty change of tissue may progress, in the absence of alcohol, in the tissues of those who altogether abstain.

In conclusion, therefore, on this one point of alcohol, its use as a builder of the substantial parts of the animal organism, I fear I must give up all hope of affirmative proof. It does not certainly help to build up the active nitrogenous structures. It probably does not produce fatty matter except by an indirect and injurious interference with the natural processes.

If alcohol be not a substance out of which the animal tissues are formed, may it not be a source of energy of actual motion; may it not supply the power of doing work? Alcohol, we see, contains two elements that will burn in the presence of oxygen, viz., carbon and hydrogen, and although by their combination already with oxygen in the alcohol a certain measure of their potential energy is lost, they are still capable of combining with more oxygen. This is proved by various experiments. When alcohol is burned, that is to say, when, with its combustible elements, free oxygen combines, there results from the chemical combination a certain degree of heat. The heat produced does not approach that obtained by an equal weight of hydrogen, it is not so great as that produced by an equal weight of carbon, but it is greater than that caused by the combustion of phosphorus, and very much greater than that caused by the combustion of sulphur.

The combustion of alcohol thus spoken of is that active combustion which is excited when a light is brought into contact with it so that its vapour may burn. But it is not actually necessary that such instant active combustion should be set up. If we distribute alcohol over a wide surface in the presence of some chemical substances it will then by its combination with oxygen liberate a greater or lesser degree of heat. If I saturate a portion of paper with alcohol and on that paper pour a little of this finely-divided powder, called platinum black, I at once get evidence of heat which may be so active that perfect combustion may ensue. In this instance the alcohol is transformed, as in burning, in great part, nay it may be altogether, into carbonic acid and water, which means the completed combustion. If in place of absolute alcohol, in this experiment, I use alcohol diluted with water, then instead of obtaining the active combination and combustion I get a slower oxidation with the production of substances to which attention has already been directed, viz., aldehyde, acetic acid, and volatile acetic ether. In this jar I have in progress these various changes in alcohol, produced by the mere exposure of the vapour of alcohol to platinum black damped with water, in the presence of the air.

Disposal of Alcohol in the Organism.

We are brought now to one of the most important parts of our study. We see that, under favouring conditions, alcohol will oxidise in the presence of the air. We see that it will oxidise in two ways—actively, with the production of much heat and with the formation of carbonic acid and water; passively with the production of aldehyde and acetic acid.

In the human body do any similar changes take place? Throughout the whole of this vast sheet of the minute circulation there is ever in progress, during life, a process of slow oxidation of carbon and hydrogen, by which heat is produced, and carbonic acid and water are produced. The heat is proved by the animal warmth which is ever present in our bodies while we live; the carbonic acid and water, as products, are proved by their continued presence in the secretions from the lungs, skin, and other organs.

Alcohol we have seen is carried by the blood into this minute circulation. Is it possible it can pass through that ordeal and undergo no chemical change? If it does undergo any changes what is their nature? These questions have occupied the attention of many gifted minds; but they are not yet solved. Let me endeavour to put the position in which they stand plainly before you.

The earlier physiologists of this century came naturally enough to the conclusion that the alcohol taken into the body is consumed there with the evolution of heat. A certain development of heat in the superficies of the body, and a certain sensation of glow which follows upon the imbibition of spirit lent countenance to this suspicion. But in course of time, independently of any knowledge of the effect produced by alcohol in the minute circulation of the blood, it began to be doubted whether alcohol was disposed of in the organism by its combustion. Some observers had noticed, in conducting the examination of the body after death from excess of alcohol, that the odour of the substance was present in the tissues, especially in the nervous tissue, and it was doubted whether the alcohol might not under some circumstances remain in the organism without undergoing any change at all. In 1860 three eminent Frenchmen—Lallemand and Perrin, assisted by Duroy, published a prize essay on alcohol, in which this view was maintained, or, as the authors would probably say, was originated; for in truth they were the first to state the view on direct scientific evidence. From the result of many experiments, they came to the conclusion that alcohol taken into the living body accumulates in the tissues, especially in the liver and in the brain, and that it is eliminated by the fluid secretions, notably by the renal secretion, as alcohol. They sought in the different tissues for evidence of the secondary products of the oxidation of alcohol, for aldehyde acetal, acetic acid, and they found none of those products, except some acetic acid in the stomach, which acid they concluded was formed from the alcohol received directly into the stomach, and from the action exerted upon it there by the gastric juice. The experiments carried on by these inquirers were so numerous and careful, and the results they arrived at were so definitely stated, their labours were for a season accepted as conclusive by many men of science, and by the majority of the public. It was ascertained by other experimentalists that alcohol is eliminated by the system in the direct way, as alcohol, and the question of elimination rested as if it had been solved.

The interval of credence in these assertions was not very prolonged. An English physician soon commenced to cross a lance with his learned French peers, and to point out certain distinct errors in their results. I have no doubt many of you know, before I mention his name, that he to whom I refer was the physician who last year lost his life from the performance of his professional duties—the late Dr. Anstie. Respecting this observer, whose friendship I owned for many years, it is meet for me to pay this public tribute of respect; that no man I ever knew combined with vigour of mind, such in[...] parable industry and courage, or a more honou[...] regard for scientific truth and honesty. The subject [...] now considering has lost no investigator more [...] learned for the work that still remains to be done.

From Dr. Anstie came the earliest expressio[...] doubt relative to this hypothesis of what is calle[...] direct elimination of alcohol by the secretions, and [...] him have come the latest objections. His argu[...] have been sustained abroad by Schulinus, and i[...] country by Drs. Thudichum and Dupré, whose wo[...] wine will, even in another century, be more h[...] prized, if that be possible, than it is now. The [...] and substance of the labours of these observers is [...] in a few words. They prove that while it is true [...] under certain circumstances, alcohol taken int[...] body will pass off in the secretions unchanged[...] quantity so eliminated is the merest fraction of [...] has been injected, and that there must be some [...] means by which the spirit is disposed of in the org[...] In a lecture I delivered on this subject in the year [...] I ventured to suggest, in commenting upon a se[...] Dr. Thudichum's remarkable researches, that p[...] one element of research was wanting to prove [...] clusively the fallacy of the direct elimination hypo[...] I thought that sufficient time had not been allow[...] tween the administration of the spirit and the final [...] mination made for it in the excreted fluids. It wa[...] I argued, shown how much spirit the tissues would [...] unchanged. The objection was sound, and it has [...] renewed by more recent experiment.

In the last research conducted by Anstie, in whi[...] was assisted by Dupré, the results of the experi[...] were unmistakable in their bearing on the point [...] under our consideration. The history of these lab[...] recorded in full in the last paper written by Dr A[...] and published in the journal called the *Practition[...]* July, 1874.

The test that had been commonly employed for [...] mining the presence of alcohol in the fluid suspec[...] containing it, was the colour test. A solution is [...] of this salt, the bichromate of potassa, with sul[...] acid. When to this solution alcohol is added, the[...] change of colour from the brownish red to g[...] owing to the reduction of the chromic ac[...] the green oxide of the base chromium. By m[...] the difference of colour produced a scale c[...] adopted, which will show the extent of the redu[...] and thereby the amount of the spirit that has [...] the change. This process was improved by Dr. D[...] He distilled the fluid in which alcohol was belie[...] be present, and then after treating the distillate wi[...] bichromate and sulphuric acid solution, he tested [...] standard solution of soda for the amount of aceti[...] which would be produced by the oxidation of al[...] were that fluid present.

This modification of test was and is a very consid[...] advance, since it enabled the observers to conduct [...] determinations with greater accuracy of detail. I[...] research they conducted with it two facts of sin[...] interest were elicited. The first fact was discover[...] Dr. Dupré. It was, that from the secretions of pe[...] who do not drink alcohol at all a fluid can be di[...] which affects the chromic test as if alcohol were ac[...] present in the secreted fluids, and that this hithert[...] suspected product is oxidised into an acid so like [...] acid it cannot be distinguished from it, and is appar[...] identical with it. To be plain, Dr. Dupré's disc[...] suggests that no man can be, in strict scientific [...] a non-alcoholic, inasmuch as "will he nill he" [...] brews in his own economy a "wee drap." It [...] innocent brew certainly, but it is brewed, and the [...] ardent abstainer must excuse it. "Argal, he that i[...] guilty of his own death shorteneth not his own [...] The fault, if it be one, rests with nature, who, acco[...] to our poor estimates, is no more faultless than the [...] of her sex.

The second fact, which came chiefly from the labours of Dr. Anstie, was that from animals under alcohol, not one of the secretions, not all the secretions combined, yielded any more than a fractional amount of the alcohol that had been administered. The experiments were by necessity made on the inferior animals, but they supplied none the less conclusively the fact stated. It was proved that an animal, a terrier dog, weighing 10 lbs. could take with comparative impunity nearly 2,000 grains of absolute alcohol in ten days, and that on the last day of this regimen he only eliminated by all the channels of elimination 1·13 grains of alcohol. This fact was of itself sufficiently remarkable, but another still more important remains to be told. In completion of his research after an animal had been treated with alcohol, as above described, Anstie killed it, instantly and painlessly, two hours after it had received the last quantity—95 grains—of spirit. Then the whole body, including every fragment of tissue with all the fluid and solid contents, was subjected to analysis, with the result of discovering only 23·66 grains of spirit.

We are driven by the evidence now before us to the certain conclusion that in the animal body alcohol is decomposed; that is to say, a certain portion of it (and if a certain portion why not the whole?) is transmutable into new compounds? The inference that might be drawn is fair enough that the alcohol is lost by being burned in the body. It is lost in the body, and out of the body it will burn. If it will burn in the organism it will supply force, for it enters as the bearer of so much potential energy. In combining with oxygen is there then a development of force or heat to the extent that would be developed in the combustion of the same quantity in the lamp, or from the distribution of it over the platinum black? At the same time, and in corroboration, is that product of its combustion, carbonic acid, to be discovered in the excretions? If there be heat, and if there be product of carbon consumed in oxygen, then alcohol must rank as a heat-forming food.

Does Alcohol Increase the Animal Heat?

In putting before you this inquiry, I am prepared to answer it by direct knowledge gained from individual experiment. In the course of some researches I had to make for reports rendered to the British Association for the Advancement of Science, it became part of my duty to ascertain what effect certain chemical agents exert over the animal temperature. Amongst these agents was alcohol.

At the time when my researches commenced, viz., in the year 1864, there was nothing definitely known on the subject. The thermometer was not then in such general use as it is now, and it had not been applied, as far as I know, to this particular determination. Generally, however, it had been assumed by the majority of persons that alcohol warms the body, and to "take just a drop to keep out the cold" had been the practice which the experience of ages seemed to justify. It is fair, at the same time, to say that Dr. Lees, and some other far-seeing observers, had for many years held and asserted a different view. They had not entered into minuteness of experimental detail, but they had observed from the effects of alcohol on those who had been exposed to cold in the extreme North and in other regions of ice and snow, that the drinkers did not live on like other men. Thus, in so far as I had what is called experience to guide me, I found conflict of opinion. It was not my business, however, to accept guidance of this kind, but to appeal to the only safe guide, the direct interrogation of nature by experiment.

It were impossible for me to recount the details of the long research—extending, with intervals of rest, for three years—which was conducted in my laboratory, to determine the influence of alcohol on the animal temperature. The effects were observed on warm-blooded animals of different kinds, including birds; on the human subject in health, and on the same subject under alcoholic disease. Similar experiments were made in different external temperatures of the air, ranging from summer heat to ten degrees below freezing point. The whole were carried on from experiment to experiment, without regard either to comparison or result until the general character of result began to proclaim that a rule existed which could hardly be considered exceptional. The facts obtained I may epitomise as follows:—

The progressive stages of change of animal function from alcohol are four in number. The first is a stage of excitement when there exists that relaxation and injection of the blood vessels of the minute circulation with which we have become conversant. The second is the stage of excitement with some muscular inability and deficient automatic control. The third is a stage of rambling, incoherent, emotional excitement, with loss of voluntary muscular power, and ending in helpless unconsciousness. The fourth and final stage is that in which the heart itself begins to fail, and in which death in extreme instances of intoxication closes the scene. These stages are developed in all the warm-blooded animals, and the changes of temperature throughout the whole are relatively the same.

In the first stage the external temperature of the body is raised. In birds—pigeons—the rise may amount to a full degree, on Fahrenheit's scale; in mammals it rarely exceeds half a degree. In man it may rise to half a degree, and in the confirmed inebriate, in whom the cutaneous vessels are readily engorged, I have seen it run up to a degree and a half. In this stage the effect on the extremities of the nerves is that of a warm glow, like what is experienced during the reaction from cold.

The heat felt in this stage might be considered as due to the combustion of the alcohol, it is not so; it is in truth a process of cooling. It is from the unfolding of the larger sheet of the warm blood and from the quicker radiation of heat from that larger surface. During this stage, which is comparatively brief, the internal temperature is declining; the expired air from the lungs is indicating, not an increase, but the first period of reduction in the amount of carbonic acid, and the reddened surface of the body is so reduced in tonicity that cold applied to it increases the suffusion. It is this most deceptive stage that led the older observers into the error that alcohol warms the body.

In the second stage, the temperature first comes down to its natural standard, and then declines below what is natural. The fall is not considerable. In birds it reaches from one and a half to two degrees. In other animals, dogs and guinea pigs, it rarely exceeds one degree; in man it is confined to three-fourths of a degree. In a room at the temperature of 65° or 70° the decrease of temperature may not actually be detected, but it is quickly detected if the person in whom it is present pass into a colder atmosphere, and it lasts, even when the further supply of alcohol is cut off, for a long period, viz., from two and a half to three hours. It is much prolonged by absence of food.

During the third degree the fall of temperature rapidly increases, and as the fourth stage is approached it reaches a decline that becomes actually dangerous. In birds the reduction may be five degrees and a half, and in the other animals three. In man it is often from two and a half to three degrees. There is always during this stage a profound sleep or coma, and while this lasts the temperature continues reduced.

It is here worthy of incidental notice that, as a rule, the sleep of apoplexy and the sleep of drunkenness may be distinguished by a marked difference in respect to temperature. In apoplexy the temperature of the body is above, in drunkenness below, the natural standard of 98° of Fahrenheit's scale.

Under favourable circumstances a long period is required before the body recovers its natural warmth after such reduction of heat as follows the extreme stage of alcoholic intoxication. With the first conscious movements of recovery there is a faint rise, but such is the

depression that these very movements exhaust and lead to a further reduction. I have known as long a period as three days required, in man, to bring back a steady natural return of the full animal warmth.

Through every stage, then, of the action of alcohol—barring that first stage of excitement—I found a reduction of animal heat to be the special action of the poison. To make the research more perfectly reliable, I combined the action of alcohol with that of cold. A warm-blooded animal, insensibly asleep in the third stage of alcoholic narcotism, was placed in a chamber—the air of which was reduced in temperature to ten degrees below freezing point—together with another similar animal which had received no alcohol. They both sleep under these circumstances, but the alcoholic sleeps to die; the other simply sleeps more deeply than is natural, sleeps and lives so long as the store of food it is charged with continues to support life. Within this bound it awakes, in a warmer air, uninjured, though the degree of cold be carried even to the act of freezing of the extreme parts.

One more portion of evidence completes the research on the influence of alcohol on the animal temperature. As there is a decrease of temperature from alcohol, so there is proportionately a decrease in the amount of the natural product of the combustion of the body. The quantity of carbonic acid exhaled by the breath is proportionately diminished with the decline of the animal heat. In the extreme stage of alcoholic insensibility—short of the actually dangerous—the amount of carbonic acid exhaled by the animal and given off into the chamber I constructed for the purposes of observations was reduced to one-third below the natural standard. On the human subject in this stage of insensibility the quantity of carbonic acid exhaled has not been measured. But in the earlier stage of alcoholic derangement of function the exhaled gas was measured with much care by another earnest worker, whose recent death we have also to deplore—Dr. Edward Smith. In these early stages Dr. Smith found that the amount of carbonic acid was reduced in man, as I have found it in the lower animals, so that the fact of the general reduction may be considered as established beyond disputation.

We are landed then at last on this basis of knowledge. An agent that will burn and give forth heat and product of combustion outside the body, and which is obviously decomposed within the body, reduces the animal temperature, and prevents the yield of so much product of combustion as is actually natural to the organic life.

What is the inference? The inference is that the alcohol is not burned after the manner of a food which supports animal combustion; but that it is decomposed into secondary products, by oxidation, at the expense of the oxygen which ought to be applied for the natural heating of the body.

For some time to come the physiological world will be studiously intent on the discovery of the mode by which alcohol is removed from the organism. It is a subject on which I shall one day be able to speak, I hope, with some degree of experimental certainty, but on which at this moment I am not prepared to offer more than an indication of the probable course of research. I may venture to add, in advance, two or three suggestions to which my researches, as far as they go, point.

Firstly, I believe there is a certain determinable degree of saturation of the blood with alcohol, within which degree all the alcohol is disposed of by its decomposition. Beyond that degree the oxidation is arrested, and then there is an accumulation of alcohol, with voidance of it, in the unchanged state, in the secretions.

Secondly, the change or decomposition of the alcohol in its course through the minute circulation, in which it is transformed, is not into carbonic acid and water, as though it were burned, but into a new soluble, chemical substance, probably aldehyde, which returns by the veins into the great channels of the circulation.

Thirdly, I think I have made out that there is an outlet for the alcohol, or for the fluid product of its composition into the alimentary canal, through secretion of the liver. Thrown into the canal it i believe, subjected there to further oxidation, is in oxidised by a process of fermentation attended with active development of gaseous substances. From surface the acid product is in turn re-absorbed in g part and carried into the circulation, and is dispose by combination with bases or by further oxidation.

Here, however, I leave the theoretical point to re to the practical; and the practical is this, that alc cannot by any ingenuity of excuse for it, be classi amongst the foods of man. It neither supplies ma for construction nor heat. On the contrary, it inj construction and it reduces temperature.

EFFECT ON MUSCULAR POWER.

Behind the question of the effect of alcohol upon animal temperature was another subject for inquiry. was fair to ask whether, if heat were not produced b some additional stimulus might be communicated the spirit to the muscular fibre. There is not in what we see relating to the action of alcohol in that would lead us to suppose it capable of giving a creased muscular power, and it is certain that ani subjected even for short periods of time to its influe lose their power for work in a marked degree. In if we were to treat our domestic animals with this a in the same manner that we treat ourselves, we sh soon have none that were tameable, none that workable, and none that were edible. I though nevertheless, worth the inquiry whether at any of the alcoholic excitement living muscle could b duced to show an extra amount of power; I then submitted muscle to this test. I gently weighted hinder limb of a frog until the power of contraction just overcome; then by a measured electrical cu I stimulated the muscle to extra contraction, and d mined the increase of weight that could thus be li This decided upon in the healthy animal, the trial repeated some days later on the same animal after i received alcohol in sufficient quantity to induce various stages of alcoholic modification of function. result was that through every stage the response to electrical current was enfeebled, and so soon as cotism was developed by the spirit, it was so enfee that less than half the weight that could be lifte the previous trial by the natural effort of the an could not now even be raised under the electrica citation.

In man and in animals, during the period betw the first and third stages of alcoholic disturba there is often muscular excitement, which passe increased muscular power. The muscles are then more rapidly stimulated into motion by the ner tumult, but the muscular power is actually enfeeble

HYGIENIC CONSIDERATIONS.

The facts I have endeavoured to lay before you in as well as in the last lecture will suggest to your m many thoughts bearing upon the health of indivi and communities, in so far as health is affected by potent agent, alcohol. I need hardly, indeed, pre to offer any suggestions, but one or two of a spec practical and everyday character may be ventured.

I am bound to intimate that the popular idea of ministering alcohol for the purpose of sustaining animal warmth is an entire and dangerous error, that when it is brought into practice during extre cold weather it is calculated to lead even to fatal co quences, from the readiness with which it permits blood to become congested in the vital organs. I ca too forcibly impress the fact that cold and alcohol physiologically, in the same manner, and that, comb in action, every danger resulting from either agen doubled.

Whenever we see a person disposed to meet the e

of cold by strong drink it is our duty to endeavour to check that effort, and whenever we see an unfortunate person under the influence of alcohol it is our duty to suggest warmth as the best means for his recovery. These facts prompt many other useful ideas of detail, in our common life. If, for instance, our police were taught the simple art of taking the animal temperature of those persons whom they find in the streets in a state of insensibility, the results would be most beneficial. The operation is one that hundreds of nurses now carry out daily, and applied by our police-officers it would enable them not only to detect the difference between a man in an apoplectic fit and a man intoxicated, but would suggest naturally the instant abolition of the barbarous practice of thrusting the really intoxicated into a cold and damp cell, which to such a one is actually an ante-room to the grave.

Once more: I would earnestly impress that the systematic administration of alcohol for the purpose of giving and sustaining strength is an entire delusion. I am not going to say that occasions do not arise when an enfeebled or fainting heart is temporarily relieved by the dilatation of the vessels which alcohol, on its diffusion through the blood, induces; but that this spirit gives any persistent increase of power by which men are enabled to perform more persistent work is a mistake as serious as it is universal.

Again, the belief that alcohol may be used with advantage to fatten the body is, when it is acted upon, fraught with danger. For if we could successfully fatten the body we should but destroy it the more swiftly and surely; and as the fattening which follows the use of alcohol is not confined to the external development of fat but extends to a degeneration through the minute structures of the vital organs, including the heart itself, the danger is painfully apparent.

In conclusion, whatever good can come from alcohol, or whatever evil, is all included in that primary physiological and luxurious action of the agent upon the nervous supply of the circulation to which I have endeavoured so earnestly to direct your minds. If it be really a luxury for the heart to be lifted up by alcohol; for the blood to course more swiftly through the brain; for the thoughts to flow more vehemently; for words to come more fluently; for emotions to rise ecstatically, and for life to rush on beyond the race set by nature; then, those who enjoy the luxury must enjoy it—with the consequences.

CHEMICAL SECTION.

The first meeting of this Section for the present Session was held on Tuesday, January 19th, Professor TYNDALL, D.C.L., F.R.S., in the chair.

The paper read was—

APPLIANCES FOR ENABLING PERSONS TO BREATHE IN DENSE SMOKE OR POISONOUS VAPOURS.

By Captain Shaw,

Chief Officer of the Metropolitan Fire Brigade.

Numerous attempts have been made, both in ancient and modern times, to enable persons to enter safely into places full of smoke or noxious vapours, but very few of the appliances employed for the purpose, even though apparently successful during experiments, have received the sanction of permanent use. Means have been invented to enable persons to pass through the flames of a furnace at nearly white heat, but they have been cumbersome and expensive, and obviously so unlikely to be of any use, except for purposes of display or public entertainment, that they have naturally fallen below the level of practical criticism, and are only mentioned here as matters of scientific curiosity.

Our great enemies in this way are smoke, and those innumerable poisonous vapours created by intense heat under certain combinations well known to chemists, but too abstruse to be explained here, which we designate under the general title of mephitic gases.

The vapours which we find dangerous probably include nitrogen, sulphuretted hydrogen, carbonic acid gas, choke damp, and numerous other defined and well known gases, but it is unnecessary to enter here into the chemical details or to be very precise as to the terms by which these vapours are designated in laboratories, as I mean simply to include under the general head of mephitic gases, all those vapours we meet in our business which will not permit respiration to continue within their range.

To enable a man to enter into and remain in a place strongly impregnated with mephitic or noxious gases, two courses are open. One is to supply him with pure air from an external source; the other to provide him with the means of filtering for himself such air as he finds, admitting to his lungs only that which is pure and useful, and rejecting the rest.

I will now endeavour to describe a few of the best known appliances for this purpose, including long breathing tubes, air bag and short tubes, smoke jacket, smoke cap, woollen filter, and fire-proof clothing, and I will take them in the order here given, commencing with the long breathing tubes.

LONG BREATHING TUBES.

For supplying air from external sources several modes have been tried, among others what were known as Breathing Tubes, one leading from the external air into the mouth and nose, the other leading outward from the mouth and nose, with a mouthpiece and nose-valve arranged for the purpose. This, in certain cases, has proved efficacious, but the working of it requires not only practice but an amount of attention which it is difficult to keep up, and when the inlet or air-pipe has to be very long, and to go round curves, the labour involved in breathing is sometimes considerable. Why this should be so I cannot say, as the pressure of the external atmosphere ought to be ample and more than ample to overcome the friction in the pipe; but it has occurred, and does occur, and therefore ought to be mentioned. Another application by these tubes is by means of a mouthpiece alone, with two openings, which can be closed alternately by the tongue, the nose being stopped with a nose-pincers. This also has proved successful in very simple cases and for short periods, but it is evident that it would not do for our rough work and rapid movements. It is quite correct in principle, but is probably best adapted, in practice, to the purpose for which it has been much used abroad, namely, to enable persons to breathe under water in certain baths which require the immersion of the head. Attempts have also been made to work with a pipe leading merely from the man's mouth to the ground, but they have been unsuccessful, and when not unsuccessful have been useless, as a

man generally is on his hands and knees on such occasions, and then does not require the pipe, or, if he is standing up, he has only to stoop down and obtain such clear air as there may happen to be available.

Air Bags and Short Tubes.

Another mode is to carry into the smoky place an inflated bag of air, with two tubes of the kind already described connecting it with the mouth, one tube leading from the bottom of the bag or reservoir, and the other to the top, the tongue acting as a valve. In this case the man inhales through the tube leading from the bottom, and exhales through that leading into the top, and the discharged air being warmed, and consequently lighter, remains for a time on the top, and, mixing with the remaining air, may be inhaled again several times. With such an apparatus working properly a man can remain in the foulest air several minutes, but it is obvious that he must be very careful in the management of the breathing tubes.

The Smoke Jacket.

One of the safest appliances for the supply of air to a person working in a smoky or vitiated atmosphere is that known for many years in most English fire brigades as the smoke jacket, and abroad as the *blouse contre l'asphyxie*, *appareil à feu de cave*, or in some places as the *appareil Paulin*, from the name of its supposed inventor. The smoke jacket consists of a blouse of cow-hide, pliable, light, and mounted with a hood which completely envelopes the man's head. It is mounted in front of the face with a pair of eye-glasses, or a half cylindrical sheet of glass firmly fitted to the front of the hood, so that the wearer can see everything in the place to which he has penetrated; and underneath the mask there can be if desired a whistle fitted with a valve, which serves for giving signals. Straps and buckles, called bracelets, hold the sleeves round the wrists, and a thong, called a *cuissiere*, or leg-strap, which is fixed in front, and, after passing between the legs, is buckled behind, prevents the blouse rising. It is, besides, held over the hips with a leather girdle, on the front of which a lamp can be carried when required. On the left side is fixed a screw, to receive the corresponding screw of a hose which is of the same pattern as those of the fire-engines, and communicates at the other end with one of these engines. The pump of the fire-engine being set to work, of course without water, drives air into the jacket, swells it out, and keeps the man in a compressed atmosphere, which is continually renewed. The surrounding air cannot penetrate, being continually driven back by that escaping at the wrists and other openings. Once inflated, the blouse holds enough air for a man to be able to breathe in it without difficulty for six or eight minutes, but it is necessary to continue working the pumps, in order to enable him to remain inside any length of time. When the lamp is lighted, air is introduced to it by means of a little pipe communicating with the inside of the jacket.

This smoke jacket is very useful for extinguishing fires in vaults, stopping conflagrations in the holds of ships, and penetrating wells, quarries, mines, cesspools, &c.; any place, in short, where the air has become unfit for respiration. The special advantages of this jacket are its great simplicity, its facility for use, and the rapidity with which it can be carried about and put on; but its drawback is, that it requires the use of an engine, or air-pump, and consequently is of no service to one man alone. For this latter reason, smoke jackets, although very effective for enabling us to get into convenient places for extinguishing fires, have very rarely proved of any avail for saving life.

Wherever vulcanised india-rubber tubes are used for the purpose of conveying air to the lungs, I should recommend very great caution, as it is undoubted that, at least in some cases, men have been known to suffer serious inconvenience, if not to incur considerable danger, from inhaling through this material. This is, however, a very trifling difficulty, and I have no doubt has only to be pointed out to be speedily obviated by improved construction.

The Smoke Cap.

Another apparatus, and one free from the disadvantage of being dependent on aid for its use, is the smoke cap, which is very light and portable, and can be brought into use in a few seconds by a man working alone.

A smoke cap is an apparatus by means of which a man is able to breathe when working in dense or poisonous vapours. It partially closes the nose, and provides for the mouth a light, closely-fitting filter with valves, and for the eyes a complete cover, which will act as a protection without obstructing the sight, the whole being capable of being put on and completely adjusted for use in a few seconds by the man who is to wear it, without aid from any one else.

It is desirable that it should be strong and fit for rough work, also that it should contain no delicate parts likely to get out of order, and no material parts inaccessible for immediate examination.

Every one of these requirements may be separately carried out without much trouble, where the questions of time and rough usage can be put out of consideration; but the combination of the whole for rough work, and the shortness of the time available in our business for adjustment have hitherto constituted very serious difficulties, which however, it may be hoped, are now, to a great extent, if not altogether, overcome.

The filter, which separates the pure air from smoke or noxious vapours, and which constitutes the speciality of the apparatus, is the invention of Professor Tyndall, who has in the kindest and most liberal manner placed it at our disposal, solely from public spirit, and without fee or reward of any kind whatever.

The first complete apparatus as now issued was designed and made up by ourselves in the workshops of the Fire Brigade, and served as the pattern for those afterwards furnished by contractors.

The smoke cap consists mainly of two parts, called respectively the hood and the respirator.

The hood is made of the best dressed calfskin blacked, cut in sections and closed with air-tight joints, each part overlapping the next to an extent of half-an-inch, and the sections strongly

sewn together with two separate rows of saddlers' stitching. The skull part is fitted to the shape of a man's head, and is about 24 inches in circumference at the widest part; underneath this there is a band about 2 inches deep forming a collar, to the lower edge of which there is attached a kind of yoke or apron-piece about 6 inches deep, shaped to fit on a man's chest and shoulders under a tunic.

To facilitate the putting on and taking off of the hood, there is an opening down the whole of the back part from the crown to the neck, and on each side a row of four eyelet holes with brass bushes, through which there is rove as a lacing a leather thong, the ends of which go round to the front, and, after passing through a small metal ring, are knotted at the ends below two hard wood knobs, to prevent their being pulled back through the ring. When the hood has been put on, the thongs are pulled in front, and, rendering through the eyelet holes, draw the whole of the skull part close to the head. The opening at the back is fitted with a piece of what is commonly known as waterproof sheeting, a thin, air-tight material which occupies very little space, and, although wide enough to allow the head to enter freely, is easily folded away by the drawing of the thongs. The lower flap or apron part is tucked in under the collar of a tunic, so as to form an air-tight joint sufficient for the purpose.

To the front of the hood inside is attached, by means of round-headed brass rivets, a frame or piece of tinned sheet metal, shaped to fit the front of a man's face from the bridge of the nose to the chin. Opposite the mouth there is attached to this frame a piece of brass, with a circular opening, cut on the inside with a female thread to take the male thread of a hard wood mouthpiece, and on the outside with a male thread to take the swivel screw of a respirator. The male screw to which this swivel is coupled has cut inside it a recess in which a leather washer is placed, so as to make an air-tight joint when the coupling is screwed up.

At a distance of about four inches above the mouthpiece there are fixed a pair of curved eye-glasses of the best clear glass, set with cement in brass rims with lugs, which are attached by screws to curved metal frames rivetted on the inside of the hood.

The respirator consists of two parts, the valve chamber and the filter tube.

The valve chamber is formed of a piece of best drawn brass tube 2 inches long and 2 inches in diameter, with an upper and lower valve plate, and between the two a slotted horizontal opening to which is soldered on and rivetted a brass connecting piece about half-an-inch long, fitted on the end with a swivel screw to match the outer mouthpiece screw on the hood.

Each of the valve plates is fitted with three ebonite ball valves, $\frac{1}{2}$-inch in diameter, turned perfectly round and without the slightest projection or rim in any part. The openings in the plates are $\frac{7}{16}$ inch in diameter, and are so cut that the seatings embrace at least one-third of the valves. The seatings, which are separate pieces are screwed into the plates, and are most carefully bevelled ont so that the valves shall make an exact fit, are neither [illegible] to stick nor so loose as to allow leakage. The valves are properly protected above by metal guards, which allow a lift of $\frac{1}{8}$ inch for suction and a shade less for delivery.

Above the delivery valves there is screwed on a nut or cap plate, which protects the valves and guards from injury, and is pierced round the edge with 28 holes for the escape of the discharged air.

The filter tube is also of brass, of the same diameter as that used for the valve chamber, and is four inches long. Across the upper end inside there is soldered on a piece of fine copper wire gauze with $\frac{1}{16}$ inch mesh, to prevent wool or other light substances passing, and over the lower end there is screwed on a brass ring or cap with a similar piece of wire gauze.

The whole of the respirator is tinned inside and lacquered outside.

The following parts of the respirator are screwed on to each other, and are therefore capable of being quickly and easily separated for examination and cleaning when necessary:—

1. The lower cap, which has a female screw, and is joined to the male screw on the bottom end of the filter tube.

2. The whole of the filter tube, which has two male screws, the one at the bottom to take the cap, and the one at the top to join a female screw cut underneath in the cylindrical or outside part of the suction valve plate.

3. The suction valve plate which has two female screws, the one at the bottom to take the top male screw of the filter tube, and the one at the top to join a male screw cut on the lower end of the valve-chamber tube.

4. The valve-chamber tube, which has two male screws, the one at the bottom to take the top female screw of the cylindrical part of the suction valve plate, and the one at the top to join the covering plate or top cap.

5. The top nut or cap plate, which has a female screw to receive the male screw at the upper-end of the valve-chamber.

The charge for the filter consists of the following materials, which are put in with the tube turned upside down, and, of course, the lower cap removed:—Half-an-inch deep of dry cotton wool, an inch deep of the same wool saturated with glycerine, a thin layer of dry wool, half-an-inch deep of fragments of charcoal, half-an-inch deep of dry wool, half-an-inch deep of fragments of lime, and about an inch deep of dry wool.

These must be packed so closely as to fill every part of the chamber, and they should be pressed down as tightly as experience shows to be compatible with facility of breathing through them when in use. After this the lower grating cap is screwed on, and the filter is then ready for use.

ALTERATION IN ARRANGEMENT OF CHARGE FOR SMOKE CAP FILTERS.

The following refers to changes which have to be made in the arrangement of the charge for the smoke-cap filters, as before explained.

Experience has shown that the fragments of lime which are put in for the purpose of absorbing carbonic acid, become reduced to powder merely from the effects of the atmosphere, and are often quickly slaked by a man's breath. As these particles when pulverised render breathing very

difficult, and it has been thoroughly ascertained that in fires carbonic acid is very seldom present in sufficiently large quantities to cause actual danger, it has been determined to remove the lime altogether, and to re-arrange the other materials.

I have accordingly altered the arrangement as follows:—Half-an-inch deep of dry cotton wool, an inch deep of the same wool saturated with glycerine, half-an-inch deep of dry wool, an inch deep of fragments of charcoal, and an inch deep of dry wool. The other arrangements remain as hitherto.

It is of course to be understood that whenever carbonic acid is known or suspected to be present, a layer of fragments of lime may with advantage be added for immediate use, a corresponding portion of dry wool being removed for the purpose; but in such cases it is advisable to remove the lime shortly after use, and to replace the wool as before.

Each particle of smoke is in fact a piece of solid carbon or charcoal, carrying in it, and with it, a small load of noxious vapour, which produces greater irritation in the throat and lungs than even the solid particles; and there is always present in smoke some carbonic acid, which, though generally at our work in small quantities, is occasionally found sufficient to cause both trouble and risk to those inhaling it.

The dry cotton wool acts with great effect as a filter, arresting the larger portion and coarser particles of the opaque smoke.

The wool, moistened with glycerine, acts as a finer filter, arresting that portion of the opaque matter of the smoke which, from its tenuity, escapes arrest by the dry wool.

The charcoal arrests the invisible pungent vapours existing in the smoke, which no mere mechanical filtration would effect.

The lime absorbs the carbonic acid produced by the combustion or burning.

The succession of the layers may be changed without prejudice to the action, but for such rough business as ours it is well to have some dry wool in at least the following places, namely: on top, to prevent the taste of the glycerine, charcoal, or lime penetrating into the mouth, between the charcoal and lime to prevent their mixing, and at the bottom, to prevent the charcoal or lime falling out.

To prepare for putting on the smoke cap, take off the helmet, open a few of the top buttons of the tunic, and turn over the collar, breast, and back as low as possible without interfering with the free movements of the arms.

To put on the cap, hold it with the face part downwards, open the lacing sufficiently to allow the head to pass in, and, taking the lower part of the sides or flaps in both hands, with the knobs and the ends of the thong hanging down, slip the hood over the head, and, as soon as the top rests on the crown of the head, adjust the wooden mouthpiece in the mouth, which will bring the eye-glasses and other parts into their proper places; tuck in the lower flaps under the tunic, take hold of the thongs in front, and pull on them until the lacing at the back draws the skull part close to the head all round.

It is not actually necessary to knot the ends of the thong in front, but it is convenient to do so, and in any case they ought to be tucked inside the breast of the tunic, lest they should catch in anything at work. After this, turn up and button the tunic, put on the helmet, and then all is ready.

Whenever convenient, it will be found a great advantage to plug the nostrils with pieces of any soft material that may be available, and thus prevent exhalations from the nose, which have a tendency to dim the glasses.

It is almost needless to mention that the hood may be put on with or without the respirator, as the latter can be coupled on and removed equally well whether the hood is on or off.

For practice the whole should be done by the man himself, without any help whatever.

With valves so very small and light as those necessarily used in an apparatus which is carried on a man's head, there is always more or less danger of their sticking in the seats or guards, especially when subjected to the combined action of heat, and of the vapour and water from a man's mouth; but this danger is generally obviated without any difficulty by the man either tapping the side of the respirator with his hand, or jerking his breath and blowing out any water which may have accumulated in the valve chamber.

The cap, with all fittings complete, is carried in a circular tin case about 10 inches long and 6 inches in diameter, with a capacity of 282 cubic inches, or less that one sixth of a cubic foot.

The weights of the several parts are as follows—

	ozs.	lbs.	oz.
Hood with mouthpiece, thong, &c.		1	4
Respirator—			
Top cap	1¼		
Valve chamber tube, with top valve plate, valves, guards, connecting piece and swivel coupling	7¼		
Lower valve plate with valves, guards, and cylindrical part................	2½		
Filter tube, with top grating	5		
Lower cap of filter tube	1		
	—	1	1
Charge			3
Tin case................................		1	8
Total		4	0

Summary of Weights.

	lbs.
Hood and fittings..........................	1¼
Respirator charged	1¼
Total as worn	2½
Tin case................................	1½
Total as carried	4

The Woollen Filter.

This is a very simple contrivance, but one mo frequently used than perhaps all the others togeth When none of the appliances previously mention can be obtained, a man who has to enter smo places will find a great advantage in placing ov his mouth and nose any woollen or other substan which will act as a filter, and intercept the gros sooty particles of the smoke.

Fire-proof Clothing.

In connection with this part of the subje though, as already explained, rather as a mat

of scientific interest than of practical usefulness, the following description is given of an apparatus for enabling a man to pass through a furnace, and even to remain in it for several minutes.

DESCRIPTION OF THE APPAREIL ALDINI.

In certain cases it may be indispensable to traverse flames in order to reach some particular spot, and it was for the purpose of preserving persons who find themselves in such circumstances that the Chevalier Aldini, an Italian physician, thought of the apparatus which bears his name.

This preservative apparatus consists of two vestments, one composed of a thick tissue of asbestos (*amianthus*), or woollen stuff, made incombustible by means of a saline solution, the other of a metallic cloth of iron wire covering the first garment, and mounted with a helmet on its upper part.

A person enveloped in these two garments can withstand the action of flames for some minutes without experiencing any dangerous effects, for on the one hand the external metallic tissue cools the flames, and on the other hand the internal tissue transmits the heat very slowly on account of the want of conductibility in the substances of which it is composed.

Aldini's apparatus dates at least from the year 1825, but, notwithstanding the good results which it has shown in the numerous experiments to which it has been submitted, it has never been adopted to any considerable extent, either because the circumstances in which it could be really of service are much too rare in comparison with the expense of its manufacture and maintenance, or because, as happens with a number of inventions, it presented in serious practice considerable inconveniences, such as rarely occur in experiments for mere show, where everything is generally arranged for the success of the operation.

The following is an account of one of the experiments made in Paris, in 1829, by some *sapeurs pompiers*, or firemen, with Aldini's clothing on:—Two piles were erected of thin wood, covered with straw, ten yards long, two yards high, and distant from each other about a yard and a-half; two lateral openings allowed the firemen to go out from the flames if they were compelled to do so, and in other ways facilitated the experiment, which consisted in traversing half the length of the burning heap, going out by one of the lateral openings and entering again by the opposite end, and then repeating the same experiment from the other side of the heap. The four firemen who were to make this trial were clothed in the new garment of metallic tissue; two carried, besides, a clothing of asbestos (*amianthus*) over a cloth garment, rendered incombustible by borax, alum, and phosphate of ammonia; the two others had a double clothing of prepared cloth; each man had boots of asbestos, and under the foot a piece of cardboard of that substance; and one of them carried on his back a child, ten years of age, whose head was enveloped in a helmet of asbestos. The firemen penetrated together into the interior of the double pile of flames, and, walking slowly, traversed it several times. At the end of 60 seconds, the child enclosed in the basket cried out so that the man who was carrying him was forced to retreat precipitately. They made haste to take out the child, who had in no way suffered; his skin was fresh, and his pulse, which beat 84 before the experiment, was only 96 after it. He could without any doubt have remained much longer in this wrapping, were it not for the fear which seized him, and which was caused by one of the straps supporting the basket having slipped a little on the shoulder of the fireman who carried it. The child, at the sight of the flames which roared below them, thought he had been thrown into them. A few minutes after he was as merry as usual, and felt no uncomfortable sensation. The fireman who carried the child had, before the experiment, 92 pulsations a minute, and after it 116. The three others remained in the flames two minutes and forty-four seconds, and came out without having experienced anything except a sharp heat. The pulsations were before 88, 84, and 72 a minute, and after 152, 138, and 124 a minute. The flame was continually fed with straw thrown upon that which was burning. There was very soon formed an enclosure of fire in which the firemen were shut up, and as a portion of the straw scattered on the ground threw up a flame which at times enveloped their legs, it was certain that the bodies of the men were exposed to the direct action of the flames. At a distance of more than six yards from the focus of the fire the heat was so intense that none of the numerous assembly could remain there. In other experiments the firemen were furnished with large shields, which they made use of to keep back the flames. It is obvious that such an apparatus as this could be of very little use for general work.

I have now gone through the principal appliances I can remember for the purpose of enabling men to work in smoke and other dangerous places, confining myself chiefly to some of those which have been to a certain extent brought into practical use, but adding one instance of what I must own to be rather a scientific curiosity than anything else.

There are thousands of other inventions which have been brought under my notice of late years in several countries, but none that I can remember at present which would be worthy of consideration at such a meeting as this. It may be that in the discussion which I understand is to follow the reading of this paper, some new idea will be suggested, and, if so, I can only say that it will be heartily welcomed as an addition to the very small stock of knowledge which at present exists on the subject, and which, so far as my corps and I are concerned, would have been smaller still but for the cordial assistance we have received from my excellent friend, Professor Tyndall, to whom I beg leave to be allowed to offer my most sincere acknowledgments, not only for his generosity in giving us valuable information, which we have been enabled to turn to practical use, but also for his kindness and courtesy in supporting us by taking the chair on the present occasion.

DISCUSSION.

Sir Frederick Pollock asked if Captain Shaw could mention any occasion upon which this apparatus had been brought into practical use, so as to illustrate the way in which it could be employed. It would be interesting to know whether this artillery, not of a destructive, but of a life-preserving kind, had as yet been brought into the field and used in the actual campaign in which Captain Shaw so successfully commanded.

Capt. Shaw said the apparatus was still in its infancy, not much more than a year having elapsed since Professor Tyndall first called his attention to it, but it had already been found very useful in going into cellars and such like places when full of smoke. Owing, however, to the impetuosity of the men, it often happened that they rushed in without waiting to put on these things, and had to come out again. As yet he could not mention any very important instance in which they had been used, but had no doubt that as the thing became more developed such cases would occur. They were most frequently used in wine cellars and similar places, where but for their employment the men would not be able to endure the suffocating vapour for any appreciable time.

Mr. Charles White said that besides its interest for firemen, the general public were interested in this question, and it would be of great service sometimes to the inmates of a burning house if they knew what means to apply to prevent suffocation by smoke, whether woollen cloth, linen, or any other fabric. There was no doubt that such a knowledge might often be the means of saving life.

A Member asked how long a fireman could remain in a hot smoky atmosphere when protected by a helmet with a respirator.

Mr. Pearsall said he had the good fortune to be present at the confidential interviews which took place between Prof. Faraday and Signor Aldini, and should have liked to hear it more clearly stated why the apparatus invented by the latter gentleman had not been adopted. It must be borne in mind that to the general public even water filters were often a great deception; the vilest poison might pass through a water filter and be drunk unsuspectingly because it looked clear and bright, and in the same way a filter of this kind might get rid of some noxious vapours, and yet allow poisonous gases to pass through. Captain Shaw had referred to the difficulty of restraining his men, and he believed it was sometimes the case that though they were the finest body of men possible, they would not always obey orders, but rushed in, and sometimes did as much harm as good by their temerity. He well recollected the intense disappointment felt by Signor Aldini, when he found that Prof. Faraday could not conscientiously recommend his apparatus, but he believed the reason was that it was too good, and that it would tempt men into certain destruction. He believed such would be found to be the reason why it was not taken up by the fire-offices, at the time when Faraday lectured upon it at the Royal Institution. Reference had been made to the experiments in Paris, and he thought it would be interesting and valuable if some medical testimony as to the condition of firemen who had worn it had been adduced in connection with the experiments with the respirator helmet.

Mr. Ladd said he had taken a great deal of interest in these helmets or respirators, and thought they might be found useful in saving life as well as property. He remembered being summoned on an inquest held upon a man who was suffocated at a fire in Windmill-street, Haymarket, and it seemed to him the most important lesson to be drawn from that inquiry was that all fire-escape men should be furnished with some such apparatus. On the occasion referred to the fireman entered the front room and endeavoured to reach the back room where the deceased man was, but was prevented by the smoke and flames; the police-sergeant or inspector on the top of the ladder encouraged him to try again and he did so, but fell senseless on the ground and had himself to be rescued by the policeman. Had he been provided with one of these respirators he certainly would not have been in that predicament, and might perhaps have saved a life. He wished to know therefore, if it was intended to furnish all fire-escape men with such an apparatus.

Mr. Sinclair, as a manufacturer of these respirato said he knew of many instances where they had be successfully used. The first case was at a fire at brewery in Bristol, where a person of the name of Syk wearing a respirator, and armed with one of their f exterminators, went in and completely put out the fi though the smoke was so dense that all previous effo had failed. Another instance had occurred lately at cotton mill in Lancashire, where the steam had be turned on, and water had also been applied, but with avail, when a man with one of these respirators and Extincteur succeeded in penetrating to the seat of fire and putting it out. His firm had been making th respirators for two years, during which time they l sold between 500 and 600, and were unable to keep u supply equal to the demand. They were in great quest by mill-owners, and were used not only in case fire but in various deleterious trades where the lu were likely to be affected, as by the fluff in cotton m A lighter kind of instrument, not weighing more t 1 oz., was made for such purposes. A great many also been supplied to ship-owners, and he believed disaster of the *Cospatrick* might have been preve had such an apparatus been on board the vessel.

Mr. T. A. Skelton suggested that these respir might be of great use in many mining accidents, w men had to be rescued after a fire.

Mr. T. Wills, as a chemist, had been rather struc one remarkable statement in the paper, viz., that bonic acid was rarely present in fires in suffi quantity to be dangerous, and that therefore the m adopted for absorbing this gas might generally be pensed with. This appeared somewhat strange wh was remembered what a very small percentage of bonic acid in the air often proved fatal. From thi it appeared that death from suffocation in fires coul occur from inhaling carbonic acid, but must arise the absolute choking up of the bronchial tubes an passages by the solid particles of carbon contain the smoke.

The Chairman said there could be but one feeling dominant in the meeting, and that was one of t fulness to Captain Shaw for the able and instr paper he had read, and which he would venture to plement by briefly stating the various steps by w this form of respirator had been attained. Some ago he was making a number of exceedingly de experiments, in which he found the dust const floating in the London air a great nuisance, it necessary to obtain air optically pure, so that w condensed beam of light was passed through it no ing motes or particles of dust should be visible. T accomplished by causing the air before it enter tubes, which were first exhausted by the air-pu pass through simple cotton wool. In fact cotton had been used by Schroeder, Pasteur, and other ago as a means of getting rid of matters suspended air. Reflecting upon this matter, and sometimes and watching the men under Captain Shaw's su tendence, feeling as he did a great interest in l bravery whenever brought into play against the forces of nature, it occurred to him that som might be done to enable these firemen to breathe midst of smoke, and so to feel their way to the their enemy. He knew that cotton wool pure and must be very effective in mitigating the evil, by cepting a considerable amount of the suspended matt he therefore obtained an apparatus which allowed l inhaling and exhaling, and connected with it cylinder filled with cotton wool. On trying th paratus with some very pungent smoke obtained resinous wood, he found that it had a mitigating but still, for his lungs, it was not at all sufficient in experiments with regard to spontaneous gene it would be remembered there were two parties, which insisted that if you kept away all the sus

matter of the air no spontaneous generation took place, but that it was organic ova or germs which sprouted and gave rise to the beings which were supposed to be spontaneously generated; and a gentleman of Rouen, named Pouchet, who was very much interested in this question, in order to catch these ova from the air, adopted the method of spreading glycerine on a piece of glass and passing air over it, when he found the ova were arrested. It therefore occurred to him (Professor Tyndall) that glycerine if associated with the cotton wool, not causing clots, for it must be very carefully employed, but so moistening the wool as to render each fibre sticky, might greatly augment its power of intercepting the smoke particles. On trying the experiment he found that this was of very great advantage to the lungs, enabling him to enter a chamber filled with smoke of an exceedingly objectionable density, and breathe in it for a considerably longer time than he could with the dry cotton wool alone. Still, however, the lungs were irritated, and it occurred to him that as a consequence of the imperfect combustion which always took place with fires, there must be present, not only smoke, but certain irritating hydrocarbons in the shape of vapour, and that charcoal being exceedingly porous, would in a great measure absorb them; in fact, that if he could succeed in intercepting all the solid particles by the glycerined wool, and the vapours by fragments of charcoal, he would obtain a nearly perfect filter. On trying this combination he found that he could go into an atmosphere of the most atrocious character, and live there for 10, 15, 20, or 30 minutes, though unprotected he could not exist in it for a single minute. In this state of matters, knowing the vigour and courage which Captain Shaw displayed in his vocation, he applied to him, asking if such an apparatus would be useful. His immediate reply was that it would be of the greatest value, but that everything of the kind hitherto proposed had proved a failure. Thereupon he invited him to make a trial. Captain Shaw came to the Royal Institution with some of his men, tried the rough experimental apparatus which had been constructed, and was satisfied that it could be really turned to account. Since then he had bestowed an immense deal of care and assiduity on the development of this simple idea, the result of which had been to bring it to its present practical form. He (Professor Tyndall) always thought it salutary that there should be a little doubt and diffidence in taking up new things of this kind, but when once they were brought before practical men if there were anything in them they would be sure to make their way. He had been present at some of Capt. Shaw's experiments, and had always admired the thoroughly practical manner in which he taught his men to grapple with the difficulties they had to encounter, giving them elementary lessons in natural philosophy, not letting them do their work simply as machines, but making them acquainted with the principles brought into play, and thus giving them an interest in their work which they would not otherwise possess. With regard to Mr. Sinclair's respirator, he thought it an exceedingly useful one. One gentleman had asked what was the proper kind of wool to be used, and he believed Capt. Shaw would tell him—ordinary cotton wool, for he had been astonished to find that with that material alone, not even rendered sticky with glycerine, Capt. Shaw was able on one occasion to exist for some time in an atmosphere in which he himself could not live for two minutes, though he had by no means weak lungs, and on a mountain side should not fear competing even with him. Still for any one not possessing extraordinarily strong lungs, ordinary cotton wool would not be of much service, and for such persons the respirator of Mr. Sinclair would be very useful. Having established the principle and fairly experimented upon it, so much so that in a friendly competition with Capt. Shaw he had remained for 16 minutes, and might have stayed double the time, with a compound respirator in an atmosphere in which that gentleman could only remain seven minutes with one of simple cotton wool, he had not taken much practical part in the matter, but he had encouraged his assistant, Mr. Cotterell, who was very skilful indeed, to work out the idea and put the respirator into the most simple forms, and that gentleman having been very successful, he would ask him to exhibit one of his devising, associated with a pair of goggles which had proved a perfect protection to the eyes. This apparatus could be put on in half a minute, and by its aid a person could remain in a most noisome atmosphere for ten minutes or a quarter of an hour. He had seen it tried that very day at Westminster, when several strangers were able to remain for some time in a thickly smoky atmosphere without discomfort. His own opinion was that every workman ought to work with his own tools; the armour of Saul did not suit David, and he hoped everyone working at this subject would follow his own ideas, and the line in which his genius led him. No doubt, so many persons being engaged upon it, it would eventually prove a benefit to humanity, and contribute to the saving of both life and property. In conclusion, he could only express his gratitude to Captain Shaw for the interest he had taken in the matter, which he had no doubt would be endorsed by the meeting in the shape of a cordial vote of thanks.

Capt. Shaw, in reply, said the Chairman had already answered the first question as to the proper material to use. All cotton wool was useful, but much more so when impregnated with glycerine. Persons who found themselves suddenly enveloped in smoke would find that even a stocking put over the mouth and nose would enable them sometimes to pass through it, especially if they took the precaution not to keep the lungs working too hard, or to get out of breath. It would protect them for something like sixty seconds; and if dipped in water and wrung out it would be still more efficacious. At the same time he did not pretend that so simple a means would be of any use to persons of weak lungs. With regard to the question how long a man could remain in the smoke with a smoke cap on, he must give two answers: if it were only a question of remaining still he could remain a long time, but it was not used simply for that purpose, and a man working required much more air than if quiescent; and when engaged as firemen were, ten minutes was about the limit. Then, again, some men generated a certain amount of saliva, and found it very inconvenient after six or eight minutes, whilst others could remain double that time. But there were two forms of cap, one of which provided for getting rid of the saliva, whilst the other did not, and with the former a man could remain at work for about a quarter of an hour, which was sufficient for practical purposes, as he could then come out, get his breath in the fresh air, and then go down again. He was quite aware that these filters were not perfect, and that certain gases passed through them, quite sufficient to embarrass any person of ordinary lungs. But to make them perfect it would probably be necessary to put in so many materials, and so to pack them within the tube that the difficulty of breathing would be vastly increased, probably so much so that the whole of the man's bodily strength would be expended in respiration, and he would consequently be unable to do anything else. He had been slightly misunderstood with regard to the men rushing in and not obeying orders, for such a thing as disobedience was quite unknown; but orders were given without detail, and though there were several precautionary appliances at hand, there might be three times as many men, and they did not wait to select who should put them on, but rushed in at once, the only effect being that those who used them could remain in much longer than the others. Their theory was caution, but in such a business it was impossible to always put it in practice. If a man went into a fire thinking there was any danger of being los'

from the character of the building, or the mode in which the goods were stacked, he could take a life line with him, but it was very rarely even that was done. Nine times out of ten the man knew exactly what he could do, and when he found he could stand it no longer he groped his way out again. In fact they would lose more time, and often incur more risk, by taking the precautions which were sometimes suggested, than they would without. One of the most important reasons why Signor Aldini's apparatus had not be used was that it could very rarely be brought into operation in the time at their disposal, since, to properly adjust it, he believed something like an hour was required. It had been shown at different places of entertainment, and was very successful as an exhibition, but it could not be used practically on account of the time it occupied. He must give a similar answer with regard to medical testimony. No doubt it would be very interesting and useful, but doctors were not generally present on such occasions, and when they were, if a man came out of a fire merely for a breath of air he would hardly be inclined to spend his time in submitting to a medical examination. Sometimes one man came out much more exhausted than another who had been in for some length of time, the reason being that the first had been doing more work. Except for such a cause they generally came out in about the same condition. If he recollected the case to which reference had been made of a man being suffocated in a back room, it was not really a case in point, because the victim was undoubtedly dead long before the arrival of the fire-escape, and the only thing which could have been done would have been to bring out the body slightly less charred than it was eventually recovered. It had been asked whether all firemen were in future to use these respirators, but that question he could not answer at present. He was a great believer in them up to the present time, but they were not perfect, and he looked forward to those commercially interested improving them, and above all, so reducing the cost that it would be within the power of fire brigades to obtain them in large numbers. Of course, in one sense, it was not a question of economy with regard to the saving of life, but in another sense it was, because if each apparatus cost £50, it would be utterly impossible for all the men to be supplied; whereas, if they only cost a shilling or two every man could carry one in his pocket. Until they were made in much larger quantities, and in a more portable form, he did not see how they could expect to use them universally, but he hoped the time would come when manufacturers would so far develope them that every man might be supplied at a moderate cost. He was glad they were being used by mill-owners, and he rather looked to the increased demand from this source leading to improvements in the manufacture, in the same way as the effort of agricultural implement makers to produce small, cheap, portable steam-engines had led to the introduction of steam fire-engines. The same remark applied to their use in mines. One person had spoken with respect to the fact, that a man suffocated in smoke must be choked by the carbon rather than poisoned, and it appeared to him (Captain Shaw) that this was so; he did not understand much about that part of the subject, but it appeared to him that when a man perfectly well and strong became suddenly exhausted, was brought out, and recovered instantly, he had been simply temporarily choked by smoke, and was not poisoned. Before concluding, he wished to allude to one point, which was quite new to him until the Chairman mentioned it. He had been always under the impression that when there was such a dense smoke that it was impossible to breathe, the place contained nothing but foul air, and consequently when anyone brought him a filter of any kind, he always asked them how they could produce pure air in a place destitute of it, and no one was able to answer him. He put the same question to Professor Tyndall, when he immediately replied, that he had met with very few atmospheres in which th was not sufficient pure air to support respiration, i could only be filtered and separated from smoke and noxious gases. And this he found to the case in the cellar of the Royal Institution, wh the Professor produced a more noisome atmosph than he could have believed possible, but still with respirator on he remained in it until his patience exhausted. Some of the respirators which had b shown possessed great merit, but he hoped they w be still further developed. For his purpose the poin most vital importance was quickness of adjustment; as they were necessarily subjected to rough usag was absolutely necessary that all the various m able parts should be quite safe and easily quickly removed and reinstated when injured. This the great difficulty, and if it could be got over, m more might be done than had hitherto been acc plished. He was glad to hear that many persons now engaged in making these respirators, and he this discussion would encourage them to still fur efforts. He had, he believed, answered all the quest which had been put, and had now only to read a p which had been put into his hand to the follow effect:—"There is one great objection to the sm cap, it may save the life of the fireman, but it will certainly frighten to death the tenants of a burn house, who will flee from their deliverers, believing t to be devils, and the flames will increase the illusi He would receive this remark in the spirit in whic was offered, and would only ask anyone to compare smoke cap he had shown with the one which Cotterell had put on, and to say which was the most pelling in appearance. He did not think any lady suddenly awakened out of her sleep, and seeing a apparelled in one of these things would be m alarmed, but would be quite ready to let him take in his arms to a place of safety.

The Chairman, in reference to Mr. Pearsall's rem upon the Aldini apparatus, said that there was no do Professor Faraday took everything into account, an he did not recommend it for general use it was f some such cause as had been mentioned by Captain Sh

Sir Frederick Pollock proposed a cordial vote thanks to Professor Tyndall for his kindness in tak the chair, which was carried, and the proceedings ter nated.

SIXTH ORDINARY MEETING.

Wednesday, January 20th, 1875; ROB RAWLINSON, C.B., Member of the Council, in chair.

The following candidates were proposed election as members of the Society:—

Austin, Richard Barnes, the Cottage, Bodicott, Banbury.
Bell, Thomas, Canwick-road, Lincoln.
Birdwood, George, M.D., 7, Apsley-terrace, Acton,
Bowes, James L., Liverpool.
Brabazon, Lord, Rivermead, Sunbury-on-Thames.
Brand, The Hon. John Henry, President of the Ora River Free State.
Brown, Alexander, 5, Spring-gardens, Charing-cr S.W.
Cannon, Matthew, Lavender-hill, Wandsworth, S.W
Chave, Rev. Edward, D.D., Vicarage, Wandsworth, S.
Church, Walter Charles, 8, Victoria-chambers, W minster, S.W.
Ellis, Alderman and Sheriff John Whittaker, 18, Broad-street, E.C.
Everett, G. A., 120, Chancery-lane, W.C.
Gössell, Otto, 22, Moorgate-street, E.C.
Hill, Samuel, 233, Camden-road, N.

...kinson, Edward, Skerne Iron Works Company, Darlington.
...ght, Alderman Henry Edmund, 10, Love-lane, Wood-street, E.C.
...ah, Robert, Darlington.
...i, Sigismund, 128, Englefield-road, Islington, N.
...pherson, Joseph, Sydney, New South Wales; and ...ralian Club, 54, St. James's-street, S.W.
...ning, Miss Elizabeth Adelaide, 35, Blomfield-road, ...ida-hill, W.
...rriott, Major-General W. F., 41, West Cromwell-road, S.W.
...tin, Lieut.-Colonel, Box-grove, Guildford.
...erman, Edward, Leyton, Essex.
...ell, James Conyers, C.E., Leyland, near Preston.
...rgill, Edward Hare, B.A., 44, Neville-road, Stoke Newington, N.
...s, Robert Philip, 8, King's-road, Gray's-inn, W.C.
...kner, Hugo, 309, Regent-street, W.
...schild, Alfred de, New-court, St. Swithin's-lane, E.C.
...hir, B. J., 9, Grove-road, Highgate-road, N.
...ard, Alfred Walter, 5, Serjeant's-inn, E.C., and 46, ...ex-street, Strand, W.C.
...ler, Richard, 6, Gledhow-gardens, South Kensington, S.W.
...n, John, Larkhill, Chorley, Lancashire.
...kinson, John Sheldon, C.E., 108, King-street, Manchester.

AND AS HONORARY CORRESPONDING MEMBER.

...rardin, Professor, College of Melle, near Ghent.

The following candidates were balloted for and duly elected members of the Society:—

...bton, William, Sutton-grange, St. Helen's, Lancashire.
... Lawrence, Essex-chambers, Essex-street, Manchester.
...mbe, David, F.S.A., 24, Berkeley-square, W.
...ley, John, British Plate Glass Works, Ravenhead, St. Helen's, Lancashire.
...ans, Robert James, M.D., 5, Kingsdown-villas, Bolingbroke-road, Wandsworth-common, S.W.
...gan, William, Ph.D., 28, Orange-street, Swansea.
...ez, George Henri Marc, Church-hill-house, Handsworth, near Birmingham.
...arlen, John, Lincoln.
...mes, Henry, 7, Westminster-chambers, S.W.
...h, Walter, 57, Lansdowne-road, W.
...ley, Joseph, Railway Works, Hunslet-road, Leeds.

The paper read was—

THE GRAPHIC METHOD OF TEACHING

By B. Waterhouse Hawkins, F.G.S.

Mr. Hawkins said he had in the first instance a ...rt proposition or text to put before the meeting, ...m which he would endeavour to suggest the ...ility in the first instance, and still more the ...antage, of getting into practice that useful habit ...illustrating in reference to teaching the various ...jects which are generally the staple difficulty ...the early education of young persons, and ...ticularly in the case of those classes which came ...der the influence of the London School Board. ...e necessity of illustrations in teaching natural ...tory had perhaps suggested the matter to him ...the first instance, but he was very strongly con...ced of the truth that there was no method ...impressive as the graphic of putting things ...fore young persons. The text was this—"Through the medium of the eyesight we can receive the largest number of impressions, and retain them for the longest possible period of time, with the smallest amount of fatigue." He believed this was incontrovertible. The next statement he wished to put forward and expatiate upon was this —that art expresses ideas by the representation of natural objects selected and combined. His first text spoke for itself, though it would be easy to dilate upon it. It was a fact of nature, recognised by all, that people could sit with pleasure and see a series of illustrations put before them. He was not about to lecture on teaching drawing, but to put forward the facilities of teaching by means of the power of drawing, and making constructive diagrams. There could be no denial of these facts, and he might remind his audience that these two propositions had been on their trial now for twenty-three years, since the great Exhibition of 1851. The universal recognition of the vast value of the results of that first international display of industrial arts and manufactures from all the civilised world was a sufficient proof of this fact, because seeing and carefully examining the works of other nations had done more than could have been attained by all the essays which could have been written in the time which that exhibition occupied.

The next great attempt to cultivate the powers of eyesight was at the Sydenham Crystal Palace in 1852, when a million sterling was subscribed and collected to carry out the largest scheme of visual education ever attempted. The educational portion of the plan originated, as was well known, with His Royal Highness the late Prince Consort. The ideas of the different departments originated with different scientific men, his own being that of extinct animals, and the association of the forms of life with the evidence of the geological periods, the different stratifications being obtained from the very ends of the earth, and combined with models which told their own story. The educational feature was the foundation of the whole plan, and it might be remembered that the charter was obtained on the declared intention that all intoxicating liquors should be excluded from the building, though that portion of the scheme had not been carried out. The main feature of the design was to show the connection between persons, things, and time, the teaching power depending upon the union and juxtaposition of some two things which related to the individual exhibited, and to the time to which it belonged. Unless this had been done it would have been a mere misleading catalogue of objects. The collection of busts was the finest ever brought together, and the description written for them by Mr. Samuel Phillips rendered them a vast school of instruction. He was sorry to say that time had worked great havoc with this collection, for on his return after many years absence he was quite pained to see the state into which things had got: in his own department, for instance, all connection between the different strata and the animals placed upon them having been lost. It was now 34 years ago since he commenced in the character of a pioneer to urge upon the educational administrators the necessity for the acquirement of the power of drawing, to form part of the then feeble efforts for the education of

the children of uneducated people, having in 1840 and 1841 incurred the expense of £50 for the construction of a series of geometrical models to illustrate the connection between the eye seeing and the thing seen. A Mr. Butler Williams, about the same time also, commenced holding classes in a room at Exeter-hall, for the purpose of drawing from the solid, cube and spherical forms; but it appeared to him at the time, more was done for the execution of the drawings on paper with high finish, to produce the effects of projection, than for the appreciation of the relation of the simple solids to complicated and varied forms, as to drawing the human figure or other animal forms. That instance of comparative failure led him to mark the distinction between representation or copying, and constructive reproduction of expressive forms. He was then met by the objection that drawings made from life were but copies of the model present; that a natural prediliction or innate genius—an innate power born with the art student—was necessary for any degree of success, or even to enable the hand of the would-be draughtsman to make the varied curves in lines expressive of the object in view. To combat this objection, he had prepared a number of pieces of tin of various sizes, lengths, and shapes; to these small tacks were soldered, so that they might be pressed on the black board into the outline of any suggested form, so as to prove that the form produced was generated by the thinking faculty. Consequently, it was first necessary to lead the would-be student to direct his or her thoughts to the right construction of the form and the size of the parts. This was shown in the case of writing, the variable forms of the letters being composed of one single curve, placed in different positions, and combined with straight lines. As to the power of drawing, he would only express his conviction that the expressiveness of a drawing depended more upon the relative size of the forms, and the position of the component parts with reference to each other, rather than upon the quality or shape of the forms themselves. To illustrate this, he need only point out that in a hastily executed sketch, with a little dot for the eye, a half v shaped line from the nose, a couple of dots, and a tick underneath for the mouth, and a few scratches to represent the hair, would, if well done, convey a most admirable idea of the individual intended. No teaching of drawing would convey that power to any individual of either sex, and here he admitted that genius was required. But as to making the forms of objects, and representing animals and other natural productions, the power of doing so might be acquired by anyone with only common application, provided the right means were adopted. It was no use giving the pupil a copy to imitate, but if the generation of a line either vertical or horizontal were enforced upon them by showing them first, a blackened iron wire against a white background, or perhaps a model of a cube or a globe, and then removing it before they commenced to draw, it made a vast difference, because what they produced was the result of their own thought. They would thus obtain self-confidence, and their thinking powers would be educated, which was the great point; indeed, he maintained from long experience, that the thinking faculties had to be operate in the first instance, and that until was recognised in all elementary schools, would be no practical drawing worth the tim materials expended upon it. The necessity f hand obeying the governing thought was in the case of writing, though after the a acquired it was done almost intuitively, and was no more thinking about it. During years since he commenced trying to teach dr by lecturing with constructive drawing black board, he had never heard of its be taught, until a fortnight ago, at the Free M and Library in Liverpool, where a Mr. Bisho a most admirable lecture on constructive dra with illustrations by his own hand. Th very cheering, and renewed his disappointed that the London School Board were going promptly in the right direction, and have c of their schools taught drawing, not only ordinary manner, by making copies of line flat copies, but also to have some person t its application to obtaining knowledge of subjects, which were to be rendered famil them by lectures from the travelling profe the various district schools. The article *Daily News*, upon which he built these hope a report of a meeting held in or about the of September last, but sadly added that the r tion did not pass, as some members of the considered it too much of an accomplishme the children of the people they had to deal It was, however, a sad mistake to suppos drawing was only an accomplishment; it w of the necessaries of life, and in his view, equal in importance to writing. In fact he rather be able to draw and represent everyth wished than write a good hand and descr Even as a question of time, it took a long t express an idea in writing, but a sketch don few minutes was equally expressive. With ence to this graphic method of teaching he only say farther, before giving an illustrati his meaning, that without it he did not beli was possible to properly teach natural hist comparative anatomy; and therefore if the Board, which now seemed to hold so impor place, were really in earnest in their educa efforts, they would certainly enforce it. B must not begin with the children, but wi teachers. No teacher had a right to up in a school amongst a number of dren who could not represent every which he spoke of, and about which h fessed to desire that they should know some [Mr. W. Hawkins then proceeded, with t of a piece of chalk and a black board, to ill his subject by producing what he termed a structive diagram" of an aquatic animal, ing with the stomach and its outlet, and then on to add *seriatim*, the heart, the vein breathing apparatus, the spinal column (wh compared to an electric telegraph cable ganglions, nerves, eyes, ears, olfactory vertebræ, skeleton, limbs, and finally the or envelope enclosing the whole.] It was pr this kind of thing which he desired to see of being done by every teacher in every for working men's children, because in th they would acquire a vast deal more know

in a much less space of time; it would be a pleasure to them, and a great advantage to society. It was a great mistake to suppose that drawing was an accomplishment which only persons of leisure were entitled to possess. It was a means of obtaining and conveying knowledge, and he hoped it would be taken up by the School Board accordingly. He recollected a conference in that hall, just before he left England, seven years ago, when a good deal was said about compulsory education for children, at the close of which a sturdy Irishman got up and said that a great deal had been said about educating the children, but he wanted to know what was to be done for such as himself. Now this system of graphic teaching by constructive diagrams was eminently adapted for adults, as he had proved only the night before last at Staleybridge, where he had an audience of more than 800 mill hands and artisans, who listened and followed his teaching quite as intelligently as their more highly educated employers. He had merely given a rough illustration, but it showed the method and system which which he desired to bring forward, and which he contended ought to be universally employed.

DISCUSSION.

The Chairman said he agreed with Mr. Hawkins that the teaching of children through the eyesight, and training their fingers to imitate what they saw in nature, was a kind of education which had not been carried out to a sufficient extent. Beyond being taught to draw, it was needful that children should be taught to understand those wonderful structures we saw in nature. He would undertake to say that the teacher who undertook to teach drawing from nature would have such a variety of examples in animal and vegetable life that there could be no satiety, and he would never come to the end of his lesson. If proper examples were put before the children, and proper lessons conveyed to them, it might, he thought, fairly be concluded that the young mind would not be led into the ways of infidelity.

Mr. George Wallis said he had felt great pleasure in seeing his old friend Mr. Hawkins present to-night to raise the question of graphic teaching once more. He (Mr. Wallis) wished to ask what difficulty there was in carrying the method out in a more practical manner than had hitherto been done. He entirely separated the question of graphic teaching from the question of teaching art, the latter being the function of the schools of art, which were formerly called schools of design. He held now the same opinion which he held 34 years ago on this subject. It happened that at the very time when Mr. Hawkins and Mr. Butler Williams were agitating this question, he (Mr. Wallis) was just commencing his career in connection with the schools of design. At [illegible] School boys were taught the elementary part of drawing on the blackboard, the master setting the copy on the board itself, but this was subsequently abandoned. While he was head master of the Manchester School of Art he read a paper on the early education of the hand and eye, and the result was that the Rev. Mr. Richson, now a canon of the Cathedral, asked him whether something could not be done to educate in drawing on the blackboard the schoolmasters and mistresses connected with the Church Education Society, of which that gentleman was secretary. They were accordingly got together on Saturday afternoons, and he gave his time to teaching them to draw on the blackboard. He satisfied himself that it was an exceedingly easy matter to teach them to draw intelligently, though the extent to which they would carry out the blackboard drawing would depend entirely upon their own ability and perseverance. He commenced with them as he wished them to commence with the children. He divided the alphabet into three classes of letters, namely, those composed of right lines, those composed of lines and curves, and those composed of curves only, A D C, for example. The object was, first to teach them to draw a clear distinct line of a given length, and then to lead them on step by step to the representation of simple objects. Many of the masters and mistresses thus learnt to draw on the blackboard in a manner which, as they had assured him, had been exceedingly useful to them in after life. When the Department of Science and Art was first founded there was an attempt to teach art on the blackboard by a collective method, in which the master should undertake to instruct 600 boys and girls without the slightest personal attention. This, however, was a failure, though he maintained that it was good as a beginning for the purpose of drilling the children in the elements of form. It must be perfectly clear that as the individual capacity of each pupil began to manifest itself, the pupils must be detailed off into another class, in which they could have that personal attention which was necessary in teaching art. Coming to the practical point which was before the meeting, he believed that we had made a new departure in our mode of national education. Great Britain had at length discovered that it was the duty of the State to educate the children of the State, and he maintained that a system by which the teachers of the public schools should be trained to illustrate simple objects on the blackboard would be of immense value to them, and an immense saving of time. The object ought to be constructed carefully and steadily before the children, so that they could systematically understand the why and the wherefore of the whole diagram. This would no doubt involve a special education on the part of the teachers; and here he came to one of the points which caused a great deal of disappointment about the period of his efforts at Manchester. After the formation of the Science and Art Department, the schoolmasters and schoolmistresses of the country thought that if they devoted a certain amount of attention to drawing, that department of education would recognise their success by giving them a special certificate and paying them upon it. The education department, however, failed to do so, and the teachers lost their interest in the subject. While the present Bishop of Exeter, Dr. Temple, was the inspector of training colleges, he asked him (Mr. Wallis) whether he could devise some system by which masters and mistresses could be tested in their power to draw on the blackboard after they had been taught. His reply was that the only method of testing them was to require them to draw on the blackboard in the presence of an examiner who was himself capable of drawing properly on the blackboard. That scheme, however, unfortunately involved the employment of a skilled examiner, and it had never been carried out. There had hitherto been a neglect of this matter. It was, however, a most essential one, and it would inevitably come up from time to time as education advanced. If once a fair recognition was given of the power to draw on the blackboard, and schoolmasters and schoolmistresses were encouraged to exert themselves and study the question, the results in the education of the children would be very great indeed. The teachers would save themselves and save the children a vast amount of time, notably in writing. In the year 1852 or 1853 a resolution was passed at a meeting of schoolmasters in that very room, to the effect that the teaching and drawing that had been then instituted and carried on for a year and a half by the Science and Art Department in connection with parochial schools, had done vast good in saving time in the teaching and writing alone. He hoped that we should by-and-by have a thoroughly intelligent and practical method of

teaching graphics established in connection with our training colleges, and that schoolmasters would be encouraged to exert themselves in the matter. There would be no great difficulty in carrying it out, provided there were the will and the determination to do it.

Mr. E. A. Davidson said he had been a pioneer in this subject at a period rather subsequent to that of which Mr. Hawkins had spoken, and he was one of the early students at the Government School of Design at Somerset-house. The Exhibition of 1851 opened people's minds to the utter neglect of drawing in this kingdom, and such students as were then in anything like a good position in the school were drafted into a sort of training class. He was either the first or the second person so trained who was sent into the provinces to start the work of teaching drawing. He took his stand upon the principle that drawing was not a merely mechanical art. They had that evening seen Mr. Hawkins drawing upon the board. Did they for one moment think that Mr. Hawkins could produce such a sketch simply through being able to draw? Was it not clear that the hand had in that case acted as the exponent of the mind; and was it not Mr. Hawkins's thorough knowledge of natural history which had enabled him to produce that representation? When he commenced his work in the provinces he went first to Chester; and he found that the public generally were at first disposed to laugh at the whole question, but the training college at Chester took up the subject, owing to the energy of the Rev. Arthur Rigg, and the matter so expanded that though he (Mr. Davidson) went to Chester only intending to have a month's trial of the question, he remained fifteen years. During this time he instructed the schoolmasters who were being trained in the college, and the only difficulty with which he had to battle was their examinations. But an improvement had taken place in that respect, and students in training colleges were now required to draw on the blackboard in the presence of the inspectors. But another practice which was now, he believed, in active operation, and which ought to go far towards carrying out what Mr. Hawkins had advocated, if there were qualified men to teach, was the fact that allowances in marks were made for drawing done, not as a portion of the drawing examination, but in illustration of the subjects in the papers generally. Drawings done in such cases entitled the students to marks which were registered in favour of his drawing certificate. He felt that the difficulty of other teachers and masters of schools of art was that they were not educated in other subjects than their immediate profession. What was wanted in the case of schoolmasters was a more highly-educated body of men. A boy might be taught to draw a cube, or a hexagonal prism, in very good perspective, and to shade it very accurately; but there must be other subjects taught in our schools if we wanted to make drawing a means of conveying the knowledge which was being stored in the pupils' minds. Mr. Wallis had alluded to the certificate money. He (Mr. Davidson) was one of the group who woke up one morning to find the whole value of their certificate money swept away. It was found that the promises made by the Government need not necessarily be kept, and that after men had worked for many years to get their certificates, those documents were a dead letter. Whether the other means of recompensing the teachers were generally satisfactory or not he could not tell. Those means consisted of payment by results. It remained to be seen whether this system was a right one, but it was evident that the dullest boys, upon whom the teachers had expended most trouble, might fail to pass a good examination, and thus bring the teacher no reward. This system remained to be improved upon. He was very glad that the London School Board had taken up drawing, and he believed that this action was owing to the presence of working men on the Board. The schoolmasters of this country were all of them anxious to be shown what the people wanted, and to become possessed of the means of teaching them. He could confirm what Mr. Hawk had said as to the interest which the children took in method of instruction which Mr. Hawkins had ad cated.

Dr. Heinemann said, in all the higher schools England, as far as he was aware, the system of grap teaching had been introduced. In the schools of G many the very baby who was sent to school begai see the things about which the teacher talked; and t system had been introduced everywhere as far as Continent was concerned. He was sorry to beli from some of the remarks which had been made, tha England there existed schools where such a system not prevail. It was sad that any opportunity shoul lost of impressing upon people the necessity of the being occupied as well as the ear. He understood the argument of the latter part of the lecture was the teacher should not only illustrate his subject means of diagrams, but should show the pupils be their own eyes how the things grew, but in order t so it would be necessary that he should be acquai with the essence of the thing. In following out method indicated by the lecturer, the teacher who only knew how to draw, but also knew the thing it would do a great deal of good.

Mr. C. Mast said, as one who had been eng in teaching in this country for more than twenty y he was extremely pleased to hear discussed suc method of teaching as the one in question. W regard to the graphic method, he agreed with ne everything which the reader of the paper had sta but, at the same time, one so enthusiastic as Mr. H kins was likely to go a little too far. The main o of teaching was to convey sound and correct knowl to the pupils, and one of the principal means of doin was to bring the direct object itself before the chil This should be done if possible. The article ough be brought before the children, and the graphic me ought to be restricted chiefly to articles which could be brought before them. Some remarks had been m as to the close connection between writing and draw and, in consequence of this connection, both sub should be taught at once. If this was done, wr would no doubt be taught more quickly than at pre In the Crystal Palace there had been a falling off the original idea. Nobody now went there to loo the fine statues or objects of art. It had become pu a place of entertainment. It was a very great pity the grandest institution which any country poss had been thus degraded by a pandering to the l tastes of the multitude.

Mr. James Heywood, F.R.S., instanced the m of the extinct animals in the Crystal Palace a example of the vividness of the ideas which migh conveyed by graphic teaching. As to the manage of the Crystal Palace at the present day, there still many matters of interest connected with it. aquarium, for instance, was a valuable means of struction. With regard to drawing there were great efforts being made at the present time. world was moving on. He did not think they exactly stationary, and, in fact, a great deal had done already.

Dr. Heinemann, as a professor at the Crystal P School, wished to state that, as far as he was abl judge, that school did a great deal of good. There nearly 500 lady students, who were taught not in mentary subjects only, but in the higher subjects.

Mr. J. Sparkes felt forced to put in a protest ag a supposition which Mr. Hawkins had made. calmly proposed that every teacher in an elemen school should be able to make a diagram of the which he had made on the blackboard. Such a th was simply impossible. We had not such talent such gifts spread broadcast over the country, and

schoolmasters of the elementary schools, moreover, were of men who were able to reckon all the natural sciences amongst their acquirements. The class from which the national schoolmasters were drawn did not afford much hope of their being able to comply with what Mr. Hawkins had suggested. If the masters were to be expected to have such qualifications they must be taken from a higher class, and be better paid. A man who could make a diagram like the one before them on a blackboard would not long remain a national schoolmaster.

Mr. W. Trewby suggested that teachers competent and trained for the graphic system of teaching might go about giving lessons at regular periods in various schools, according to the practice which prevailed among teachers of French and drawing and other subjects of study.

The Chairman said, though he agreed with Mr. Hawkins that they could not expect every schoolmaster to be a Cuvier, or a Profesor Owen, or a Waterhouse Hawkins, they might yet expect a very great advance and improvement upon the class of men they had hitherto had as masters of elementary schools. With regard to drawing generally, there was a fatal facility in this country of manufacturing artists, for art had become fashionable amongst a class of men who had more money than judgment and taste. In looking upon modern exhibitions of pictures, he had upon the whole experienced more pain than pleasure. There were some would-be artists who put their works before the public and found purchasers, though they were painted by men who had never been in a school of any sort. If he went to the theatre he could see by the scenery that the scene-painter necessarily had some knowledge of perspective and shadow; but if he went to some exhibitions he found that the ideas of the artists on those points were in a hopeless muddle. With regard to the power of expression, the words of Mr. Hawkins ought to be impressed upon every individual mind, that that power was not so much in the line as in the combination of lines which gave the development of the mind. Those who wished to know what could be conveyed by a few lines of sketch or etching ought to see the etchings or unfinished sketches of some of our greatest men. A wonderful example was Landseer's "Sick Monkey."

Mr. Hawkins, in reply, said he had been a little misunderstood by the gentleman who thought that he was demanding too much from the schoolmasters. He only expected that to be done which had been done by himself and by several imitators who adopted his system in America during his six years sojourn in that country. At the same time he should be sorry to convey the false impression that he disparaged a teacher whose talent was displayed in the words he uttered. He did not intend to demand that there should be great facility in making sketches, but he did cling to the idea that was expressed in the discussion at the London School Board last September. The idea was that a person should go round to the schools to lecture and discuss the question, and give useful hints. The schoolmasters might then take it up in earnest for the purpose of expressing by hand that which was really the thought of the mind. He should be sorry that it should be supposed that he wished to throw difficulties in the way of a class of teachers who were already overworked and underpaid.

On the motion of the **Chairman** a vote of thanks was accorded to Mr. Hawkins.

In California a large and increasing trade is carried on in curing or drying fruits, which at one time was done by exposure of the fruits to the air. This, however, has been superseded by the process of desiccating with a blast of hot air. By this means the fruits retain all their freshness of flavour.

MISCELLANEOUS.

INDIA-RUBBER PRODUCING PLANTS.*

Those trees belong to the three following families:—1st, *Euphorbiaceæ*, comprising especially the *genera Hevea*, and *Siphonia*, different species of which are indigenous to the warm and damp portions of the Amazon basin as well as the Brazilian province of the Rio Grande. The two trees which are the most used for this purpose are the *Hevea quianensis* and the *Siphonia elastica*; 2nd, *Artocarpeæ*, a natural order to which belong the tree named Ulé (*Castilloa elastica*) which grows in the Gulf of Mexico as far as Guayaquil, and several fig trees indigenous to India, Java, and the north of Australia; 3rd., *Apocyneæ*, a family in which we find representatives in the south of Brazil, Equatorial Africa, Madagascar, Malacca, and Borneo.

The best india-rubber is that from Para, in which country the harvest commences in the month of August and is continued in the months of January or February. The milky juice of the *Hevea*, which is the chief source of the rubber, becomes too watery during the rainy season for being then collected; in the fine season this juice, as soon as it runs from the incisions made in the trees, has the colour and the consistency of cream; the caoutchouc proper soon becomes hardened, and separates itself so as to be suspended in an opaline liquid. It is in the evening, as a rule, that the incisions from which juice is to run is made in the trees, and it is on the following morning that persons go to collect the juice which has flowed out. The Para caoutchouc is more tenacious, purer, and more durable than other kinds; thus it is especially employed in the manufacture of articles which should unite strength with elasticity.

Among the trees which yield caoutchouc of second quality, the most useful is the ulé (*castilloa*), which grows in abundance in Central America, and in the western part of South America, as far as Peru. This india-rubber tree flourishes particularly well in forests with an undergrowth of brush-wood, which are at the same time hot and damp. It arrives at its greatest perfection in the basins of Lakes Nicaragua and Managua. The juice of the ulé runs during the whole year, but is best in April. A tree of fifty centimetres, or nearly twenty inches in diameter, properly managed, is capable of yielding 20 gallons of juice, which gives about 25 kilos. (55 lbs.) of india-rubber. As a general rule, the coagulation of this milk is effected by the addition of certain vegetable juices.

The caoutchouc becomes separated in the form of a brown and soft substance, with the odour of fresh cheese. In the district of Saint John, in Nicaragua, there are 600 to 800 persons engaged in drawing off the caoutchouc; about 2,000 may be reckoned in the neighbourhood of Panama, where the reprehensible practice prevails of felling the trees for obtaining the milky juice.

The worst caoutchouc is that of Guatemala, which is more or less mixed with resinous substances. The Guatemala india-rubber is, besides, of unequal quality; the best is whitish, and the worst spongy. The south of Brazil, between 18 and 19 deg. of S. latitude, produces a good caoutchouc known under the name of Pernambuco rubber, which is derived from several species of the *Hancornia*. These trees, about the size of our apple trees, have pendant branches with narrow leaves, which give them the appearance of weeping willows.

In Asia, the principal india-rubber tree is the *Ficus elastica*, which is found especially in Assam, India (on this side of the Ganges), in Java, Sumatra, and other places. This is the species which especially produces what is called the Singapore rubber; but under this

* Journal de la Société d'Horticulture.

name is also sold that of the *Urecola elastica*, a climbing species which attains an immense length. To obtain the juice of this plant, it is cut in logs, one end of which is heated; this caoutchouc is of very inferior quality. The Madagascar rubber, obtained from a creeping shrub, is very good, and is worth nearly as much as that of Para; this kind is especially used in France. Equatorial Africa is rich in trees and climbing shrubs which produce caoutchouc; but it is drawn from the wood, and prepared so carelessly, that the product is of very bad quality.

Although the trees which yield caoutchouc are very numerous and widely spread over different countries, the method of preparation is often so primitive and wasteful that there is every reason to fear that, in a not far distant future, this substance, which it would be impossible to do without, will become more and more scarce and ultimately fail altogether. It therefore becomes a matter of the highest importance to place the preparation of india-rubber under proper regulations, strictly enforced, or to plant and cultivate young trees in the place of those of spontaneous growth, which are destroyed in large quantities every year.

VIENNA EXHIBITION.—ITALIAN JURY REPORT ON FOREST PRODUCTS.

The reports of the Italian jury at the Vienna Exhibition are now being published by the Minister of Agriculture and Commerce. That on the "Products of the Forest," by Signor G. C. Siemoni, contains a vast amount of information on this subject. It appears that the area of the woods and forests of those countries t took part in the exhibition at Vienna was as follows

	Hectares.		English a
Russia	190,074,159	..	469,483,
Norway and Sweden	30,569,000	..	75,505,
Austro-Hungarian Empire	14,791,717	..	36,535,
German Empire	14,154,262	..	34,961
Roumania	8,000,000	..	19,760
Italy	5,025,893	..	12,413
Spain	4,747,059	..	11,725
Switzerland	786,900	..	1,943
Portugal	561,000	..	1,385
Belgium	434,896	..	1,074
Greece	350,770	..	860

In the above the extent of forests in France is given, as she took no part in this exhibition as reg forest products, a fact much to be regretted, particu as she made such a splendid show in this branc Paris in 1867. Some statistics which, however, di take into consideration the annexation of Nice and S or the loss of Alsace and Lorraine, give the area of forests of France at 612,750 hectares, (5,513,492 a Italy, as has been shown, occupies the sixth place o list, and the extension of her forests stands in the position of 17·64 per cent. of the entire area of kingdom, whilst the amount of country covered forests in the Austro-Hungarian Empire is 23 per Sweden (not including Norway) 42 per cent., Roumania 53 per cent.; Portugal and Greece as comp with their area are less wooded than Italy.

The forests of Italy are distributed throughout kingdom in the following manner:—

REGION.	Population.	Area.		Proportion of extension of forests as r	
		Territory.	Forests.	Population.	Extent of Ter
		Hectares.	Hectares.		
Piedmont and Liguria	3,535,736	3,432,798	638,316	18·05 per cent.	18·59 per
Lombardy	5,601,280	4,718,982	846,749	15·11 „	17·94 „
Modena	490,645	539,025	57,186	11·65 „	16·09 „
Parma	474,598	573,945	153,053	32·24 „	26·66 „
Tuscany	1,997,067	2,403,409	634,355	32·24 „	26·38 „
Ex-Papal States, not including Roman Provinces	2,436,683	2,934,475	427,272	17·12 „	14·55 „
Naples	6,787,289	8,530,959	1,097,927	16·18 „	12·87 „
Sicily	2,392,414	2,924,024	125,513	5·24 „	4·29 „
Sardinia	588,064	2,425,018	1,045,022	77·79 „	13·12 „
Totals	24,273,776	28,482,335	5,025,893	..	..

Some idea may be formed of the vast extension of forests in the Austro-Hungarian provinces from the quantity of timber exported in 1865, which amounted to not less than 1,900,000 cubic metres, representing a value of about a million sterling. This amount is far inferior to what it might be, as for want of roads and means of transport in many of the mountainous districts large tracts of forests are absolutely unproductive. The value of the timber felled in the German Empire amounts to 265,838,400 marks yearly; and to give some idea of the quantity of gold representing this sum, a cube measuring 1·70 metres each way of wood gilded was exhibited, its cubic contents being equal to 4·397 metres.

The annual production of timber in France is estimated by some authorities at 36 millions of cubic metres, and by others at 20 millions, of which 18 millions of cubic metres are firewood. As the consumption amounts to upwards of 55 millions of cubic metres, of which 10 millions are of building timber, and 45 millions of firewood, and taking the lowest estimated production, there is a deficiency of 35 millions of cubic metres yearly. To meet this about 70 millions of francs were exp in 1857, and 157 millions of francs in 1865, from must be deducted 31 millions of francs, which rep the value of the exports of timber from France.

The total value of the forests of European Russi extremely little is known respecting the Asiatic p sions of that vast empire) amounts to 160 million r (£25,600,000) annually.

The production of timber of Sweden is estima 30 millions of cubic metres, while that of Norway in was 2,993,989 cubic metres.

With regard to Italy, there are unfortunately r liable statistics as to the annual production of timb

Although in that department the number of It exhibitors was extremely limited, it is satisfacto find that the show made by them in this section w superior to that which has been made by them in former exhibitions, as the number of rewards giv Italian exhibitors bears evidence. In fact out o ten exhibits in this section prizes to eight were awa

The most important exhibit in the Italian section

that of the forest administration, which consisted principally in a collection of all the different kinds of trees grown in Italy, commencing with the larch, beech, and pines, and gradually approaching the flora of Africa, with the pistachio, the palm, the date palm, the broom of Etna, not to mention those trees that are more especially cultivated in the south, such as the orange, the lemon, the olive, the carob, &c. This collection was admirably arranged by the Institute of Forestry of Vallombrosa. A collection of fruit was also shown, together with a complete series of dried plants, representing all the known varieties indigenous to the peninsula. The grand diploma of honour was awarded to the Italian Forest Administration for this exhibit.

Amongst the industries associated with forestry may be mentioned the manufacture of utensils for domestic use, such as spoons, platters, &c., made from beech, lime, and other woods, which is carried on in some of the mountainous districts in Italy.

Amongst the most important productions of the forests of Italy, that of sumach and manna, cultivated in Sicily, certainly occupy the first place. The cultivation of sumach in the province of Palermo, has increased nearly threefold during the last four years, and at the present time no less than 2,030 hectares (5,014 acres) are devoted to its growth in that province alone, which may be attributed to the little amount of trouble and the large profit that it yields. The total production of sumach in the province of Palermo at the present time is estimated at 39,310,780 kilos. annually. To this production is allied its preparation for the market, and in this province alone 11 steam-engines are employed for grinding the leaves of the plant. The export of sumach from Palermo in 1872 was 21,354,039 kilos. The average price of this substance is 31 francs per quintal in powder, and 26 francs per quintal in leaf.

Manna is the concrete saccharine juice of the *Fraxinus Ornus*, a tree much cultivated in Calabria and Sicily. In the province of Palermo, 2,070 hectares (5,113 acres) are cultivated for this product, the export of which in 1872 amounted to 94,238 kilos. The average price of manna in sticks is 8 francs per kilo., whilst that in lumps varies from 1·60 to 5 francs per kilo.

The products of Africa were represented by Algeria, which alone has an extension of 1,440,000 hectares of forests (3,556,800 acres). In that country the cultivation of the *Eucalyptus globulus* (about which so much has been said and written lately) has been introduced with most successful results. Asia was represented by Japan and India, whilst America contributes a most interesting collection of timber from Brazil, amongst which occupied a conspicuous place a gigantic trunk of the *Araucaria braziliana*, 40 metres in height.

It is announced that renewed experiments are to be made at the Royal Arsenal, Woolwich, with various kinds of fog signal guns, with the object of devising some system of giving them varying sounds when fired. The success attending the first experiment has induced the committee to order considerable enlargement of the parabolic mouth of one of the guns then employed; it will, in fact, correspond in shape with a horn, and it is expected that when fired it will produce a horn-like sound.

The Channel Tunnel Company have given notice of their intention to apply to Parliament, during the ensuing session, for power to take lands at the foot of the cliff in St. Margaret's Bay, about three miles from Dover, in the parish of St. Margaret-at-Cliffe, and all the beach and foreshore between Ness Point and Coney Burrow Point, for the purposes of their undertaking. Should they succeed, the works will be immediately proceeded with.

There is an idea afloat of supplementing the Transcontinental line of electric telegraph between Port Augusta and Port Darwin, in Central Australia, by a tramway, to be worked by horses, for about 2,200 miles.

CORRESPONDENCE.

PROTECTION TO INVENTIONS.

SIR,—I have waited for the termination of the interesting discussion on Protection to Inventions and Mr. Bramwell's reply before addressing you a few observations which may be of service to all who desire the amendment of the present law of patents. I had hoped that some other opponent of the system of patents would have been present and assisted Mr. Horatio Lloyd in his criticisms of Mr. Bramwell's paper, and anticipated many of the objections I am about to make.

The paper has not only been pronounced able, but exhaustive; as far as the ability is concerned everyone will agree, but as Mr. Lloyd said, it shows the ability of the skilled advocate aided by great practical knowledge of the subject from one point of view. In dealing with the opponents of patents this is particularly apparent. Before entering upon the argument of his opponents, Mr. Bramwell takes care to enlist the sympathies of his hearers in favour of a system of pecuniary rewards being necessary to call forth great inventions, by enumerating a few which were undoubtedly patented, but ignoring the many which have been made without the incentive of patents. When we remember that all the most useful tools, the smelting of ores, the manufacture of glass, paper, pottery, ink, &c., railways, tanning, weaving, dying, printing, all these and many other things were invented without patents, it surely betrays a great want of respect for the reasoning powers of his audience, when Mr. Bramwell asserts that because some great inventions have been made by outsiders who have taken out patents, therefore "to continue this, the highest class of invention, protection is an absolute necessity." But, without going back to the older inventions, I maintain that the greatest discoveries and inventions of modern times do not owe their existence to patents. If Wheatstone and others contributed to the success of the application of electricity to telegraphy, so did Ronalds, Faraday, Oersted, Gauss, and a host of others, who never claimed any pecuniary reward for their discoveries. If modern agriculture has been improved by the application of machinery to the soil, it has been more permanently improved by the application of chemistry, owing principally to Liebeg, who never patented his suggestion of making the phosphates soluble by the addition of sulphuric acid, although this suggestion gave rise to the manufacture of superphosphates and artificial manures. In fact, if Mr. Bramwell's paper had not received such encomiums from the press, it would be unnecessary to notice the puerile arguments which he uses on this question of great inventions. Nobody, I believe, denies that patents stimulate minor improvements and hasten the adoption of new processes of manufacture which require the expenditure of capital to bring them to perfection. The real question in dispute between those who defend and those who oppose patents is whether the advantages obtained by the community by putting a stop to secret manufacture, hastening improvements, and inducing outsiders to push forward improved processes, outweigh the evils arising from the monopoly given to individuals by the patent system.

This is the question Mr. Bramwell discusses in the second part of his paper, and he enumerates some alleged evils of the patent system. Now, notwithstanding his disclaimer in his reply, in which he asks for his omissions to be specially pointed out, I maintain that he has certainly failed, probably through ignorance, in fully stating his opponent's case. I am inclined to think that, as he says he has read Mr. Macfie's book only since he wrote his paper, his ignorance of the arguments against patents is real and not assumed. How else can we account for the absence in his original paper of all

mention of Lord Selborne, Mr. Justice Grove, and Sir W. Armstrong, who, after long experience of the system of patents, have been brought to the conviction that the evils are so great and so inherent, that unless the system can be materially altered in its working it had better be abolished at once.

As to the evils which he enumerates, some of them he makes light of, and others he states in a form most convenient for refutation by counter assertion, but he fails to remind his hearers that, whatever these evils may be, they touch a great many people, thus ignoring the principle which lies at the bottom of the discussion, that as inventors are few, but the people who use inventions are many, the onus of proof lies with those who advocate monopoly, and that the advantages must be great of a law which, in the words of Mr. Rogers, can confer a right on one person only by inflicting a wrong on a number of others. Mr. Bramwell evidently cannot have read Mr. Groves's evidence before the Select Committee, who says "That the evil of the Patent-law is divided among a large mass of the public; it is frittered away, and therefore cannot be very pointedly represented. Whereas the evil to the inventor (when you get, as you do get, very hard cases) is a single case, which is an apparent strong grievance. The grievance is an abuse which strikes the world very much; but the discriminated injury to the public, on the other hand, by obstructive patents, is so minute when spread over the whole community, that it is unobserved." When enumerating the evils, it would have been well if Mr. Bramwell had alluded to this view of the question which intensifies all the evils he does mention.

As it would occupy too much space to consider each of the evils separately, let us see how Mr. Bramwell deals with a few of those evils specified. The first evil he calls interference with trade. It would have been more to the purpose, if instead of using this rather vague expression, he had said, "By granting a monopoly to an individual you put it into his power to restrict trade, and if he chooses, to put a stop altogether to certain trades." If Mr. Bramwell will refer to my evidence before the Select Committee he will find that I named instances where this was done partially or wholly. In one case I pointed out that if the Runcorn Soap and Alkali Company had not had the courage to contest a patent granted to Mr. Henderson, all consumers of pyrites would have been forced to obtain their supplies from one source, viz., the Tharsis mines in Spain, for with the monopoly of the copper extraction, no other company could have competed with them. It may seem a small thing this, to Mr. Bramwell, but if he will only for a moment consider the importance to every trade in the country of a cheap supply of sulphur, iron, and copper, that such trades as the alkali trade, artificial manure manufacture, all chemical industries, the manufacture of soap, glass, paper, cotton, wool, &c., are directly or indirectly affected by the price of sulphur, perhaps he will allow that granting a monopoly in the shape of a patent does not interfere with trade; and to crown all, in the two cases I cited, the patents were invalid but nevertheless of great value to the holders of them, although obstructives to the trade generally. Connected with this case the sixth evil may be considered, viz., that the existence of patents gives rise to expensive and difficult litigation. Here again Mr. Bramwell does not state the whole evil. The case of the Runcorn Company v. Henderson cost a considerable sum of money, but it was not the money spent in litigation which caused the greatest evil. In my evidence I stated that my firm and many others were ready to work the process which was the subject of contention, but, owing to the annoyance of possible litigation, we were prevented, and it was quite an accident that a firm was found courageous enough to contest the patent. The evil is measured, not by the few cases which come before the courts, but by the fear of litigation, preventing manufacturers making use of processes or machines which are not properly the invention of those who hold the patent right, and, indeed, i most cases ought not to be the subject of any pate whatever. Most manufacturers have sometimes be called upon to pay for the use of so-called inventio which have been patented, and if they do not care run the risk of litigation, are generally content to pay forego the use altogether; and yet Mr. Bramwell thin it a sufficient answer that the number of patent ca tried is only one-third of 1 per cent. of all cases tr and heard. If Mr. Bramwell will refer to the evide given before the Select Committee, he will find that m of the witnesses complained, not so much of the v patents for real inventions, but of the number of fri lous and invalid patents which, owing to the fear litigation, were just as useful to the patentees and as structive to industry as the valid ones, which they outnumbered.

In his reply to the charge that a patent for an inv ing by barring the road stops further invention, Bramwell simply begs the question by asserting (wh is not the case practically) that the law does not the inventor a patent for all the modes of obtaining end, and that all inventions which do not clash this can be freely used. You will note this is merel assertion of Mr. Bramwell's, who does not say he had any practical experience of the law. Let us what Sir W. Armstrong has to say on this point. is scarcely possible to strike out in any new direc without coming in contact with patents for scheme crudely developed as to receive little or no accept from the public, but, which, nevertheless, block road to really practical improvements." Here we the testimony of an engineer, but with chemical metallurgical processes this is even more frequently case. Mr. Justice Grove says:—"When I had time to devote to chemistry, electricity, photography, than I have now, I doubt whether there was a s day—certainly not a week—in which in my am laboratory I did not infringe patents, and in law I liable. I do not believe myself that there is a s working chemist now, or a single experimental m facturer, who every week or month does not, and not, infringe many patents."

As a chemical manufacturer on a large scale, I corroborate this, and in my evidence will be found which fully sustain my assertion. Such a long disc as Mr. Bramwell's would require an equally long for a full reply. I trust what I have written wil sufficient to show that there is a reply, and to prove he very inadequately showed the evils inherent in present system.

As for the remedy, many of the suggested amendm are likely to diminish some of these evils, but persuaded that unless the alteration in the law practice of the law goes at least as far as the sugges of Mr. Justice Groves, which would diminish the nu of patents very considerably, little will be done to r the patent system endurable. As in all monopoli many who suffer are generally disunited, those who or fancy they gain are united, and until the evils be positively past endurance, their union will tend continuance of the monopoly.

The question of protection to inventions in this many other respects greatly resembles protection dustry.—I am, &c.

Edmund Knowles Muspra

Liverpool, 6th January, 1875.

COLOURED MARBLE.

Sir,—In the *Gentleman's Magazine*, Vol. 38, reference was made to a Prince de San Seve Naples, who had learned to give a fixed tint of colour to white marble, so as to penetrate the mass, spective of any thickness, so that the figure o Virgin, painted on a cube of white marble, two

figure, was impressed on all the leaves sawn from the block. But, prior to 1660, an Englishman named Bird practised this art with success. Several specimens of marble thus coloured were shown to Charles II., and broken in the King's presence, so as to prove such success. In the year 1745 the wife of a stonecutter named Long, of Bow, in Essex, also performed the art with success. At Oxford specimens of the coloured marble were also seen. The plan or recipe was to take 2 ozs. of aqua-fortis and 2 ozs. aqua regia, of sal ammoniac 1 oz., and 2 drachms of spirits of wine; also 2 drachms of pure silver, with gold to the value of 4s. 6d., A.D. 1745. The silver having been calcined and placed in a vial the aqua-fortis was poured upon it. The silver having evaporated, a watery mixture was produced, yielding a blue, and then a black colour. Then the gold was calcined and placed in a vial, and the aqua regia having been poured upon it the mixture was placed aside to evaporate. The spirit of wine was then poured upon the sal ammoniac and allowed to evaporate. The result of the mixture was stated to be a fine golden-coloured water, of divers colours. With these fluids pictures might be painted on soft, white marble, the figure being renewed daily with fresh fluid. Thus a picture, drawn on the surface of the marble, would appear even in its inmost parts.—I am, &c.,

CHR. COOKE.

Headington, Oxon, Jan., 1875.

GENERAL NOTES.

Philadelphia Exhibition.—Mr. Forster, speaking on the 15th inst. at a meeting of the Bradford Chamber of Commerce, said that while he thought that in this country we had been "exhibited enough, and had had exhibitions enough," he should be sorry to see Great Britain refrain from taking a hearty and earnest part in the Philadelphia Exhibition of last year. There were several reasons why we should do so, even if we were rather tired of exhibitions. America was our most important customer, and we wished the commerce to be still greater; the Americans were very friendly towards us; the proposed exhibition might afford an opportunity of coming to some agreement with them on the subject of the Patent-laws; and we might be able to convince them of the value of free trade. With respect to the failure of the negotiation of the Reciprocity Treaty between Canada and the United States, the right hon. gentleman said that while he would be pleased to see the trade of Canada increased, he did not think that either we or the Canadians had much cause to lament the failure to conclude the treaty, and he strongly suspected that the spread of free trade between the two countries, and between the two countries and England, was the more likely in the event of the withdrawal of the treaty.

New Material for Casts.—We noticed a short time ago (says the *Academy*) a French invention by means of which plaster casts might be made more durable and of greater excellence. We are now informed of a German discovery of a new plastic material that will, it is said, supersede the use of plaster altogether. The constituents employed are entirely of a mineral nature, and yield, when mixed together, a smooth hard white mass capable of a high degree of polish. The material is especially adapted for taking casts of such objects as are required to withstand the influences of the weather, and the finest and most delicate work can be reproduced in it quite as well or better than in plaster. It is also spoken of as affording an excellent ground for stereo-chromic pictures on account of its great hardness and strength. As it is fire-proof as well as water-proof, a coating of it may be used to protect wood carvings and other inflammable decorations of a building. Even light gauze and muslin hangings are rendered quite fire-proof by it. This latter quality was tested recently at the Munich Court Theatre, and it was found that stuffs or wood treated with it were rendered absolutely incombustible. The invention has been patented by Herr Walz, a merchant of Pforzheim, and Herr Kreittmayr, the curator of the Royal National Museum of Munich.

Adulteration of Scammony.—A large trade has hitherto existed between Aleppo and England in extract of scammony; but we are told that comparatively little is now exported. "On account of its mixture with other substances," only twenty cases in all, weighing 2,100 lbs., were shipped during the past year, the value of which was £1,680. and the whole of this came to England. In the previous year 737 cases were exported, showing that adulteration alone is rapidly driving this article out of the import market, for the roots are produced as abundantly as ever, and are dug up and sent to England, the extract being procured from them in this country. 467 cases, weighing 93,340 lbs., and valued at £362, were shipped from Aleppo to England in 1873. Considering the bulk and weight of the roots as compared with that of the extract and the consequent increase of the cost of freight, it would seem that this exportation of the roots themselves can scarcely be a profitable trade to the shippers, inasmuch as 467 cases are valued only at £362, while 20 cases of the extract are worth £1,680.

Coal and Iron Industry of Charleroi.—The report of the Chamber of Commerce of Charleroi, which has just been issued for 1873, contains some important observations on the mineral industry of Belgium generally, and of the Hainault in particular. It appears from this report that the number of blast furnaces in activity during 1873 was 31; in 1872 there were only 30, and in 1871 only 27. The quantity of pig-iron produced in the year was 364,760 tons, or 35,290 tons less than the corresponding production for 1872. The number of rolling mills in this group last year was 22, comprising altogether 431 puddling furnaces, 156 re-heating furnaces, and 249 steam-engines, of a collective force of 7,275 horse-power. The number of workmen employed was 8,005, and the production of rolled iron effected during the year was 231,029 tons. The establishments for working iron existing in the Charleroi group were 18 in number. The value of pig-iron manufactured in the year in the Charleroi district was £2,005,686, and that of rolled iron £2,752,321; in all, £4,758,007. The report states that the number of collieries in activity in that group in the year was 56, having 112 centres of working. The number of extraction engines was 177, of a collective force of 10,226 horse-power; and the number of ventilating engines was 146, of a collective force of 4,507 horse-power. There were besides 222 engines for miscellaneous purposes, of a collective force of 2,063 horse-power. The number of men employed below ground in the Charleroi basin was 31,896, while the number employed above ground was 11,513. The extraction of coal effected during the year was 6,614,500 tons. The wages paid to workpeople amounted to £2,532,964, and the other working expenses to £1,711,443.

The Horse-power of the World.—Dr. Engel, director of the Prussian Statistical Bureau, has been making estimates on such statistical data as are available of the total horse-power of steam engines in the world, as every country has tolerably correct railroad statistics. Dr. Engel thinks that the following returns with reference to locomotives are not far from right:—

	Year.	Number.
United States	1873	14,223
Great Britain	1872	10,933
Zollverein	1871	5,927
Russia	1873	2,684
Austria	1873	2,369
Hungary	1869	506
France	1869	4,933
East Indies	1872	1,323
Italy	1872	1,172
Holland	1872	331
Belgium	1870	371
Switzerland	1868	225
Egypt	1870	212
Sweden	1872	185
Denmark	1865	39
Norway	1871	34
Total		45,467

It may be assumed that there are still four or five thousand additional locomotives in countries from which no statistics have been received, so that something like fifty thousand engines of that description, of an aggregate of 10,000,000-horse power, are now in use. Dr. Engel estimates all the engines in use, locomotive, marine, and stationary, at about 14,400,000-horse power.

Merchant Navies.—The *Magdeburg Gazette* publishes statistics showing that, although the German navy consists at present of only twenty-three vessels, with sixteen gunboats and six torpedo boats, the mercantile marine ranks next to those of England, America, and France. It consists of 219 steamers of 165,178 tons, and 263 sailing ships of 1,143,810 tons. The former have increased since 1867 by nearly 50, and the latter by more than 20 per cent. It has nearly reached the strength of France, which has 316 steamers of 240,275 tons, and 4,951 sailing vessels of 906,705 tons, its tonnage having thus already exceeded that of the French marine. England and its colonies have 4,343 steamers of 1,641,000 tons, and 32,461 sailing ships of 5,573,000 tons, while America has 3,625 steamers of 1,048,205 tons, and 17,049 sailing ships of 2,146,585 tons. Next to Germany comes Russia with 185 steamers of 36,000 tons, and 3,089 sailing vessels of 771,292 tons. Austria has 97 steamers of 52,005 tons, and 2,692 sailing vessels of 288,176 tons. Sweden has 406 steamers of 22,000 tons; Italy, 118 steamers of 37,810 tons, and as many as 19,488 sailing vessels of 1,031,907 tons; and Spain, 151 steamers, mostly colonial, of 45,514 tons, and 4,363 sailing ships of 345,186 tons. The merchant navy of Germany is manned by 90,000 sailors, while that of France has 96,000.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

JAN. 27.—"The Mercantile Marine of Great Britain," by Capt. BEDFORD PIM, R.N., M.P.

FEB. 3.—"The Protection of Buildings and Ships from Fire, with Arrangements for the Ventilation of Ships," by J. A. COLEMAN, Esq., C.E.

FEB. 10.—"The Sandblast and its Adaptation to Industrial Purposes," by WM. NEWTON, Esq.

FEB. 17.—"Description of M. Kastner's New Musical Instrument, the Pyrophone," by M. DUNANT. The instrument will be exhibited.

FEB. 24.—"The Art of Illustration as applied to the Printing Press," by HENRY BLACKBURN, Esq.

AFRICAN SECTION.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

JANUARY 26.—"The Expedition up the Niger in the *Investigator*," by Capt. KNOWLES, R.N.

INDIAN SECTION.

Friday Evenings, at 8 o'clock. The following arrangements have been made:—

JANUARY 22.—Opening Address, on "The Objects to which Effort might Properly be Directed," by Sir GEORGE CAMPBELL, D.C.L., K.C.S.I.

FEBRUARY 12.—"The Possibility of Adapting the Roman Alphabet for the Languages of India," by FREDERICK DREW, Esq.

CANTOR LECTURES.

The first course of Cantor Lectures is on "Alcohol: Its Action and its Use," by Dr. B. W. RICHARDSON, F.R.S. The following are the remaining lectures of this course:—

LECTURE V.—MONDAY, JANUARY 25TH.

The secondary action of Alcohol on vital functions.—Physical deteriorations of structure—general and special—incident to its excessive use.

LECTURE VI.—MONDAY, FEBRUARY 1ST.

Influence of Alcohol on the nervous organisation, with special reference to the mental phenomena ind[uced] by its use.—Summary.

Members are privileged to introduce *two* frie[nds] to each of the Ordinary and Sectional Meeting[s of] the Society, and *one* friend to each Cantor Lect[ure].

ISSUE OF MEMBERS' TICKETS.

Tickets for the African Section during [the] Session 1874-5 are issued with this *Jour[nal]*. Members have the privilege of admitting [two] friends to each Sectional Meeting, and [the] tickets can be filled in for one or two person[s as] required. In no case can more than two fri[ends] be invited to one lecture. The dates of [the] meetings will be duly announced in the *Jour[nal]*, and members are particularly requested to fil[l in] the dates when issuing the tickets.

SCIENTIFIC MEETINGS FOR THE ENSUING WE[EK].

MON. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 (Cantor Lectures.) Dr. B. W. Richardson, "Al[cohol:] its Action and its Use." (Lecture V.)
Royal Geographical Society, University of London, [Bur]lington-gardens, S.W., 8½ p.m. Rev. Dr. Mulle[ns], "The Central Provinces of Madagascar."
Entomological, 12, Bedford-row, W.C., 7 p.m. A[nniversary] Meeting.
Institute of Actuaries, 12, St. James's-square, S.W., [7 p.m.] Mr. A. H. Bailey, on "The Expenses of Life Ass[urance] Companies; How they Affect the Assured."
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m.
Social Science Association, 1, Adam-street, Adelphi, 8 p.m. Mr. Thomas Webster, Q.C., F.R.S., on [So]cieties and Associations for the Amendment, Co[dification] of, and Instruction in Law, with Suggestio[ns for] their Co-operation."

TUES. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., (African Section.) Captain Knowles, R.N., on [The] Expedition up the Niger in the *Investigator*."
Royal Institution, Albemarle-street, W., 3 p.m. [Mr.] Ray Lankester, on "The Pedigree of the Animal [King]dom."
Medical and Chirurgical, 53, Berners-street, O[xford]-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westmi[nster], S.W., 8 p.m. Continued Discussion on "The [Con]struction of Gas Works."
Anthropological Institute, 4, St. Martin's-place, 8 p.m. Annual Meeting.

WED. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 Captain Bedford Pim, R.N., M.P., on "The Merc[antile] Marine of Great Britain."
Geological, Burlington House, W., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, 8 p.m. Mr. Percy Gardner, on "A Greek Inscr[iption] Found at Ilium Novum, in the Troad."
Archæological Association, 32, Sackville-street, W.,

THURS....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. P. M. Duncan, on "The Grander Phenomena of Ph[ysical] Geography."
Philosophical Club, Willis's Rooms, St. James's, 6 p.m.

FRI.......Women's Education Union (at the HOUSE OF THE SO[CIETY] OF ARTS), 3 p.m.
Royal United Service Institution, Whitehall-yard, Major-General Sir Frederic J. Goldsmid, "Jou[rney] from Herat to Khiva."
Civil and Mechanical Engineers' Society, 7, Westmi[nster] chambers, 7½ p.m. Mr. W. F. Butler, "Report o[f the] Rivers' Pollution Commission."
Royal Institution, Albemarle-street, W. 8 p.m., W[eekly] Meeting. 9 p.m., Professor Huxley, on "Recent [Work] of the *Challenger* Expedition, and its bearing on [Geo]logical Problems."
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p[.m.]
Junior Philosophical Society, 6A, Victoria-street, 7½ p.m. Mr. L. Franklin, on "The Crusades, and [their] Connection with the Society of the Middle Ages."

SAT.......Royal Institution, Albemarle-street, W., 3 p.m. J. T. Wood, on "The Discovery of the Temple of D[iana] and other Results of the Government Excavatio[ns at] Ephesus."
Tonic Sol-fa Teachers' Association, 165, Aldersgate-st[reet], 8 p.m. Mr. Longbottom, "Studies of Musical Co[mpo]sition."

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FRIDAY, JANUARY 29, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FIRES AT SEA.

The Council have decided to offer the Society's Fothergill Gold Medal for an effective means of extinguishing fire on board ship, and they have directed the Secretary to enter into communication with leading ship-owners, with the view of enlisting their aid in this important matter.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Alkali Examination is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

INDIAN SECTION.

The opening meeting for this session was held on Friday, the 22nd inst., under the presidency of Sir GEORGE CAMPBELL, D.C.L., K.C.S.I., late Lieutenant-Governor of Bengal, who delivered the following

OPENING ADDRESS.

LADIES AND GENTLEMEN,—We have met this evening to open the Indian Section of this Society. I believe that this Section is one of very great importance, and that it may very materially affect the interests of India. I fear that I am very insufficiently prepared to do justice to the subject, but I will try my best in a few words to open the proceedings of this deparment.

We Englishmen, or Britishers, as perhaps I should say, as governing India, occupy a very peculiar position. Our own institutions are free institutions, and we rely very much more on the enterprise of the people than on the machinery of Government. On the other hand, we who have these free institutions govern a country which is without free institutions, without the energies which usually attend them, and which is much more inclined to depend on the aid and support of Government than are the people of this country. It therefore becomes extremely difficult for us, with our free ideas and free ways, to adapt ourselves to the government of the country where the people are not free, and where we are rather bound to fulfil the functions of an absolute Government. Some things it is in our power to do well. We may make good laws, govern the country well, and we do many things for the good of the people; but in some respects we are undoubtedly deficient. We have not a Government machinery such as is necessary for many of the material improvements which it is incumbent on us to introduce into India, where there is vast room for improvements of that kind. With respect to agriculture and the arts, and other material improvements, there is still a very great deal to be done, but, as I have said, the machinery for so doing is much wanting. In England we rely for these things on private enterprise, and we have not, and need not, that system of Government machinery which we find in France and in other countries where the people are so much more accustomed to rely on the action of the Government. In France there are Ministers of Agriculture and Commerce, and in other countries of Europe you have the same thing — a State machinery accustomed to deal with the material interests of the people. In this country we do not possess such machinery; and in India, although we may in many respects govern well, we have extreme difficulty in furnishing the means of material improvement, engineering works only excepted. With respect to such works we have done great things; but with respect to the improvement of agriculture, of the arts, and of the manufactures of India, we have done very little, while I believe it is incumbent upon us to do very much. In respect of legal, moral, and other improvements, the Government of India has not only very considerable machinery, but it has the aid of other societies, such as the Social Science Associations, and others of various kinds. On the other hand, in respect of material improvement, in which we are so deficient, it has as yet had very little aid, and for that aid it must, I think, and may look much to this Society. I myself have had much practical experience of the great difficulties to be encountered with regard to material improvement in India. I have especially felt the great want there of improvements in agriculture and in the arts. Whilst it was my lot to administer a province of the Indian Empire, I tried to do what I could to introduce improvements of that kind, but the difficulties I found in the way were very great indeed. I found that when I attempted to introduce the teaching of agriculture, teaching the arts, or the teaching of material improvements of that kind, the difficulty was this—we were unable to find at hand persons who had the knowledge necessary to teach the people of India. When I attempted to establish agricultural classes as a department of our colleges in Calcutta, I found that in reality we were altogether without the men who had the necessary knowledge; that although we might have men who had a knowledge of European agriculture, and men who had a knowledge of India, we could not find those two departments of knowledge combined; we could not find men who really had so competent a knowledge both of agricultural science and of Indian agriculture as to supply the practical teaching required. In fact, when you came to practical work, it appeared that the natives knew a great deal more about their own agriculture than did our agricultural professors. We have not even now therefore advanced to such a stage as to be competent to

teach the science of agriculture to the people of India. It is necessary we should first study the subject in order to make us competent to teach, and until we attain that knowledge by great labour, and as I hope by the assistance of this Society, we shall not be able to assist them as we ought and as we desire. The same experience on a larger scale has been felt by the Government of India. Some few years ago it established a department of agriculture and commerce, but I am bound to confess that up to this time for practical purposes that department has been a failure. It has been found that we had not the means, nor the knowledge, nor the machinery necessary; so that although that department has nominally existed, it has not up to this time been able to introduce any considerable improvements of a practical character. That being so, it seems clear that there is room for great effort and great improvement, and for that improvement I think the Government of India must very much rely upon the aid of a Society constituted as this Society is—a Society devoted, I think I may say, to material as distinguished from moral and legal improvement, a Society which has taken upon itself to advance material improvement in all its branches of Arts, Manufactures, and Commerce, and which has been good enough to establish an Indian Section, in the hope that by its means a great deal may be done in regard to the progress of India.

An immense field lies before the Society in this respect, and I think it offers a theatre in which real improvement may be practically developed to a very great extent. We know that in this country there are a very large number of practical men interested in India from a commercial and industrial point of view. On the other hand, there are resident in this country a large number of men thoroughly experienced in Indian administration; men possessing a great deal of leisure, a great deal of knowledge, and a great deal of practical experience and influence; and I believe that the function of this Society is to bring together these old Indians, and the commercial and industrial representatives of this country, in order that they may work together for the material improvement of that great country, which has been committed to our hands, and in which we have so great an interest.

India, as I have said, is a very great country, and one which has a very great population. That population may be individually and physically inferior to the European populations, but it is by no means wanting in intelligence, in industry, or in skill. On the contrary, I believe that it is eminently fitted for improvements in the arts, in manufactures, in everything that requires skill of hand and steadiness of head. That population up to the present time has not, I think, exceeded the capabilities of the country in regard to the means of sustenance, for I have not yet seen evidence that we have there an excessive population. But that population is rapidly increasing; it is likely that it will very soon, if it does not already, press very narrowly on the means of subsistence, and it is above all things most desirable and necessary, that in order to support that great population we should study the means by which production may be increased and improved. We should to the utmost of our power develop the material resources of India, not only to enable that great and increasing population to support itself, but also, in the interests of this country, to make it possible for India to pay for the manufactures which it imports from England. It falls upon India, not only to support itself and to pay for its great commerce with England, but also to remit to this country what perhaps is not properly called a tribute, but still is a payment for services rendered, which already amounts to not less than 13 or 14 millions a year. Therefore the produce of India has not only to support the people and to pay for the European products which are so largely imported into that country, but also to remit this large sum of money every year wholly without return. I need not say that it is impossible for any country to support such a drain unless its resources are very largely developed, and the only hope of developing those resources in such a way as to meet this great and increasing drain is by improving the modes of production, and the means of bringing the increased produce to market. I do not think it is necessary for me to impress upon you any further the immense importance of increasing and improving the industrial resources of India; and if my general proposition be acceded to, I will now go on to mention some of the particular subjects in regard to which I think improvement is especially to be sought for. I can by no means attempt to exhaust the infinite number of subjects with regard to which such improvement is desirable, but I will mention a few of the most important.

I need not say that agriculture is certainly the most important of all, and I will dwell for a few moments on the agriculture of India, and the extent to which there is room for improvement. I think I may say, broadly, that as regards the general system of agriculture in India, during the last 100 years for which we have been the dominant rulers of a large portion of the country, what must very forcibly strike one is this, that during that period there has not been the slightest improvement with regard to the general system of agriculture. I by no means say that the native system is very bad; on the contrary, I think it is tolerable. Perhaps 100 years ago it was as good as the agriculture of this country; but we cannot doubt there must be enormous room for improvement with regard to such a simple system as that which has existed in India for thousands of years. We know very well that not only in the course of thousands or hundreds of years has there been a vast improvement in the agriculture of this country, but we know that in the last 100 years the improvement has been absolutely enormous. It is impossible to look back and compare the character of the agriculture of this country of the last century with that of the present day, and not to feel at the time when our powers in India first commenced how immensely our own agriculture needed improvement, and how immense an improvement has since taken place. But I must say, and I say it with shame and grief, that in the period of 100 years, during which there has been so enormous an advance in the agriculture of this country, there has been absolutely no improvement at all in the agriculture of India. We have not mastered the subject; no one of us has

really mastered it to that degree that we can in any really practical respect show the natives how they can improve their system. I say it is a shame to us that we have not succeeded in doing this, and I think we are bound to study the subject until we can do something in this way. It is quite clear to my mind that although the natives are sufficiently industrious, and sufficiently skilful in their own small way, there must be enormous room for improvement. For instance, with regard to a system of manuring, a system of green crops, a system of providing food for cattle, and through cattle, of increasing their resources in the way of manure; and it is quite clear also that the breed of cattle may be immensely improved. So far from their cattle improving, it is unfortunately the fact that they are deteriorating, not perhaps directly through our fault, but because of the increase of population and the increase of cultivation; the natural amount of forage and the natural grazing grounds are diminished, and no artificial food being supplied, the cattle become less and less fully fed; they become thinner and weaker, and are notoriously deteriorating before our eyes. I say we are bound to make the most persistent efforts to improve the mode of agriculture and the breed of cattle, and generally to develope all the various departments into which agriculture necessarily branches out.

In connection with this subject I may dwell for a few moments on one very important question, to which great attention has been paid in this country, and with regard to which great interest is excited, namely, the system of irrigation. You are probably well aware that the Government of India, although they have not succeeded in improving the general modes of agriculture, have yet undertaken great works of irrigation, in the hope that by that means the production of the country would be very largely increased, and to some extent it has been increased. At the same time I do not think we have sufficiently studied this subject, or that we sufficiently understand it, and I do not think we have as yet found the means of spending our money on irrigation to the best advantage, or to distinguish between those schemes which are really likely to prove successful, and those with regard to which there are difficulties which stand in the way of financial success. It seems to be generally assumed that in India you have only to supply water, and the result will be a great increase of crops. That is undoubtedly the case with regard to some parts of the country, which are almost rainless, because there are some parts where nature has refused the annual supply of rain, but which are capable of being watered by rivers from sources where the rainfall is abundant. With regard to these rainless countries, there can be no doubt that the works of irrigation are enormously beneficial, and that they really have been a great success. But still India is not a country which is usually rainless. These comparatively rainless tracts are not very extensive as compared to the whole country, and there are very much larger tracts, sustaining infinitely greater populations, where the rainfall is very considerable; where a failure of rain is only occasional, and where the direct success of irrigation works is neither so immediate nor so certain. The great difficulty with regard to those irrigation works in countries where the rainfall is not usually deficient, and where the crops do not usually fail, seems to me to be this—that it is very doubtful whether a supply of water alone is sufficient, unless you supply at the same time manure by which the water may be utilised. You are aware that with regard to all agriculture there are some kinds of application to the soil which stimulate but at the same time exhaust it. It may be that in a country which has hitherto, by the help of the natural rains, supplied moderate crops, the soil will bear those moderate crops without a supply of manure greater than what the native system usually affords; it may be that you get from year to year, upon an average, a moderate return, and that if you apply water you may get for a year or two a larger return; but if you do not at the same time supply manure you may exhaust the soil, and you may find, as many men of considerable practical experience say has been found in some of these irrigation districts, that by irrigation you have exhausted the soil, and taken a great deal out of it which you have not returned to it, and therefore you have not obtained that benefit you hoped to obtain. This and other questions connected with irrigation it is necessary to study well before you can apply to full advantage the immense capital which these irrigation works require. Then there are the whole questions of drainage sanitation connected with these irrigation works, and these have as yet not been sufficiently studied. I think it is necessary that these questions should be very fully studied, and when we understand them, we should combine with irrigation a system of improved agriculture; and then only will the great benefit which may be expected from these works be fully obtained.

So much as regards the general question of agriculture in India, but then I may say there are questions with regard to the special cultivation of particular crops, in some of which we have already attained considerable improvement, but in others, I think, there is room for considerable improvement still. When I look at this question in a practical point of view, putting aside for the present the new agricultures which we have introduced into the hill climates, to which the natives are not yet accustomed, and confining our attention for the present to the old cultivated plains of India, I find that almost the only article in respect to which we have attained by European methods a considerable improvement is indigo. There is a very large European industry in indigo, and the cultivation of it has certainly been very much improved; but so far as I know, it is the only article of cultivation in the ordinary lands in respect of which any great improvement has been achieved by European enterprise. The only new crop which has been introduced in a general way throughout India is the potato, but it is not more than an additional vegetable—it is not an ordinary article of food, and we have not yet succeeded in adding much to the food of the people by its introduction. Then there is opium. The opium cultivation in Bengal is under the superintendence of the Government, and no doubt we have succeeded in producing a very large supply, though with what ultimate results is a very difficult and disputed question. The native grown opium in Malwa, however, is as

good as the Government grown opium in Bengal, and, I think, we can hardly say that the efforts of Government have greatly improved the cultivation of this particular produce.

Then I come to the great staple, cotton. We know that immense efforts have been made to improve the cotton cultivation of India, and it has sometimes been supposed that great success has attended our efforts. I am quite aware that with regard to the preparation for the market, with regard to the picking and the mode in which the cotton is brought to this country, very considerable improvements have been effected. But, speaking from my own personal observation, I may say that, as a rule, almost without exception, we have not succeeded up to this time in improving the cultivation of cotton in India; and that that is a problem which still remains for us to solve. We have great cotton-fields in India, we have a very large quantity of cotton, but the cultivation is of an inferior kind, and I think our efforts should not be relaxed until we succeed in producing a superior article, a cotton bringing a price something to be compared with Egyptian and American cotton. Up to this time, throughout the whole of India, with the exception of one or two districts of Bombay, in which some improvement has been effected, the cotton is cultivated under the old native fashion, and we have not achieved any improvement whatever. We must not, therefore, relax in our efforts until we really succeed in so improving the cultivation as to produce a much more valuable and thoroughly merchantable article.

With respect to the other and coarser fibres, you are probably aware that the production of jute has very largely increased, that the commerce in jute is largely increased, and that it is now one of the great staples. Still, that increase has been obtained solely by commercial means, and not by agricultural means. The ordinary jute is cultivated entirely by the natives, after their own fashion, and by their own efforts, and we have done nothing to improve it. And although probably the jute production is so good that it is not very necessary for us to do anything in this respect, still I am much impressed with the idea that there are very many others of the fibres of India which might be very materially improved, and brought to this country in large quantities with great advantage. The fact is, India is a great producing country. She has a great variety of hemps and fibres of different kinds; but up to this time I think I may say that the only great article of commerce is jute; and the other hemps and fibres are still mainly consumed in India, and not brought to this country. But I think, considering how very suitable India is to the production of fibres, and what an immense mass of hemps of various kinds are grown and used there, we ought so to improve and develop that production as to be able to import into this country very many of the finer, better, and stronger fibres besides jute.

Rheea we are making great attempts to improve, but the hemps we have not yet succeeded in improving in any degree, and we have not yet made them an article of commerce with this country. Efforts have been made to raise flax in India, but what seems to me very unfortunate is this, that while the flax plant, for the sake of its seed, is very well known there, in order to obtain a fibre fr the stem we have gone, not to those parts of In which are most fit to produce long fibres, but the driest countries, that is to say, the Punja My view would be that if we are ever to produ good flax in India we must go, not to the dry, to the moist districts, where we may expect to h long stems and long staples, and where we may much more than we have yet done. I by no me despair of producing very great improvement regard to the cultivation of flax in India, see that the plant is cultivated throughout the len and breadth of the land, and it is only necess that we should so improve the native agricult as to produce a stem fitted for fibre, and not o for the seed which at present is very larg produced.

To silk a great deal of attention has been p and I think this Society has itself paid m attention to it; but little has been effected, the silk produce of India is not at present, I f an increasing produce. I believe very much mains to be done if we are to develope it. V respect to sugar we have also not been very cessful. There is only one more article to whi will specially allude, to which, I think, atten has not been sufficiently paid, and with respec which, I believe, that a great improvement an great commercial development is possible. allude to tobacco. The production of tobacco India is enormous, and I believe that the material in India is in many parts good. Within the last few years I unders that an export to Europe has been establis and it has been found that it is by no m bad tobacco. But the natives of India are very cient in respect to the manufacture of this tob not knowing how to properly prepare it for ma or for the uses to which it is applied. But th only because they have never been taught ho prepare it. They are extremely skilful with fingers, and I have no doubt that if the su were sufficiently attended to the natives woul as competent to prepare cigars and cheroots as people of Cuba, Manilla, Burmah, or any c country. I observed only this morning in paper that the price of American tobacco has much gone up; the supply seems to be at pr somewhat short, and I think, considering immense production of tobacco which al exists in India, the great varieties of soil climate in respect of which tobacco may be duced there, that it is well worth the atte of all interested in the material improveme India, and of this article in particular, whether much may not be made both of the cultivatio the manufacture of tobacco in India.

I have hitherto dealt with the agricultu the cultivated parts of India, the modes of n agriculture, and the introduction of impr staples amongst the natives. I will now adv a different branch of my subject, viz., the cu tion of the waste lands of India and of the s cultivations which have been introduced Europeans in those waste lands which have been occupied by the natives on account o culiarities of soil and climate. You are prol aware that the waste land question has been a deal fought over in India, and the Govern has been accused of an indisposition to enco

European enterprise, by not granting to enterprising men ready to cultivate them, those lands which are lying barren and waste, and useless to the Government. I have taken a great deal of interest in that question, and I am prepared to say that in my deliberate view, the Government is not open to censure of this kind. It seems to me that the Government has to look two ways. First, to the eventual interests of the country; and secondly, to the development of these waste lands, under the best system. Now, I think it is not good for the future prosperity of the country that the Government, in order to develop these lands, should rush to the extreme of giving them away recklessly to land jobbers, in a land jobbing fashion. I have always thought that people do not appreciate a thing that they get absolutely for nothing, and that if you make the acquisition of these lands too easy they will be sure to fall into the hands of land jobbers. On the other hand, I feel we are bound to protect the revenue of India, and not sacrifice our land revenue; but I feel also that the land revenue derived from these remote hill tracts is very small, and the material improvement to be derived from their development by introducing Europeans is so great, that we ought not to stand in the way of making those lands available to *bona fide* men who really purpose to develop them. That is the system which has been followed in the colonies with success, and that is the system which we are attempting to follow in India. That is to say, we will not give away these lands to any man who chooses to say, "I am going to cultivate thousands of acres," without any guarantee that he will cultivate them. But if any approved man chooses to bring the money in his hand, and to pay down, say, 10s. per acre, we are willing to give him land, and to give him the utmost facility for cultivating it. Waste lands have been cultivated largely on these terms, and we hope they will be still more largely taken up in the same way.

I have not had much to do with the cultivation of coffee, but my particular attention has been attracted to the great tea cultivation which now exists in several districts of Bengal. I have personally inspected many of the tea plantations, and I am quite satisfied that, after many ups and downs, the tea cultivation has now reached a safe and sound position, and that it is now likely to be very largely developed, to the great benefit of the enterprising men who have achieved that success, and to the great benefit both of India and of this country. I think that the tea cultivation of India has taken deep root, that it will continue to increase, and there is no fear now that it will fail. The one great difficulty with regard to it has been the labour question, as you are probably aware, but I hope that day by day this difficulty will diminish. There were very great difficulties in the first instance. It is undoubtedly the case that when coolies unaccustomed to the climates of these remote districts suitable for tea cultivation were first taken there great hardships were endured by them; there was great mortality, and it was absolutely necessary that Government should intervene to protect its subjects from treatment which involved a mortality revolting to humanity. But I can say now with satisfaction that these difficulties have to a very great extent been overcome, for in a great majority of tea-producing districts the coolies employed are now very tolerably healthy. The great difficulty now is with regard to the means of communication. It still happens that the best tea-producing district in India, the great valley of Assam, is separated from India by a long voyage, and by a very difficult country, through which there are very deficient means of communication; and up to this time it is unfortunately the case that the transport of coolies from the populous districts to the tea districts of Assam has been attended with great risks, and occasionally with great mortality. The reason is, the voyage is so long and difficult, that the coolies are necessarily crowded together in the steamers, and they have at times suffered much in consequence, passing through countries which are the very hotbeds of cholera and other diseases. While I administered the government in India my attention was very much devoted to these subjects, and to the means of facilitating communication between the populous parts of India and those which required populating. My view was, that if we could establish easy communication between the populous districts of Western Bengal and the district of Assam in the east, that the mortality and the difficulties attending the progress of the coolies would be overcome; that you would have a very large population, which would be quite ready to go to the tea districts, those risks having been diminished; and that the tea districts would be very largely developed, at the same time that those countries that are threatened to be over-populated would be relieved from their surplus inhabitants. A good deal has been done in this direction. We have taken advantage of the late famine to employ the people very largely in making roads, which lead from these populous districts to the unpopulous portion of the country. The Government are now establishing a line of steam communication which, I hope, will lead to great improvement; and I hope it is still possible, we may see railways developed in that direction. Already a railway has been undertaken through Northern Bengal, which leads a considerable distance towards Eastern Bengal and Assam. I hope such a railway may be achieved, that the roads which are now being made will have eventually rails laid on them, and that the tea industry may be very greatly developed. Then there is a cultivation which has been undertaken by Government, and by a few enterprising men, in the hill countries, from which great benefit may be anticipated. I allude to the cultivation of the Cinchona plant, which yields quinine. I need not tell you that the great scourge of India is fever; cholera may carry off thousands, but fever carries off tens of thousands, and the one medicine which the natives above all appreciate is quinine. You are also aware that the production of quinine is at present limited to very distant and remote parts of the world, in South America, that it is a very expensive medicine, and so not within the reach of the great millions of India. It will be an enormous benefit if we succeed in making that cultivation so common on those Himalayan hill sides, now unproductive, that the people of India may be supplied at a cheap rate with this most valuable medicine. So far we have succeeded to a great extent in experimental culti-

vation. Thousands of acres, both in the Himalayan and Neilgherry hills, are now planted out with the cinchona tree. They have obtained a considerable size, and have begun to yield bark, and there seems to be good reason to hope that if this subject is studied scientifically and practically, the cultivation may be attended with complete success. Then there is another cultivation which has not yet been systematically attempted, but in which I think a great deal may be done in these Eastern districts, and on the warm hill-sides and bottoms, now occupied by jungle, I mean the cultivation of the india-rubber tree. Up to this time an important and active commerce has been carried on in india-rubber on the Eastern frontier, but it is confined entirely to commerce with the wild tribes who bring down the india-rubber from the trees in the jungle; and the more we have entered into the subject the more we believe that the result of that commerce is to destroy the trees, and, in fact, to kill the goose which lays the golden eggs; thus destroying the sources of production. We find that these wild tribes use the trees in a very reckless manner, that the finest trees are destroyed for the sake of very little india-rubber, and there is every probability of the supply being soon dried up. On the other hand, if the trees are attended to and cultivated, it is a very rapidly-growing tree, and one which, by little cultivation and attention, may be made to reproduce itself in a very short time; so that if these trees were once brought within scientific management, there is every reason to believe that within a very moderate compass we might have forests of them, which would produce a large supply of this very important article, and thus, too, lead to a great development of the productive resources of India.

Not only with respect to these trees, but in respect of other trees and other productions of those hill slopes now barren and abounding in jungle which is useless, I believe great improvements may be made. There are thousands of square miles of country which abound in jungle, where the vegetation is enormous, where the powers of nature are very great, but where the produce is useless, and it is for us to supply, by skill and by scientific arboriculture, useful produce in its place. I have often thought that in the Himalayas of Eastern Bengal where chestnut trees now useless as regards producing food for the people are naturally abundant, they might very well be superseded by forests of edible chestnuts. Again in many parts of the waste Himalayan valleys, where we have now much useless scrubby jungle, we might have forests of olives and other trees of that kind, and we might substitute for the very poor peach, apricot, and pear trees which grow there, others of a better kind. Indeed, as regards the science of arboriculture generally in India there is a vast field for improvement.

Then, going beyond the vegetable produce, I will touch very briefly upon the subject of minerals. India is certainly a country not so well supplied with minerals as it is with vegetables, and they are not relatively so important. I will not attempt to touch on every metal found in India, but will confine myself to the one great metal, iron. There cannot be the least doubt that the iron-fields of India are enormous; that there are tracts of country which are one mass of iron, and there is a vast amount of iron of an excellent qual which yet remains to be developed. Some sm portion has been developed, but the iron indus has not yet been very successful. But in ma parts of the country where there is iron there also large quantities of coal. The coal is not the very best quality, but still it is tolerable, I cannot believe that in these days when i has become dear, and when the demand for has become so great, that it is not possibl can be developed with very great advantage. am told that some enterprising men in country are now attempting to develop this dustry, and I hope this Society will give them utmost aid, that we really shall attain to a considerable production of iron before very lo

Then with regard to manufactures. The ma factures of India do not now hold the posit which they once did. The native manufactu have very much declined, and the native ar do not think have been improved, but rat spoiled, by the introduction of bastard Europ modes, which have to some extent interfered the native art, which was pre-eminent in Cashmere shawls, and things of that kind. W the old native manufactures have declined, I th it is our bounden duty to do what we can to int duce new and better arts and modes, and in respect there is an immense field for our effo The natives are most apt, and there is a large for introducing industrial arts, of which we h as yet very little availed ourselves. I do not th that, up to this time, we have succeeded in do our duty by the natives of India in respect teaching them the common arts which h been so much developed in Europe late years. I have already detained you long, and it would be impossible for me enumerate a tithe of the many subjects in res of which, I think, these intelligent and skilful may be taught to use for popular purposes m of our European arts. I would only instance on the art of pottery. There is nothing in respec which there is such an enormous consumpt amongst the natives. They use earthen vessel all sorts and kinds. Their shapes are very g but their material is, up to the present time, famous; in fact, nothing can be worse than material of which their pottery is made. No cannot understand why it should not be very e possible to improve that material, or why we sh not introduce the arts by which common potte made in this country, and thus effect a very g improvement in the comforts and every-day us the people of India. But in respect to the arts in respect to agriculture we have not yet succe in adapting ourselves to the ways and fashion the natives of the country. We find that we almost more difficulty with regard to indus schools than we have with regard to agricult We have not examined as we should the m and tasks, and habits of the natives. We teach ourselves before we can teach them, an think it is possible, by the aid of this Society, an immense deal may be done in the way of c municating to the natives of India our com every-day arts. I do hope that a g deal will be done in that direction, that the attention of this Society will especially directed to that end. Then, while

have not done much in the way of introducing the small arts, and while the Government has not done much in the way of introducing great arts, I think it is undoubtedly the fact that of late years private enterprise has succeeded in introducing arts on a great scale, by which I mean great manufactories by which cotton and jute are spun and woven on a large scale. There are now great manufactories in Bombay and Calcutta where natives are successfully employed, and where I think I may say, without fear of contradiction, that the natives have shown that they are capable of doing very great things in that way. Native men and women, and children also, have shown that they have great aptitude for working in manufactories. That much is proved by the experience of the existing mills. I know this is a delicate subject with respect to competition with Manchester and Dundee, but my view is that, as the governing body, we are bound not to favour one side or the other, but to do the best we can to develop the industrial resources of India. I do not think that by a protective system on the one hand, or by an attempt to stimulate it on the other, we should try to favour one party or the other; but what I do think is most important, and what I hope this Society will succeed in doing is to bring out the facts as much as possible, to ascertain what are the respects in which India has considerable advantages for manufactures, what are the difficulties which stand in the way, how far it is possible that Indian manufactures can succeed, and in what respect is it probable that they will not succeed in competing satisfactorily with the manufactures of this country. I hope this is one of the subjects to which attention will be devoted in the present Session. I hope we shall bring men of Indian experience face to face with men of English experience, that the whole subject will be discussed; that it will be ascertained what are the points in respect of which India gives facilities for manufactures, what are the points in respect of which the difficulties are such that it would be well not to attempt competition in this country.

I have detained you so long that I will now only very briefly allude to one or two other subjects, with respect to which attention may probably be devoted by this Society. There is the great sanitary question; the whole question of the sanitary condition of India. This Society, I think, has devoted much attention to sanitary questions, and these are enormously important in India; not only because they so much affect the people of India, but because up to this time we do not in the least understand them. We have attempted a good deal in the way of sanitation in some parts of the country with regard to the towns, and have to some extent succeeded; but with regard to the country at large, the native villages, and the great tracts of native country, where fever and cholera are very destructive, we have not succeeded at all. It is a great question in respect of which immense effort is necessary to solve questions which have hitherto been almost insoluble. We do not know how fevers are generated, how they are communicated, or how they are staved off. We do not know how far they are due to the water, how far to the air, how far to overcrowding, and to other causes. I think the efforts of this Society may be very beneficially directed to solve these questions so far as it is possible to solve them.

Then there are other subjects with respect to which I think discussion may be invited. There is the subject which has created a very great interest in India, namely, the effects of alcohol, and the development of a taste for drinking amongst the people of India. It has been said, and I am afraid with some truth, that it is ourselves principally who have developed in India a taste for strong liquors. It is said by some that our revenue system is such as to develop the use of spirituous liquors. I do not myself think it can justly be said that has been the case, because our only action is to heavily tax these liquors; but at the same time there are many excellent people who will connect the two facts, that wherever we go there also drinking increases. The subject therefore is well worthy of discussion. I hope it will be discussed, and that some satisfactory result may be arrived at. Then there is a great dispute with regard to the real effect of opium—whether the consumption of opium is really more injurious than the consumption of wine and spirits in this country? All these subjects very much affect the material prosperity of the people of India, and there is ample room for discussion and inquiry with regard to them.

Then there is the old subject of communications of roads, railroads, harbours, and lights. The Government of India has often been very much blamed because it has not made more roads and more efficient communications. I do not think that blame is fair. Those who blame should remember that the difficulties with regard to roads in India are enormous. The country is difficult in the extreme, the climate is extreme, the rivers and the mountains and everything else are upon a great scale, the soil in large parts of the country does not afford metal or materials for roads. We have done what we can, but I believe our principal success has been by introducing the great system of railways; that system has been on the whole eminently successful. But having made great trunk lines which have been successful, the attention of the Government is now directed to the question of making the smaller branch lines, and it is felt that if these are to be made they must be made in a much cheaper style, and on a smaller scale. The question is upon what principle the railways may best be made, and upon that there are many opinions; and with respect to these opinions I think the aid, counsel, and assistance of this Society will be very welcome to the Government of India, and discussion as to the nature of railways to be made in the future will be very useful to those who administer the Government.

Then, at present, very prominent is the question of the harbours which are required on the coasts. We are very deficient in respect of harbour accommodation, and there are now before the Government great proposals for supplying such accommodation at several of the most important places. But there are very many different opinions with regard to the best mode in which these harbours can be made. There are engineering questions; questions of navigation, and so on; and with regard to that also, I think the Government may be

be very much aided by the discussions here, and by the counsel which its experienced members may be able to give. Then there are the lights which are required to facilitate navigation by the Suez Canal and the Red Sea, and other places connected with our commercial intercourse. With regard to all these subjects, I feel quite sure that discussions here will be of the utmost benefit, and will much strengthen the hands of the Government.

Many other things might be mentioned, but I think I have said enough to show you that there is a very ample field for an Indian Section of this Association. I hope that field will be sedulously worked and cultivated, and that in that field Indian and English experience will be brought together. I do hope that not only we may bring together much experience in this room for the great benefit of both countries, but I also believe it is quite possible, by developing these subjects and creating an interest in them here, you may create a corresponding interest in India also. I know of no problem in respect to India which is more interesting than that of turning into a useful channel the immense amount of education and development that we are now bringing out amongst the native classes of India. We are at this moment educating very highly large numbers of young men of the most intelligent classes of India. But, having educated, we do not know what to do with them. We find the supply of educated men is greater than the demand. We turn out hundreds and thousands of these educated men in a literary point of view, but the result is that they all want Government appointments, and we cannot find them for them. They are dissatisfied and disgusted, and think they are ill-treated because they are not provided for. I think and I believe the Viceroy, Lord Northbrook, a little time ago pointed out, that if justice is to be done to this education, you must turn it into material channels, and not leave these young men to suppose they must all be lawyers or obtain Government appointments. You must turn that education into useful material channels; and amongst these young men themselves and amongst the native population I think there is a very considerable disposition to accept this view—that it is absolutely necessary that a large proportion of their educated men should learn to rival Europeans, not only in respect to intellect, but in respect to practical art; and I do hope that if these subjects are earnestly taken up by this Society, we shall find that we shall have in the great towns in India affiliated societies which will take them up on that side of the water also, which will correspond with us and learn from us, and that so working together the societies in India and this parent Society in this country may really effect very material improvement, both directly in the condition of the people in India, and indirectly by affording a field in which the education which we are now supplying to the natives may be turned into a useful channel. I trust then that this branch of the Society will flourish, and that much will be done by it, and that both directly and indirectly very great benefit will result from its mission.

DISCUSSION.

Mr. Andrew Cassels, after expressing his great sense of obligation to Sir George Campbell for the masterly address he had just given, said there was only one point on which he should venture to differ from him, that was with regard to the staple of Indian cotton. He understood him to say that indigo was the only article in which there had been any great improvement of late years, but having had a great deal of experience in connection with cotton he might speak upon it with some degree of assurance, and he believed that nothing in India had more improved during the last thirty years. When he first went to India the produce of clean cotton per acre was only between 30lb. and 40lbs., whereas, owing to the better teaching of Manchester, it was now from 60lbs. to 100lbs. At the same time he did not hesitate to say that with regard to the staple, the improvement during the last thirty years had been equal to from thirty to forty per cent. At the present time, notwithstanding all that had been done to introduce American sea cotton into India, the produce of that foreign seed cotton was not held in so much estimation in the Liverpool market as some of the indigenous growths; in fact the Hinghun Ghât cotton now held the highest place in the estimation of Lancashire spinners, and brought a higher price than any other. It had been truly said that India had to make payments of something like fourteen million sterling per annum for the interest of her debt, for pensions and so forth, and in payment for sleepers, railway iron, and other stores, and these payments could of course only be met by means of these efforts. Consequently, they ought to be encouraged to the utmost; but unfortunately they were subjected to an export duty by the Government, instead of being allowed to go out free. In the second place, although there had been a department of agriculture and commerce created, intended to promote the commerce of India, the same department had to take charge of the revenue, and he need not say to anyone who knew anything of India, that under such circumstances revenue matters naturally overshadowed the other two, and consequently until this mistake was rectified no very great results could be anticipated. In the next place they had to grope very much in the dark for want of facts, there being no statistics on which reliance could be placed. He had lately had occasion to look into some of the figures which had been collected, and was really ashamed to see how defective were the statistics in many respects. Thus a short time ago the population of Bengal was said to be forty millions, whereas it was now said to be sixty millions, which of course would necessitate a different scale of taxation and administration generally. He agreed with much that had been said with regard to Indian manufactures, and was happy to say that he had recently been in negotiation with a very able and experienced writer on the subject, as the result of which he hoped they would in a few weeks have an opportunity in that room of going thoroughly and fairly into the great question. On the one hand, Manchester manufacturers contended that our duties in India were protective, and on the other hand, manufacturers in India said that England had so many advantages that they were quite overshadowed. He hoped that matter would be brought to a test very shortly, when all the facts bearing upon it would be brought forward, so that a clear decision might be arrived at. But if it were really desired to encourage Indian manufactures it seemed to him that the five per cent. duty upon them must be removed as one of the first steps.

Dr. Burn said there was no doubt the products of India were very numerous and valuable, but the way to get at them had not yet been scientifically studied as it ought to be. The collection of the revenue and the constitution of the courts attracted a deal of attention but the products of the country and its commerce were comparatively neglected. He would also remark that Europeans could not safely invest capital to any great extent in India, until there was greater security. We had just escaped, almost by a miracle, from one of the greatest calamities which could befall a nation, and fo

this happy result they had in great measure to thank Sir George Campbell; and now one of the most necessary points to study was how to prevent a recurrence of such a famine. This was a most vital point, because no one would invest large capital in a country, or attempt to improve its agriculture, when they could not be sure that a single year would not sweep away the whole of their cattle and other produce. These famines were sure to recur, but he believed their fatal results might be prevented by reverting to the ancient village system, under which a sufficient store of grain was kept in each village for one or two years' consumption, together with a like quantity of fodder for the cattle, and an ample supply of water in the tanks. Irrigation would not save India, it would only foster cultivation up to a certain amount, and in certain respects it was a dangerous expedient. He had known something of the ravages of fever in Guzerat, and not only was the destruction of life enormous, but there was a great loss of energy from the malarious influence of the irrigated soil; quinine was a most effectual remedy, but it was not always to be had. Extensive irrigation ought only to be applied in those districts where the rain was deficient, but in other parts where the rainfall was the natural means of feeding vegetation it could not be employed without danger. The sandy deserts were the richest parts of India when irrigated, and there irrigation was quite safe and healthy. He would much rather see capital expended in laying by stores of rice, which was very cheap, and, unlike any other grain with which he was acquainted, kept perfectly for years; in fact he had seen rice taken from stores in the Deccan which had been kept for ten years and was perfectly edible. It was preserved simply by excluding it from the air in cavities specially prepared for the purpose under ground.

Mr. Hyde Clarke remarked that although it was hardly usual to discuss an introductory address, so many subjects, and so momentous, had been brought forward, that instead of being able to discuss them in a single evening, enough work had been laid out for several sessions. He should not therefore be tempted to enter in detail upon any of the points mentioned by Sir George Campbell, but it was impossible to see him again present on such an occasion without bearing in mind that he was one of the founders of the Section, and had done much to put it in the position of utility to which he had himself borne witness. And though he had been absent for some time from them, engaged as had just been remarked in the most laborious duties, still they felt that his spirit had been with them, and it was very gratifying to find him again presiding over them, not merely in an ornamental capacity, but bringing with him that experience and fertility of suggestion by which he had always been distinguished. As chairman of the Indian Section, he claimed the privilege of moving a vote of thanks to him for presiding on that occasion, and in so doing he might be pardoned for one or two remarks on some of the many interesting points which had been mentioned. For instance, with regard to the question of caoutchouc, if any one considered how valuable a material it was in telegraphy and many of the arts, the practical nature of the suggestions would strike the mind at once. Unfortunately the savage tribes of Africa were not the only destroyers of the valuable trees which produced this material; the same thing was going on all over the world, and very shortly it would be found that the price would be so enhanced as to seriously interfere with many manufactures, and render many articles of public necessity and utility difficult to be obtained. If, therefore, the Foreign Department of India could be induced to take that matter into consideration, a valuable service would be rendered. It was very gratifying to hear what had been said as to the extension of the tea culture, but at the same time it was a matter of regret to them all to remember that they had lost one of their most valuable friends and colleagues—Dr. Archibald Campbell—who had taken a most active part in connection with that subject. With reference to the culture of tobacco, no doubt some persons would look upon it as a mere matter of pleasure or luxury, but it was really a commercial product, which might prove of great importance to India. At the present time the tobacco crop of Virginia had been so much affected as to yield only one-fourth of an average, so that the time was most favourable for paying attention to its production in India; and by making timely representations to the Government, and the commercial community in India, they might be able to do for tobacco what Mr. Cassels had already said the Government had done for cotton. He would not attempt to anticipate the valuable discussions that would hereafter arise on many of the important subjects that had been mentioned, and would confine himself to moving the vote of thanks he had already mentioned.

Mr. Ward said he would not presume to second the motion just made, which he would leave to abler hands, but he would venture to make one remark, which might be encouraging to those who were hoping for the further development of jute, flax, and other products which had been spoken of as comparative failures. It might be in the remembrance of many that some time ago there was a meeting to consider what could be done for the tea culture, when almost everyone was in despair about it; and, in fact, he was almost the only one who took a hopeful view. They had now heard of its great success, and it should encourage them all to remember that the failures of to-day might a few years hence turn out to be great successes. With regard to the tea itself, he believed that it was the best in the market, and that the difficulty was to get enough of it; and he should, therefore, like to know if any arrangements were being made for extending railway accommodation to Darjeeling. The Government, in making arrangements for the transport of troops and human beings, should also bear in mind the importance of giving every facility to tea planters for bringing their produce to market, but he knew at the present moment of an estate upon which there were about 3,000 chests of tea awaiting means of transport.

Mr. Fitzgerald asked whether Sir George Campbell's remarks about the silk cultivation not having answered expectation, referred to those kinds known in Italy, China, and elsewhere, or whether they referred also to the Tussore silk, which was especially an Indian product.

Dr. Boycott having briefly seconded the vote of thanks,

Mr. W. Botly referred to the importance of developing and improving agriculture, which he was confident, from his own experience in this country, would prove exceedingly profitable. He had known estates, formerly letting at from 10s. to £1 an acre, which had been so improved in value as to now fetch from £4 to £5 by irrigation and drainage works, and he was convinced that what would pay here would pay all over the world.

Mr. Elliott asked whether the natives of India had any method of supplying the exhaustion of the soil caused by the production of jute, oil seeds, and other exhausting crops.

Dr. Fayrer, C.S.I., said one important question which had to be borne in mind and discussed with regard to irrigation was whether, although of great importance, it did not often involve questionable results; whether, when the rainfall exceeded about 16 in. per annum, it was desirable at all; whether it did not induce a greater amount of sickness than need be. Another point of some importance which had not been touched upon was the destruction of trees which had been going on for some time, and was still proceeding, and which he believed tended to alter the climate, to increase the heat and dryness of the atmosphere, sterilize the soil, and interfere with the agricultural progress of the country.

The vote of thanks having been passed unanimously,

Sir George Campbell, after acknowledging it, and paying a cordial tribute to the memory of the late Dr. Campbell, proceeded to reply to some of the observations which had been made. With respect to railway communication with the tea districts of Darjeeling, he was happy to say that a railway in that direction had been sanctioned and commenced, and was already far advanced towards completion. He had long been an advocate for that railway, but at the same time he had been compelled to admit that it was impossible to construct such a line in the interests of Darjeeling alone, unless taking into account the interests of the populous districts of Northern Bengal. When afterwards administering the government of Bengal, he went into this subject very narrowly, and found that the districts lying between Calcutta and Darjeeling were in fact amongst the richest and most populous districts in India, and that there was every reason to believe that a railway through that district would prove a safe speculation, and develope the country without loss to the Government. Having ascertained the facts as well as the means at his disposal enabled him, he laid those facts before the higher power, and urged upon them that a line in that direction should be constructed. The question was just hanging in the balance when the famine occurred in Bengal, and, lamentable as were some of its effects, it had this good result, that the Government upon the first note of alarm were induced to sanction the prosecution of the railway works, which were at once begun, and had been proceeding actively ever since. He should explain that the railway was in the first instance limited to a place called Julpigoree, about thirty miles from the foot of the hills. There was some doubt whether the remaining distance should be sanctioned. He himself had urged that the missing link should be completed, and yet hoped that it would, but it had not been finally determined. With regard to Mr. Elliott's question as to the methods used by the natives to supply the exhaustion of the soil, he could not give any very definite answer; but they showed a considerable amount of skill and agricultural knowledge, being perfectly conversant, for instance, with rotation of crops. They were quite aware that they could not get such crops as jute or oil seeds every year, and generally practised a rotation, except where the fertility of the soil was kept up by inundations of the great rivers. Considerable inquiry had been made on this point in Eastern Bengal, and the results tended to show that no very rapid exhaustion was taking place. At the same time he was quite convinced that this was one of the subjects which required a great deal of attention. The heavier the crop, the greater demand upon the soil, and the more fear of its being exhausted; and if commerce called upon the country to supply more jute and oil seeds without at the same time supplying an improved agriculture, great evils might eventually result. He quite agreed with Dr. Fayrer that the question of the sanitation, or insanitation, resulting from irrigation, was one which required to be studied with the greatest care, and which had not received anything like the attention it demanded. In fact many persons seemed blindly to suppose that merely spending money upon irrigation was sufficient to put the country into a vastly improved position. There were, however, two sides to the question, and it was doubtful whether, both in respect of sanitation and exhaustion of the soil, there might not be evils counterbalance the benefits of irrigation. With regard to the destruction of trees he was not prepared to give so confident an opinion, but his impression was that the destruction of trees and denudation of mountain tracts had not gone on to the same extent as had produced so pernicious an influence in Europe. A considerable destruction of timber trees had taken place undoubtedly, but in many parts, where cultivation did not take place, the greatest evil was that useless jungle sprang up in the place of useful trees; and he was not inclined to think that in those parts with wh he was acquainted they had suffered much from t cause. Still there were districts—notably in Punjaub—where the evil existed, but the attention the Government had been attracted to it, and eff were made to promote the planting of trees in the p of those which had been destroyed. In these days o and order, however, there was not the same power to enf this as in more despotic times. For instance, when he serving in the Punjaub as a young man, he took u himself to make a law in his own district that every who cut down a tree should plant five in its place, orders of that kind could hardly be enforced now. the dryer parts of the country the attention of Government was being given to this point, however, in the moister they were not likely to suffer. With gard to the Tussore silk, he could hardly answer question, which was really a commercial one; bu did not think the silk trade had increased of late. Tussore silk trade was an important one, and means should be taken to develope it; but it mu remembered that the worm which produced it w wild worm, not usually cultivated. He believed, ever, that a good deal might be done in the w semi-cultivation, that the growth of these little an upon the jungle trees might be promoted by takin cocoons from one tree to another, and that the n were already beginning to put this method in pra He could not follow Mr. Cassels into the question o far the cultivation of cotton had increased, but his re seemed to have special reference to the Hinghun cotton. He (Sir G. Campbell) had at one time adr tered the province in which that was grown, an gone carefully into the subject with the Commis Mr. Carnac, the results of his investigations bein which Mr. Carnac agreed with him—that this was indigenous, that it was produced in the same w it had been for two or three generations, and that i provement had been effected by new modes of culti Mr. Cassels, whose authority no one could dispu the improvement at from 30 to 40 per cent., whi was glad to hear. He also understood that in som of Bombay improvements had been effected in the vation itself, and these he hoped to find extend to districts.

AFRICAN SECTION.

The opening meeting of this Section wa on Tuesday evening last, when the Rev. H Waller occupied the chair.

The Chairman said he was very sorry to be obl announce that Captain Knowles, who had prep paper on the Niger and the voyage of the *Inve* had been suddenly stricken down by illness, wh was glad to say, was not dangerous, but which nevertheless prevent him from appearing among for some weeks. In his absence, however, Dr. Man read a paper by Mr. Shepstone on some passage early native history of the Natal territory, which be of especial interest at the present moment on of certain difficulties which had arisen within the In the first place, however, he would himself giv glance at the movement now going on in Africa, ment which was not only enlisting the sympathie outer world, but which also seemed to emanate power within itself. Beginning with the norther the east coast, a new state of things was there orig and all honour to the Khedive of Egypt for h tions to advance his people. He was a man qu years ahead of his fellows, and though it was a h for him to drag them onward to his own posi was a man eminently fitted for such a work. Sir Baker had already stated in that room how he h to abolish the slave trade, and though this seeme

impracticable, the Khedive did not think so. He had shown his determination in this matter by engaging the assistance of Colonel Gordon, who already said that he saw no difficulty in developing the whole of that district which Sir Samuel Baker and Messrs. Speke and Grant had before described. Writing to him from Gondokoro at the end of November, he said there was no difficulty in ventilating that country with a wholesome atmosphere, by bringing trade into it, and abolishing the slave trade. Indeed one tribe, the Dinkas, had already so far been won over to his side, as to stop and capture a convoy of 1,600 slaves, thus striking a deadly blow at this vile traffic. Two engineer officers had already joined him, one of whom, Lieut. Watson, wrote that he found travelling there as easy as up the Rhine, which was already a wonderful advance. Colonel Gordon desired very much that some scientific men would come out to him, in order to make observations, &c., for which he had not time, and said that they would find no difficulty in reaching him or in pushing their way right and left from his stations. If therefore, any one present felt inclined to take part in this work, or were acquainted with those who would, he should be glad if they would communicate with him, when he would at once place the matter before Colonel Gordon. From the centre of the lake region the Khedive meant to draw a very large commerce, there being an enormous accumulation of ivory there, which hitherto had been brought out by the Arabs at Zanzibar, but which, together with metallic treasures, the Khedive had determined to divert into the more northerly route. Passing down the coast towards Aden, a very different state of things would now be found to that which existed a few years ago; and here again might be noticed how much depended on the genuine thorough goodness—for he could call it nothing else—of one man. Half the difficulties connected with trade and missionary exploration on the east coast had been removed by the establishment of a branch of the British India Steam Navigation Company. He believed that honest Scotch philanthropy had been at the bottom of it all. Mr. Mackinnon and the gentlemen associated with him were determined to back up what Livingstone had begun, and acted not so much with a view to profit as to aid that part of Africa, and the result was that whereas it used to take six months to communicate with Zanzibar, letters could now be received in less than three weeks. Some few years ago it was difficult even to make people believe in the existence of the slave trade and all its horrors in that region, but now by degrees a most wholesome alteration in opinion was taking place, and Her Majesty's Consul-General said that the slave trade had been paralysed along that coast in the most extraordinary way. In fact, the slave trade by sea was stopped; but unhappily, there was a chance of its being renewed, in a way which, if it were not checked, would certainly arouse popular clamour when it was mentioned in the House of Commons. The Sultan of Zanzibar, who apparently stood to lose everything by the abolition of the slave trade, was now most honourably and thoroughly desirous of putting a stop to it, as he (the Chairman) had been convinced on evidence brought before him by those who knew the Sultan best, in opposition to his preconceived opinions. The fact was the Sultan saw that it was better for him to have the British for friends than enemies, and he was *bona fide* desirous of carrying out the treaty which he had signed. The difficulties now lay not with him, but with the Government at home and the Crown lawyers, as had been plainly shown by a naval officer in a paper printed in the *Independent*, but which was about to be reprinted in a separate form by Messrs. Longmans. The subject required thorough investigation, and he hoped it would not be lost sight of. But though both the Khedive of Egypt and the Sultan of Zanzibar were thoroughly desirous of improving the moral and material condition of their people, they could not go much farther down the coast without coming to a halt. The Portuguese had in this region a set of subjects and colonists who had been a disgrace to their name, who had always been the greatest slave dealers, and had proved a veritable curse to the east coast. They had now taken advantage of what was going on in the north, and seeing that the coast line of the Sultan of Zanzibar was secured by English cruisers, they were supplying the demand for slaves in Madagascar with greater activity than ever. There would be no excuse for the Portuguese if this went on, because communication was now easy, and there was no reason why intelligent active governors should not be sent there, who would make themselves acquainted with what went on, and who, if they were sincere, could put a stop to the slave trade much more easily than the Sultan of Zanzibar. He hoped, therefore, that an appeal would be made to the intelligence, humanity, and Christianity of the ruler of Portugal, and that this great blot would soon pass away. If not, it would bring its own scourge with it, and Portugal would yet have a heavy price to pay for lagging behind in the onward march of civilisation, and for placing a stumbling block in the way of all that concerned our common humanity. Going further south yet, we again met with a state of things which savoured of improvement and advance. Ten years ago no one could have pictured to himself twenty-one thousand Europeans quartered in one of the most barren parts of Southern Africa, but such was now the case, owing to the diamond discoveries; and men were led by a hand, which certainly led them for good, into the interior of the country, where they settled down to gain their livelihood, and to draw after them many other relatives and friends. The discovery of gold had always been looked forward to by those who knew anything of that region. The Portuguese had worked—unsteadily, as they always did—at the gold fields on the south of the Zambesi, and everyone who had travelled amongst the natives knew that there were gold deposits. He himself had never met with a native north of the Zambesi who did not know what gold was, and the native name for it, and he had always foretold that some day these discoveries would be made. It was a problem which no one could solve, but it certainly seemed, as if in the providence of God, the most sterile and dangerous parts of the world had a sudden interest attracted towards them beyond discoveries. For many long years Africa had been left to herself, but now this growing rushing tide of European life was drawn towards her, which he trusted would result in the good of the people. No doubt it would not be an unmixed good, but surely it was not too much to hope that in the great immigration of those who thirsted for gold, there must at all events be one true golden view of something like honesty, something like an Englishman's feeling toward the oppressed, by which these poor people would by-and-bye profit. Looking down the east coast from north to south, there was a new life going on, a new interest excited, a new thirst aroused to know more of this wonderful continent. To some extent this progress was impeded—it was like a ship making headway against the stream, but it was sure. No one could be brought in contact with these natives, but must feel that there was something strange before him; perhaps the fears of childhood with regard to a negro were almost engraved in human nature, and it was almost too hard a task to make the English people take an interest in them, and long to help them, but by degrees this feeling seemed to be giving way, and the desire to know more of them and to help them was gaining ground daily. No one could help a feeling of despondency at the news of Livingstone's death, but it had always struck him as being most significant that on the very evening of the day when the sad intelligence arrived, Colonel Gordon took his departure from this country, and he was betraying no trust in saying that no man ever left England more determined to do good for these tribes or to sacrifice his life, if need

be, to aid them, than Colonel Gordon. Indeed, he was the personification of all that was wanted for the work he had undertaken, and he was sure that he would not now withdraw from these native Africans the aid which had been given them first of all by Mackenzie and Livingstone. If he could indulge his own feelings he should have liked to give a more detailed account of what Livingstone had done, but he had been asked to do this on another occasion in the form of a paper, wherein he could more fully convey that which struck him with regard to his wonderful career. He would only now say that there were already three missionary enterprises on foot, and that three parties, in the course of a few months, would be all wending their way to the district of Lake Nyassa, to the head waters which communicated with the Zambesi, the great highway into the eastern part of Africa. He believed there was a design in all this, and that there was a bright day coming for Africa, and he trusted that his auditors would not only give their attention to that which was looming in the future, but that all who came there to listen to what was detailed by the friends of Africa, would not only do so with deepening interest, but would go on one stage farther, and try, by their personal exertions and influence, to push forward the good work, until that continent which had been covered with such a deep curtain of darkness, might yet prove to be worthy of the beautiful world in which it was placed.

Dr. Mann then read the following paper by Mr. Shepstone:—

THE EARLY HISTORY OF THE ZULU-KAFIR RACE OF SOUTH-EASTERN AFRICA.

By Theophilus Shepstone,

Secretary for Native Affairs in the Colony of Natal.

The last 80 years' history of the colony of Natal shows more wonderful changes than we could well imagine, if we tried to invent a probable, or even a possible story, for our own amusement.

The "ups and downs" in the fortunes, not of individuals only, but of whole communities and populations, and the revolution in the social as well as in the political condition, which each change caused, are so wonderfully strange, as well as complete, that it would be difficult to find a country which could furnish a true story of itself so full of vicissitudes as Natal.

Ten, or at most twenty years more, will deprive us of the testimony of nearly all the few remaining eye-witnesses of the earlier of those exciting scenes which thus revolutionised the country. The particulars of the short sketch I propose to give you have been gathered from those eye-witnesses, and I believe them to be almost as correct as in the nature of the case it is now possible to make them.

It is necessary that I should first describe, as shortly as possible, the different phases of condition through which the inhabitants of this country have passed since 1812, for it was about that year that the great disturbance of their ancient comfortable mode of life commenced.

I shall endeavour to trace the causes which led to that disturbance, and its consequences, and in doing this I shall be obliged to take a glance at what is now called Zulu-land, for it was there, towards the close of the last century, that domestic events in a chief's family gave the first small impulse to the movement; and it is one of the most curious points in our wild story, that this impulse was to receive its strength and direction from such civilisation as then existed in the Cape Colony, before it could so rudely influence, as it afterwards did, the destiny, not of Natal only, but of the whole of South-Eastern Africa.

Up to about the year 1812, then, and for how many centuries before we cannot now tell, this country was thickly populated by numerous tribes, under independent chiefs. These tribes lived so close together, that tribal change of residence was difficult, if not impossible. They intermarried with each other—possessed flocks and herds—lived in ease and plenty themselves, and at peace with their neighbours; until this luxury occasionally culminated in a periodical quarrel (as is the natural tendency, the natives say, in all that grows fat), and this quarrel was settled by a periodical fight, but those fights were then by no means such serious matters as they afterwards became. In those days armies never slept in the open, *i.e.*, away from their homes. The day was fixed beforehand, the men of the rival tribes met in battle on that day, and the result of the single encounter decided the quarrel. The few old men still living, who lived then, delight to tell how that in those good old times they did not fight to shed blood, or burn houses, or capture cattle, or destroy each other, but to settle a quarrel, and see which was the strongest; how that their women looked on while the men fought; that prisoners taken in battle were not killed, but kept till ransomed; and especially how that many a young warrior, when the day's strife was over, would hand his shield and assegai to a companion to take home for him, that he might accompany his late foes, to renew his vows to some daughter of the rival tribe. For then, unlike later times they will touchingly add, "The sun that saw tribes fight never set till their quarrel was ended." But although their relations with each other, as tribes were so simple, and the opposite of aggressive there was always imminent danger of one ground of quarrel arising, which aroused every feeling of animosity, occasionally split up tribes, and caused more bloodshed, and the exhibition of more ferocity, in one year, than all their punctilious tribal battles did perhaps in ten. I mean quarrels between relations for succession to the chieftainship, in which sections of the tribe took opposite sides. This is certainly not changed in our experience of human nature, exhibited either in clas or families; but from the account of these quarrels they seem to have been kept up with such persevering malevolence as to suggest an explanation of what we ourselves experienced in our contact with these people, *i.e.*, that strong attachment to individuals and families which makes them earnest partisans; and that wonderful respect for, and devotion to, any person of whose duly constituted authority they are sufficiently convinced, which makes them obedient subjects.

We see, then, that with the exception of family quarrels, these people were unwarlike and harmless and lived in happiness and contentment with each other. Then, as now, the seasons favoured the high lands one year, and the low the next, and interchange of commodities for food went on, as it still continues to do, between the inhabitants of the two different classes of country, and friendly relations between tribes were the rule.

Such was the general condition of perhaps a million souls in what is now the colony of Natal

up to the year 1812, when the first or quiet phase of their history closes. Time will not admit of my entering into the detail of their social condition, such as their belief in witchcraft, and its effects, with other matters, which, although sufficiently interesting, are not necessary in so short a sketch as this of their general history.

In this year (1812) these people saw the first fruits of a single seed of knowledge, sown in the mind of a lonely fugitive, perhaps twenty years before; although sown to the westward of the great Fish River in the Cape Colony, it germinated to the north of the Tugela. And the fruit of this first lesson in civilisation was sad enough, for it inaugurated the second or turbulent phase of their history. It inspired one among the many tribes in that region (north of the Tugela), which were then living in almost the same circumstances and condition as those in this country, with a military spirit, and caused it to introduce a military organisation. This change soon developed itself still further, and became aggressive, so that the neighbouring tribes were compelled to adopt the new system also. But for some time wars, although more frequent, were carried on under more or less observance of the old rules. Tribes were not at first destroyed, although conquered. It was not until this new mode of warfare was directed by the sanguinary genius of Chaka, that extermination, as far as possible, followed every conquest. So great was the terror caused by this policy, that tribe after tribe gave way before him, and forced themselves through their weaker neighbours, whose feeble resistance they easily overcame. Several powerful tribes were driven in this way to force their retreat through what is now Natal. In vain did the inhabitants combine to resist; although numerous enough, they were undisciplined, and unused to earnest fighting; so they were easily defeated, and some of them carried to the south by the tribes they had attempted to oppose.

I have mentioned the year 1812 as the date when the second, or turbulent phase of their history commenced, because it was about that year that the first of these large tribes entered this country on their retreat from Zulu-land, through the present division of Newcastle, whose inhabitants were not only defeated, but plundered and scattered, and became in turn aggressors upon their weaker neighbours. This was the first actual experience they had of the great coming change. From the date of that event, wave after wave of desolation swept over the land, in the shape of retiring tribes, carrying all before them, in the attempt to place as great a distance as possible between themselves and the universal enemy Chaka. The alarm and demoralisation caused by the passage of these foreign bodies through such a people as then inhabited Natal, can be better imagined than described. But it is difficult for us to imagine even their full effect. The instinct of self-preservation, stimulated by terror, turned friends into foes, lifted every man's hand against his neighbour; and justified every treachery and atrocity hitherto unknown among them. But it was not by fugitive tribes only that such effects were caused—Chaka himself had to finish what they had merely begun. And after clearing away or subjugating the population north of the Tugela, he sent his armies periodically to this side, to ravage a country whose inhabitants were already sufficiently demoralised and spiritless, but who nevertheless possessed an abundance of the means of subsistence. His orders were to spare neither man, woman, nor child, to burn all houses, and destroy all food; and faithfully enough did his men execute those orders. The object, of course, was to render existence impossible within the reach of his arms, except under his rule. He aimed at universal sovereignty. And it was only during the last years of his life that he expressed his willingness to share the world with the white man. Several tribes offered themselves to Chaka as vassals, and were accepted. These afterwards contributed very much to the sufferings of the friends they had deserted. Their knowledge of persons and places enabled them to render much service to the armies of the great exterminator. Year by year did these armies extend the sphere of their operations, until at length they reached the tribes which had retreated through Natal, and established themselves to the south. These were either destroyed or were, for the most part, incorporated by Chaka, or driven upon the Kafirs on the frontier of the Cape Colony, among whom they became a sort of slave property, under the name of Fingoes. It is a strange coincidence that a recent Acting-Lieutenant-Governor, General Bisset, and I, were both present when Sir Benjamin D'Urban, the Governor of the Cape, at the head of a division of the British army, emancipated these very people from their slavery, in the Kafir war of 1835-36; and that in the course of our respective duties we have both had much to do with the measure.

But to return to our own population. Those who still remained in the country—and there were many thousands who did so remain—were by this time reduced to a condition absolutely hopeless and wretched. Naturally the means of subsistence furnished by their cattle and other smaller domestic animals had failed first; for they were eagerly sought after by Chaka's soldiers. Their stores of grain held out longer, but in time they were exhausted also, and as hopelessly as the cattle, for their granaries could not be replenished by cultivation, because cultivation attracted attention, and had therefore to be abandoned. Living in their usual huts, or indeed anywhere, except in rocks and bushy kloofs or glens, was out of the question. To live at all, without their usual food, seemed impossible. Their dogs had long been too weak to help to capture any, and, lean and hungry as they were, had been eaten by their masters. Wild roots were the only means of subsistence within their reach. These were scarce, required much labour to procure, and afforded but slight nourishment after all. No wonder, then, that the country was filled with the dead; and that, as the natives express it, the assegai killed people, but hunger killed the country. No wonder that these victims were left unburied by their emaciated friends, to feed wild animals, and still less that these animals became as much an object of dread as Chaka's warriors. Many poor wretches who could, crawled towards the Tugela to be picked up, as they termed it, by Chaka's haughty vassals. There they could at least get food, whatever the Government might be. Others refused to leave

their country, and preferred meeting the death that seemed to stare them in the face, to submitting to those who had caused them so much misery, and whom they had such small cause to trust.

It seems impossible, that in a cup so brimful of sorrow, space could be found for one additional drop. But it was possible, and that drop was the bitterest of all. In terror of wild beasts, in still greater terror of Chaka's ruthless soldiers and vassals, maddened by hunger, and altogether demoralised by the circumstances which surrounded him, a man conceived the horrible idea of feeding on his fellow man, and at once put it into practice. Starving wretches, in misery equal to his own, rallied round him, and a band of cannibals was soon formed, to be increased by two or three in other parts of the country. These bands hunted for human beings as men hunt for game. Driven first by necessity, they acquired a taste for this revolting practice, and continued it long after the necessity ceased. They had become so formidable that it was not until about the arrival of the first Dutch emigrants in Natal that the last of them were dislodged from the Biggersberg, and driven over the Kahlamba mountains by Dingaan. I have heard many a stirring story of escape from these cannibals, from the lips of those who were captured, and who had themselves listened to discussions as to whether they would eat tender or tough when they were killed.

To such a state of things, then, was this country reduced in the course of less than ten years after the first fugitive tribe entered the Division of Newcastle; and it continued, with little amelioration, until Chaka's policy had absorbed, with few exceptions, the whole of the survivors, and the Zulus actually occupied one-third of what we now know as Natal.

This completes my brief description of what I have called the second or turbulent phase of the history of our natives. To the third belongs the revival of hope, caused by the arrival of the Dutch emigrant farmers, and the establishment of a settled Government in Natal. To this I shall do no more than make an allusion presently.

I have said that all this suffering was caused by a lesson in civilisation learned by a fugitive in the Cape Colony. I must now relate to you a little of the personal history of that fugitive, to show how he came to be in the way to learn such a lesson, and how he applied it. To do this I must go back to the ten years which brought the last century to a close.

One of the most considerable tribes then occupying the country north of the Tugela was that of the Umtetwa. The Zulus were but a small collection of families, tributary to their more powerful neighbour. Jobe was the name of the Umtetwa chief. Warned by the example afforded by family quarrels about the succession in other tribes, he had determined, on the approach of old age, to make arrangements such as he supposed would leave no opening for dispute in his family. The two sons nearest the succession were named Tana and Godongwana. The old chief formally nominated the elder son, Tana, to succeed to the chieftainship at his death, and assigned to him one of the royal kraals as his residence. Had the old man done this and died, the great change we have been considering would most probably not have taken place; and if they had not, Natal could scarcely have become a British colony. But he lived on, to the great disappointment of his ambitious son, until, weary with waiting, the latter formed a plot to destroy his father. The younger brother, Godongwana, was privy to this plot—perhaps its originator. The two brothers lived together. The conspiracy became known, however, to the old chief, and he took immediate and very strong measures to repress it. He ordered the instant execution of both the young men, and sent a force to carry out the order. Special directions were given that the younger should not escape; he was considered the more dangerous of the two. Accordingly, the hut in which the brothers were sleeping was surrounded in the night, and nearly all found in it were put to death. Godongwana, fortunately for himself, succeeded in rushing through his assailants and leaping the outer fence. He did not escape scatheless, however. He was wounded in the back by a barbed assegai, and had to carry it away in his body. Daylight showed Tana, the eldest son, to be among the dead; the younger had escaped. His only chance of life now was to conceal himself. His sister knew he was wounded, for she had heard that the man who had leaped the fence was wounded, and she knew that no one but her brother could take such a leap. She sought for him as few but a sister would seek, and found him the next evening, faint and hungry. She extracted the spear, and ministered to his wants as best she could, told him of the danger of his position, that his father was angry at his escape, and had ordered strict search to be made for him; gave him her own kaross or robe, got a few attendants to accompany him, and bade him depart, with her blessing, until better times should come. At first the young man thought he would stay as near his home as possible, and he tried to linger among neighbouring tribes; but they were all, more or less, subject to his father's influence, and, generally speaking, willing to purchase the old chief's favour at the cost of his son's life. Many attempts were made to destroy him, but failed. I should weary you were I to tell the many stories of miraculous interposition in favour of this young man which are believed by the natives. In some of these the sister's robe is said to be the instrument of his safety; others, some ointment she had given him. But, whatever amount of truth there may be in these stories, it is quite clear that, finding his life so much sought after, he took a dive, no one knew where, and was not heard of for years after. In the meantime, although his people believed him to be dead, his father professed the contrary, and to the last refused to nominate a successor other than his missing son. But on the death of the old man, it became necessary to appoint a successor, and Godongwana's younger brother, of another house, assumed the government of the tribe.

Things went on quietly enough for a while with the Umtetwa tribe. At length strange rumours reached them. It was whispered that Godongwana was still living, and that he intended to return. In due time the fact that he was actually on his way became known. Soon after this followed descriptions of his person, and his mode of travelling; and highly exaggerated these descriptions were. Of course he was handsome, and

looked every inch a chief. But the strange animal he sat upon was the wonder of all men. When it carried him along, no one, at first sight, could say whether it was all man or all beast. It looked as one animal. It had, however, been ascertained, people said, that it was a man sitting upon an animal, and that man was Godongwana, the son of Jobe, chief of the Umtetwa tribe, and that the animal was an "Injomane." What this meant no one could tell, as a horse was as much an object of curiosity to the natives of these parts in those days as a live unicorn would be to us. To give you some idea of the notion these people had of a horse, I will relate an incident which occurred twenty years after the time of which I am now speaking. One of the tribes, now in this colony, had met an expeditionary force from the Cape frontier to the south of the St. John's River. Part of that force was mounted. During the engagement that followed one of the horsemen got separated from his horse, and it ran wildly away. The chief immediately gave orders for every exertion to be made to destroy it. He thought that letting the animal loose was one of the modes of warfare used by the enemy; that it tore men to pieces with its teeth, and stung them to death with its tail. It seemed to them so active an animal that the sooner it was despatched the better. The poor innocent victim of this calumny was of course easily despatched, amidst triumphant yells from the valiant warriors.

You will see, then, that a young chief, returning to the tribe over which he claimed authority, under such circumstances, and sitting upon a horse, would do so with no small prestige in his favour. The reigning brother offered a futile opposition, and lost his life for his pains. Godongwana soon established himself as the rightful chief of the Umtetwa tribe, for (as the natives, in allusion to the scar he received in his leap for life, express it) his wound was his witness. In compliment to his strange history, his name was changed from "Godongwana" to "Dingiswayo," which means "The Wanderer," or "he who was caused to wander." And I shall now speak of him by that name.

It seems that in his travels he had reached the Cape Colony, and must have lived with or entered the service of some colonist. Whether he got his horse honestly or not is a question which must now, I fear, for ever remain unsolved. It was during his stay in the Cape Colony that he acquired the information, or made the observations, which were to effect the great change in his native land and the surrounding countries of which I have just given you a very imperfect idea. He learned the strength of standing armies, the value of discipline and training, as compared with the mobs called armies in his own country. He saw that if he could gain possession of his tribe he could gratify his ambition. He had heard of or seen bodies of civilised soldiers; he had ascertained that they were divided into regiments and companies, with regularly appointed officers, and he thought that all soldiers were bachelors. He had no sooner got possession of power than he set to work to organise his tribe in accordance with these ideas. He formed all the young men into regiments, with commanders in due subordination to each other, and very soon he had a formidable regular force at his command.

To possess such a force, and to use it, seems to have been a necessary consequence with such a man, and he was not long in making the trial. As might be expected, no tribe could withstand the attacks of his army, newly formed though it was. But he was neither blood-thirsty nor avaricious. He fought to conquer, and to show his superiority, caring little for capturing cattle. He forbade the destruction of women and children. The great test of victory in his mind seemed to be the power of feeding his army on the grain stores of the conquered. "Let the weak man sow, and the strong man reap" was his motto. It is said that he always halted his army until the enemy's corn was exhausted. But his opponents usually tendered their submission, and re-occupied their country as Dingiswayo's vassals the moment he withdrew his forces; so that he never destroyed, or permanently dispersed any people with whom he went to war.

But the surrounding tribes had already, in self-defence, adopted the new military system, and Dingiswayo, not calculating the effect of this on his neighbours, eventually himself fell a victim to the organisation he had introduced. He was taken prisoner when in advance of his main body with a small guard, and put to death by a chief who had often been his prisoner before, and whom he had as often released, in deference to his grey hairs; for, said Dingiswayo, "he was the companion of my father." But it must be said, in excuse for this old chief, that it was his great wife—a lady whose head was much larger than her heart—who insisted on the execution of her husband's generous enemy.

Dingiswayo was the introducer only of the novel war system, but the man who caused it to make such an impression on the country must be now briefly spoken of, to render this sketch intelligible.

Senzangakona, chief of the small tributary Zulu tribe, had an illegitimate son, named Chaka. The young man was energetic and talented, and, like many such young men, assumed airs which did not quite suit his position, and were offensive to his father's family. In consequence of their hostility, he and his mother were compelled to flee for their lives. They took refuge with Dingiswayo not long after that chief had succeeded in organising his army. Chaka entered one of Dingiswayo's regiments as a private soldier, and was present with it in all that chief's expeditions. His gallant conduct soon won for him a great reputation as a soldier. He narrowly watched his master's policy of forbearance and its consequences, and disapproved of it, because he thought it would lead to dangerous combinations against the supreme chief. In his opinion the only safe plan was to inflict such an injury as would thoroughly disorganise, if not destroy. Hence, when he acquired power, he adopted the uncompromising system which raised the Zulu name to such renown in South Africa.

When Chaka had served long enough in Dingiswayo's army to understand the system it was based upon, and to mark its defects, his father, Senzangakona, died. Chaka was of course not entitled to the succession, for there were other sons whose claims were superior. But in deference to their supreme chief, the tribe submitted the question to be decided by Dingis-

wayo, and he being convinced, not only of his young soldier protégé's ability, but, of what was of far greater consequence, his loyalty to himself, appointed Chaka chief over the Zulu tribe, at that time weak, tributary, and insignificant.

Up to the death of Dingiswayo, Chaka always faithfully co-operated with his old master, and it was the result of a combined movement by these two chiefs that drove the powerful tribe on its retreat, to enter the present division of Newcastle about 1812, as already mentioned. And thus was caused the first shock felt by the doomed but unsuspecting inhabitants of this land.

All the troubles which followed, and which I have very imperfectly described, were caused by Chaka alone. His genius overbore all opposition, and he died within the territory which now constitutes this colony, on the 23rd September, 1828, undisputed sovereign of all South-Eastern Africa, from the St. John's River on the south, to King George's River on the north; including a large portion of what now forms the Orange Free State, and the Transvaal Republic, as well as the tribe and territory of his old master and patron, Dingiswayo.

This brings us to times to ascertain the history of which we have more or less of documentary evidence to refer to, I shall not, therefore, trespass upon them. I have selected the period embraced in this sketch, because it is of necessity less known than that on which books have been published, and because the tale of its occurrences, however imperfectly I have told it, may teach us valuable lessons,

I wish, in conclusion, to present a kind of analysis of this history; and you must be good enough to bear in mind that it relates to a period scarcely extending back sixty years from this date. It shows three phases, representing three conditions, as opposite, each to the other two, in most respects, as it is possible for any nation to be.

In the first, we have simple, primitive, unalloyed barbarism, unmitigated, as well as untainted, by any trace of civilisation. Under this condition, which probably had lasted for centuries, the people enjoyed peace, prosperity, and plenty.

In the second, we have the same barbarism, the same people, and the same country; but we have also added to these a dash of civilisation—a stray, but not very incorrect, notion of one of its practices, which poisoned all enjoyment, cut off all that sustains life, turned thousands of square miles into literally a howling wilderness, shed rivers of blood, annihilated whole communities, turned the members of others into cannibals, and caused miseries and sufferings the full extent of which can now never be known, and which, if even known, could not be told.

In the third, we see civilisation no longer represented only by a mere notion or idea, but in its living bodily form protecting and ameliorating the condition of the remnants of this wreck. Where, a few years ago, so dreadful a storm of human passion and violence raged, we now see a British colony, with its quiet farms, its representative institutions, its Christianity, its electric telegraph, and its little railroads; and we see also its inhabitants occasionally discussing the most advanced topics of the most enlightened civilisation of the age. When we realise the idea that these three great changes have all taken place in the country we live in, during the short compass of less than a man's lifetime, we shall understand and wonder at the fearful rapidity with which revolutions sometimes overwhelm a people; and we shall wonder still more when we contemplate the apparently trivial events from which such momentous consequences have sprung—events which, if calculated according to the ordinary doctrine of chances, would have stood at one hundred to one against occurring at all. But trivial as they were in themselves, they have already influenced the destiny of thousands, and have, in my opinion, contributed in no small degree to the planting of civilisation in this land for some wise and beneficent purpose, which I sincerely hope may be faithfully fulfilled.

ADDITIONAL NOTE ON THE KAFIRS OF NATAL.

By Robert James Mann, M.D., F.R.G.S.,
Late Superintendent of Education in the Colony of Natal.

The interesting memorandum, by Mr. Shepstone, which I have communicated to the African Section of the Society, relates to a period included between the years 1785 and 1828. The colony of Natal, which is now the centre of the region alluded to in this narrative, and which is essentially the gate by which civilising influences are flowing in to the native tribes of this part of the African continent, is not a large State. It is a mere strip of land, about one-third the size of England, between the Drakenberg range of mountains and the sea, and looking out by its seaward slopes upon the Indian Ocean. The Natal territory begins at the River Umtamfumé, nearly 800 miles beyond the Cape of Good Hope, up towards the Indian Ocean, and leads along the seaboard for about 150 miles. The seacoast lies between the 29th and 32nd parallel of south latitude, but the territory extends inland along the 30th meridian of east longitude to a distance of about 250 miles, being at that northern point not more than 220 miles away from the southern tropic. The capital Pietermaritzburg stands in same parallel of latitude that Grand Cairo occupies on the other side of the equator.

This part of Africa, it will be remembered, was discovered by the renowned Portuguese navigator, Vasco de Gama, at the end of the year 1497. He made the land suddenly while beating up to the India Sea, towards Hindostan. It is not certainly known which part of the coast it was that he first sighted, but it was certainly some part that now lies within the colonial territory. Tradition marks the beautiful inlet of smooth land-locked water, which at this time forms the harbour of the colony, as having been the Christmas-day haven of the old seaman, and the land has hence been named the "Land of the Nativity." Scarcely anything beyond the fact of its geographical existence was, however, known for another two centuries and a quarter after its discovery.

In the year 1823 an officer of the Royal Marines, who had been engaged in surveying the African Coast, repeated the action of the Portuguese navigator. He paid a passing visit to the Bay of Natal, and was so favourably impressed with its

aspect, that when he returned to the Cape of Good Hope he proposed to occupy it as a trading station. The Government at the Cape declined to have anything to do with the scheme, but Lieutenant Farewell managed to interest about 20 individuals in his plans, and with the personal co-operation of Mr. Foynn, but recently well known as one of the earliest English settlers in Natal, he returned to the Bay, and established himself in huts which were erected, as the first lodgment of the expedition, on the exact spot where the market square of the Port of Durban now stands.

Lieutenant Farewell's party landed at the Bay within five years of the termination of the period that is touched by Mr. Shepstone's narrative. The shores of the beautiful Bay and the surrounding hills were at that time virtually destitute of human inhabitants, and the military frontier of the Zulu despotism was fixed some thirty miles further up the coast towards the north-west; but in a position that lies far within what is now known as colonial territory. Chaka had at that time a large military post, or camp, close to the river Umblali, at a spot which is still spoken of as Chaka's kraal, although it is now filled and made musical with the swaying and rustle of the sugar cane of the colonists. Mr. Foynn, the companion of Lieutenant Farewell, has left a very graphic and touching account of the desolate condition of the land at this time. He says that there was not a single native hut or village to be found between the river Tongaat, which was within half a dozen miles of Chaka's military kraal at the Umblali, and the Bay. There were no cattle, no gardens, no growing crops; the entire country was an unoccupied wilderness. Occasionally a few half-starved stragglers were encountered deriving a miserable and precarious subsistence from wild roots and shell-fish. It was the rarest occurrence to see more than two natives together. In the hill regions of the interior some small remnants of the broken tribes, clinging to the fragments of their Lares and Penates, still managed to hold together in concealment in the impenetrable bush, and dragged on a miserable existence, dogging the emissaries of the conqueror from place to place, and occasionally dying of actual starvation. As Mr. Shepstone states, some of these wretched and starving savages actually became cannibals under the pressure of their privations and sufferings. Dogs were commonly eaten, and the hyænas became so daring and fierce from feeding on human flesh that they boldly attacked full-grown men and women, and frequently carried away children.

The English settlers, of course, had to make application to Chaka for permission to establish their operations at the Bay, and a deputation was sent up to his military post at the Umblali for this purpose. The military despot, with most probably a keen eye to the material advantages he might receive from a handful of men, that he could not possibly have any cause to fear, and with perhaps also some memory of the marvellous things he had heard from his old master Dingiswayo, of the doings of this white race, gave at once a ready consent. The wretched and starving stragglers in the surrounding bush, however, began almost immediately to flock in round this nucleus of white men, instinctively impressed with some sense of safeguard and protection from their presence, and this constituted the first germ of the black population of Natal—giving first a voluntary obedience to the white settlers, and subsequently a formal allegiance to the Queen—that has since grown to nearly three hundred thousand people. By a recent investigation, Mr. Shepstone has ascertained that there were no less than ninety-two distinct small tribes residing within the territory which at this time constitutes the colony of Natal, before the invasion of Chaka, and anterior to the period that is spoken of by Mr. Shepstone. The Zulu tribe, that afterwards waxed so mighty and so dread, was no doubt primarily but a small, powerless tribe of the same gentle and unaggressive character. At the present time representatives, and in some sense descendants, of forty-three of the original tribes are to be found in the native districts of the colony; and there are, also, over and above this, seven other tribes that have come in from beyond the borders of the colony, and nine new tribes that have been formed by the Colonial Government by the commingling of the fragments of the old tribes of the district that had been almost exterminated by the raids of Chaka. In all there are now fifty-nine distinct tribes of Natal Kafirs, each with its own separate headman, or chief; but all in orderly subjection to the English Government.

The traveller who goes among these Natal Kafirs in their own locations at the present day, finds them living there very much in the manner in which they lived in the same region before the advent of the white man, and before the invasion of the armed legions of Chaka. They dwell in hemispherical huts of reed and straw, which they enter by crawling on all-fours through a low arched orifice, in some sense resembling the entrance of a bee-hive. These huts are planted in circles on the hill-sides, within a ring-fence of faggots and wattle. With the exception of these thatched hemispheres they have no architecture. In their own reserves they have never attempted to hew a stone or to fashion a brick, although they now continually see their white neighbours doing such things. They remain almost without clothes, and for domestic utensils and implements have little more than the rude sun-baked pots, carved wooden bowls and spoons, and woven grass beer vessels of their forefathers. Their beds are small coarse mats spread upon the ground, their pillows logs of hard wood, and their fireplaces clay hearths formed in the centre of the huts, without any chimneys. They have herds of oxen and flocks of long haired sheep, and of goats, which are looked after by the boys and men, and gardens of cultivated millet and maize, which are tilled by the girls and women. It is exceedingly remarkable that these people, with considerable powers of observation, and much natural aptitude, have, after their dispersion by the aggressions of Chaka, again gathered themselves back into the fold provided for them by civilised protection, with an exact reproduction of their old life of primitive barbarism. Each tribe is again headed by its own patriarch, or chief, who in many instances is the direct descendant of the old ruler. But these several chiefs are now each and all children of Queen Victoria, and living beneath the shadow of her shield. They are still chiefs in the sense that they are looked up to by their people as the traditional heads of the clans, and with authority to settle petty

disputes, and to punish petty offences, but they are also now Lieutenant Chiefs, held responsible to the supreme chief, the Lieutenant-Governor of the Colony, for their administration, and all grave matters are referred to the magistrates and judges of the land. They are eminently sociable in their tastes, and clannish in their instincts, and live in close intercommunication and fellowship. They are great talkers, and by means of this talk a certain measure of informal and undesigned education goes on amongst them. The young men are restlesss, impulsive, and noisy, like overgrown children, and some of this impulsiveness takes a form of empty boasting and grotesque displays of marshal ardour of the Bobadil class, which in all probability is the principal legacy that has been left to the race by the traditions of the warlike deeds and days of Chaka, but this juvenile fervour tames down as they reach the years of manhood and maturity. The old men are almost universally sedate, sagacious, shrewd, unswerving in their ready obedience to order and to law, and with a very keen and adequate sense of the advantages they enjoy in being within the pale of a settled and just Government, and of the great fact that they have taken a guarantee in this against any possible return of the old wretched days of spoliation and systematised murder. The indolence of the men, and their disinclination to make any effort in social advance is, no doubt, in a very considerable measure, due to the geniality of the climate, and to the very restricted range of their actual wants, rather than to inherent and ineradicable incapacity.

The Kafirs, as a race, are somewhat below the stature of average Englishmen, and have slim, lithe, and active frames, capable at a push of bearing considerable exertion of a certain class, such as long journeys on foot, although disinclined, as a rule, to sustained labour. Many of the true negro characters are strongly marked in them. They have the woolly hair, the broad noses, and the thick lips, and also much of the docility, the light-heartedness, and the extravagantly grotesque humour of this race. But some higher qualities, which the negro does not possess, are superadded to these. They have on the whole a finer physical development—more gracefully and lightly sculptured limbs, a higher cerebral organisation, and greater natural shrewdness and sagacity. It is most probable that they are a fusion of the negro stock with a race that has originally come down from the highlands of Abyssinia, and passed through the equatorial tribes, mingling with them, and sending forth a mixed race of their common descendants towards the south. Mr. Palgrave's description of the Kahtame Arabs of the south-eastern districts of the Arabian peninsula, whom he believes to have originally come from the highlands of Abyssinia, and to be quite distinct from the Ismaelitie Arabs of the north-west of the peninsula, very forcibly recalls many of the peculiar characteristics of the Natal Kafirs, and it is worthy of note that he speaks of one of the peculiarities of the Kahtanic Arabs as being a readiness to fuse with the negro tribes. Among the Kafirs of Natal there is sometimes more of the one of these forms of physical organisation and sometimes more of the other, presented to observation. Even in the same family the projecting jaw, the long head, and the broad flat nose of the negro are sometimes seen side by side with the sharp features, the thin lips, the projecting nose, and the upright head and prominent square forehead of the higher and nobler type. In these instances it is sometimes the negro element and sometimes the Arab element of the organisation that seems to crop out. It is a fact well recognised by ethnologists that the true negro characteristics are in a state of mitigation, if not in abeyance, towards the eastern borders of the vast African continent. The great source of this mitigation may therefore very naturally be looked for far up along those eastern borders of the sea-girt land, and it is precisely there in the high regions of the eastern coast that the Abyssinian cradle of the Kahtanic Arab is found by the adventurous explorer.

The Chairman said that the Zulus, who had been so well described with regard to their military organisation, had played a great part in Africa, and he believed they would continue to do so for many years to come. He quite concurred in the view expressed by Dr. Mann, that they originally came from the north, but there was now a partial reflex action going on, and some of them were making their way back again. A party of them crossed the Zambesi in 1859, and, profiting by their military discipline, had formed themselves into a tribe which was devastating a great part of Eastern Africa. These were the people who were mentioned by Livingstone as the Masitu; they massacred adults in all directions, but enlisted boys of 12 and 14 years of age, and brought them up in their own habits, teaching them to cast off their spears and bows and arrows, and to fight at close quarters. One of their most desperate battles at Dingaan was won by breaking their assegais in two, so that the warriors were obliged to use them as daggers instead of throwing them; and in all ages it had been found that those who could thus fight at close quarters had been more than a match for those who depended on long shots. So it had been with these Masitus; they had completely decimated the tribes on the east and west of Lake Nyasa, on the east side of Lake Tanganyka, and there was great reason to suppose that they extended to the west of it also. He mentioned this to show what good discipline could accomplish, and how easy it would be for a few determined men, with a knowledge of warfare, to form troops and subdue a large country. Englishmen might take a lesson from this, and if something like the Hudson's Bay Company were started in Central Africa, it should be remembered that a few men with a knowledge of European drill and tactics could not only protect themselves, but insist on peace being preserved in their neighbourhood. And he would add, that if there were one thing more than another which Africans understood and appreciated, it was the blessing of peace, and they would always cling to anyone willing to enforce law and order.

Mr. Trelawny Saunders, in proposing a cordial vote of thanks to the Chairman for his interesting address, and for the valuable hints he had thrown out, said that if ever English merchants, who were always lovers of peace were desirous of establishing themselves in Africa, they must begin by making themselves respected, and show their ability to keep their own ground by means which the natives could appreciate. If they wished to penetrate into the interior they must do so with arms in their hands, not only to peacefully carry on their own pursuits but to put down lawlessness and establish order. The advocacy of such a system would go far to make English men understand how civilisation might be carried on in Africa, and might induce young men of enterprise such as those who established the Hudson's Bay an

East India companies, to form some new African company, which should be the beginning of a new era of civilisation in that great country.

Mr. SWANZY, in seconding the resolution, said he had always taken a great interest in the progress of Africa, and he had been very much pleased with the suggestions offered by the Chairman that evening. His experience up to the present time had not been very favourable to African companies, but he did not doubt that a powerful association, well armed, might penetrate into the interior. What they were to do when they got there he did not know, but that was another matter. There was ample scope for trade with the interior, but not on the West Coast, as he had already shown on a former occasion. He should, however, be happy to aid in the formation of a company at any time, and to give them the benefit of such experience as he had gained in a long course of African commerce.

The vote of thanks was carried unanimously.

SEVENTH ORDINARY MEETING.

Wednesday, January 27th, 1875; Captain Sir JOHN HERON MAXWELL, Bart., R.N., in the chair.

The following candidates were proposed for election as members of the Society:—

Arteaga, Rodolfo de, 79, Gower-street, W.C.
Browne, Roland Jay, 3, Hare-court, Temple, E.C.
Cleaver, the Hon. William, 122, Cannon-street, E.C.
Emmott, W. T., Binfield-lodge, Clapham, S.W.
Fox, Colonel A. Lane, Upper Phillimore-gardens, Kensington, W.
Gisborne, Thomas Matthew, 4, Upper St. Germain's-terrace, Blackheath, S.E.
Waugh, John George, 11, South-square, Gray's-inn, W.C.; and Highfields, Crouch-end, N.

The following candidates were balloted for and duly elected members of the Society:—

Haliday, Maj.-Gen. Andrew, United Service Club, S.W.
Hands, Richard Medwin, Coventry.
Higgin, James, F.C.S., 22, Little Peter-street, Gaythorne, Manchester.
Hirst, J. H., 8, Small-street, Bristol.
Lewis, William Henry, Charnleigh, Roath, Cardiff.
Twite, Charles, F.R.G.S., Uuruguay, and 5, Victoria-street, S.W.
Whittem, Thomas Sibley, Wyken Colliery Company, Coventry.

The paper read was—

THE MERCANTILE MARINE OF GREAT BRITAIN.

By Capt. Bedford Pim, R.N., M.P.

In the remarks I am about to make I shall endeavour to place before you, as fully as time will permit—although of necessity I must be at least comparatively brief—the leading features of a subject of the gravest importance and the greatest interest to us all, "The State," that is, "and the Condition, of the Merchant Marine of our Country." Possibly the words I have just spoken to some of you may have appeared strange, and, indeed, exaggerated; but, on a little reflection, I am disposed to believe you will admit my present subject to be, in the highest degree, both important and interesting to us all—to us all, individually as well as collectively, since I shall be able, as I proceed, to show that we are all more or less dependent upon our merchant shipping, not merely for the comforts and the luxuries, but even for the necessaries of everyday life.

The area of these dearly-beloved islands of ours, including the Channel Islands, is about 80 millions of acres. Of this about 50 millions are cultivated for crops, leaving the remaining 30 millions to be accounted for by lands covered with houses and buildings, by gardens and parks, lakes, rivers, roads, bogs, moors, and woods. This 50 millions is altogether insufficient to sustain our great and ever-increasing population, even in the commonest food. In fact, careful calculations show this area of the British Islands to be capable of sustaining about one-fourth only of our population of 32½ millions; and, consequently, that for the sustenance of the remaining 75 per cent. of our people—that is, for at least 24 of our 32½ millions—we have to depend upon supplies brought to our shores by merchant shipping from foreign countries.

Seen from the other side, the same great question assumes an aspect such as this:—The imports for the year 1873, in money-value, amounted to £371,287,372, the exports for the same period being £311,004,765. Thus the total value of the cargoes brought into Great Britain and taken out from her in a single year amounted to the vast sum of £682,292,137. In order to accomplish this enormous carrying to and fro of the earth's produce, and of the productions of human industry, shipping having an aggregate tonnage of 6,500,000 tons is employed by us. Or, estimating each sailing-ship at an average of 240 tons, and each steamer at 400 tons, 2,500 steamers and 22,000 sailing-ships, making a grand total of 24,500 vessels, engaged in conducting this indeed mighty commerce.

Again, allowing for each 100 tons of sailing-ships three men, and for each 100 tons of steamers five men, the services of no less than 200,000 seamen would be required.

The cargoes thus conveyed to us on this gigantic scale, year by year, very largely consist of various articles of food and clothing, necessary for health and happiness. On the other hand, the exports represent our national industry and enterprise, or, in other words, they exemplify our national wealth.

The amount of our imports and exports, therefore, is clearly seen to materially affect the personal interests of all classes of our national community, from the highest to the lowest in the land,—and this, not as a matter of wealth only, but as bearing directly upon the primary and vital question of our very existence. And so, considering the intimate connection existing between our imports and exports and our merchant shipping, I do not hesitate to assume your hearty assent to my proposition, that the "state and condition of our merchant marine" very closely touches the health, the wealth, and the happiness of every individual of ourselves now here present, of every other individual also of our fellow countrymen and countrywomen through the length and breadth of these realms.

If this be true, as certainly most true it is, how great and imperative must be the necessity—not to say, the duty—incumbent upon us, by every

possible legitimate means, to promote the expansion as well in numbers as in efficiency both of our merchant ships and of the sailors who man them.

Now, under what aspect and in what form does this great matter really present itself to us? To such an inquiry the answer is as simple and plain as it is both startling and lamentable. Since the repeal of the Navigation Laws in 1849, just one-quarter of a century ago, the marine carrying trade of this vast commerce has gradually been melting away from our flag, and falling into the hands of other nations. Indeed, at the period of the commencement of the great Civil War in the United States, in April, 1861, matters looked dark indeed for us, our Transatlantic kinsmen having then absorbed a very large proportion of the marine carrying trade of the world. At that time the tonnage of American merchant shipping was about equal to our own. One effect of the American Civil War, however, was to throw the United States completely into the background in respect to their merchant shipping. And yet, notwithstanding the approximate extinction of that once formidable rivalry, at the present moment a very large proportion of our own commerce is carried in foreign bottoms. Had it not been for the American Civil War, it would be difficult indeed to say to what condition our merchant service before the time now present might have been reduced; so that in this case, at all events, we have an illustration of no common magnitude of the saying, "It is an ill wind that blows good to nobody."

It is not my purpose even to attempt to deal with the policy of abrogating the Navigation Laws in 1849. That measure is in itself a matter involving many and intricate questions closely affecting our national domestic economy. It also continues to be in so complicated a position that, at any rate on the present occasion, I shall not pause even to cross the threshold of the subject. Instead of this, I am content to point out that, all competition notwithstanding, the amount of our national tonnage still retains very respectable comparative proportions, though, perhaps, not all that could be desired when looking at our essentially maritime position, to our dependence upon ships and sailors, and to the rapid increase of our population. Our tonnage is equal to that of three other countries of Europe—France, Holland, Norway—and that of the United States. I have computed that at the end of last year, exclusive of river steamers, England possessed—

	Numbers.
Sailing ships	22,000
Steam ships	2,500
	Tonnage.
Sailing ships	5,300,000
Steam ships	1,200,000
	Sailors.
Sailing ships	150,000
Steam ships	50,000
Total	200,000
Deduct *known* foreign sailors	25,000
Total	175,000

From this general sketch you will be enabled, I hope, to form some idea of the extent, as also of the range, of our mercantile marine resources.

I will now proceed to discuss the state an condition of the merchant navy of Great Britai That I may be enabled to do this in order and wi the greater clearness, I propose to divide the su ject into two parts:—The first part I shall d vote to the men; and the second part will de with the ships.

SEAMEN.

As I have already stated, in our sailing-shi and steamers, exclusive of river-boats, there a employed not less than 200,000 seamen. Of th number three-fourths serve in sailing-ships, a the remaining one-fourth in steamers. Of t 200,000 seamen, a very large proportion, amoun ing to about 25,000, or one-eighth of the ent number, are *known* to be foreigners; but, by pe sons who are well qualified to form an accura judgment on this subject, I have been inform that the foreign sailors in our ships in reali exceed even 50,000 in number, since now-a-da men are shipped without questioning; and, in ve many cases, almost the entire crews of ships saili under our flag are composed of foreigners. I ha reason to believe that an English ship sailed fr our shores the other day without a single Engli born subject belonging to her; and certain it that, at the shipping ports, notices to the followi effect are far from infrequent:—"Wanted, a f hands—foreigners preferred." Foreign sailors, may observe, are to be had comparatively cheap

If we assume that 150,000 British-born seam are to be found in our merchant service—this sur is a sufficiently large number of men, probal a larger number than belong to any other tra in the kingdom—to make an inquiry into th condition a matter of great interest. It is to t condition of these men that I desire to invite att tion, not at all after a sensational fashion, but the calm dispassionate spirit of a man who h served in the merchant navy, who naturally ta a deep interest in its welfare, and who has h more or less intimate experience of it for upwar of 30 years; who, moreover, is deeply impress with the grave national importance of this subjec and also of the absolute necessity for a searchi inquiry into the entire organisation, or rather t total disorganisation of this invaluable class men. In proof of the urgent need for such searc ing inquiry, it cannot be denied that our mercha sailors are less understood than any other class working men in the United Kingdom. Were not so, the existence of the following facts wou have been impossible:—

1. That the sailor is ill-used.
2. That he is inadequately paid.
3. That he is badly fed and housed.
4. That his life—a life of continued exposure a hardship—is rendered the less endurable by sys matic neglect; and that he is altogether wo off than the members of any other class of h fellow-subjects, not even excepting the deniz of our prisons.

As a consequence of these facts, and a lo course of neglect, it has been conclusively show that, on the whole, and with certain not exceptions, the merchant sailor of to-day not the same personage he was less th a generation ago. "The Committee of I quiry into the Condition of our Seamen" ha investigated this matter exhaustively; and th

report states, that from a large number of replies to pratical inquiries, they find 89 per cent. of such replies agreeing in the opinion that the sailors in the merchant service—as a general rule—have deteriorated as seamen; 65 per cent. of these same replies agree in like manner in the conviction that they have deteriorated in physical condition; and 71 per cent. of the same replies are unanimous in considering him to have deteriorated in subordination.

Now listen to what the merchant sailor says of himself. Take the north-eastern ports, for example, in which, of all parts of Great Britain, the men naturally and justly might expect steady employment and good treatment. They say, "we sailors (skilled workmen as we are, and valuable men) gladly take any employment on shore, where even the farm labourer, although he runs no risk of life and limb, gets better paid."

So much for what the north country seamen say of their present condition, and what they say speaks plainly and direct to the point, needing no comment to explain, no argument to enforce their words; but let us look to other points of the compass. The petition which I now will read to you—a document plain, clear, and conclusive—and which in a few days I shall have the honour of bring before the House of Commons, emanates from seamen representing, not the northern ports alone, but also the southern, the eastern, and the western.

To the Honourable the Commons of Great Britain and Ireland, in Parliament assembled.

The humble petition of the undersigned mariners respectfully showeth:—

First.—That in the opinion of your petitioners, founded upon their own experience, the men employed in the British Mercantile Marine Service are subject to great disadvantages, which can only be remedied by practical legislation.

Second.—That the present way in which ships' articles are drawn up is arbitrary, and productive of inconvenience and injustice, and that advantage is taken of the articles to bind seamen to other duties than those which properly belong to them on board ship, and to membership in "benefit societies," which have no natural relation to the purpose for which articles of agreement were designed by your Honourable House.

Third.—That it would conduce to the welfare of the seamen and the interest of owners of ships, if, at the time of signing articles, it were made compulsory upon owners to give any mariner who required it an allotment note for two-thirds of his pay payable monthly, for the support of his family or relations, and that it would tend to diminish the evils that arise from the present system of advance notes.

Fourth.—That in the opinion of your petitioners it is unreasonable and unjust that a mariner who fails to comply with the articles of agreement is punished criminally, while he is compelled to take costly and tedious civil remedies against the employer who fails on his part.

Fifth.—That the laws and regulations with respect to the supply of food to mariners are in many cases evaded or defied by owners or masters; that quantity is deficient, the quality inferior, and that no inspection of food is provided or enforced.

Sixth.—That under the present system so much time elapses between the discharge of crews and their being paid that much suffering and immorality arises therefrom. That wages should be paid within forty-eight hours after the termination of the voyage, and any further delay should entail two days for one in favour of the mariner.

Seventh.—That in the opinion of your petitioners it would be a great advantage to owners, masters, and seamen, and the nation at large, if seamen were required to pass a practical examination in seamanship before being allowed to sign as an "A.B.," and that it should be made penal on the part of the master or other person to engage uncertificated men, and that the apprentice system should be restored, and it should be made compulsory upon owners to carry a number of apprentices in their ships according to their size and tonnage.

Eghth.—That great inconvenience and injury result to the mercantile interests of the kingdom from the large and increasing employment of foreigners and Lascars in British ships. That within the last few years the proportion of foreigners to British seamen much exceeds that of one quarter of the whole.

Ninth.—That a serious evil arises from the shipping of foreigners, generally the outcasts of their country, from the amount of disease they introduce on board ship in spite of the beneficial working of the Contagious Diseases Acts. Your petitioners therefore pray your Honourable House to so legislate that a compulsory medical examination of seamen shall take place before the crew will be allowed to sail in any ship under the British flag.

Tenth.—That great abuses have crept into the present system of shipping seamen at the various shipping offices in the United Kingdom which require the attention of the Legislature, and especially in regard to large companies.

Eleventh.—That, in the opinion of your petitioners, great abuses do exist by the practice of shipmasters charging interest upon moneys that may be advanced out of seamen's own wages.

Twelfth.—That the berthing accommodation at present alloted to sailors is altogether insufficient, and in most cases so disgracefully bad as to call for immediate legislation.

Your petitioners therefore pray your Honourable House to take such steps as shall, in the wisdom of your Honourable House cause the above and other grievancees of the merchant seamen of the United Kingdom to be presently remedied.

And your petitioners will ever pray.

Signed on behalf of the London Seamen's Mutual Protection Society.
President, TOM. S. LEMON.
Secretary, A. PETERSEN.

It is not to be supposed that the men are alone in their complaints—their most just complaints—for the officers also seem to be in almost as bad a plight. For instance, the Master's Society of Sunderland point out that they "believe the Marine Boards and Courts of Inquiry are not properly constituted to satisfy the ends of justice (considering the difficulties that surround a seaman). They are not aware that any other class of her Majesty's subjects are liable to be deprived of earning a livelihood for errors of judgment, neither are they aware of any class or profession liable to be tried in the same way as masters and mates of the mercantile marine. They do not object to inquiries, but wish that the courts may the more effectually scrutinise and deal out justice. In fine, they wish to be dealt with as other subjects of her Majesty are."

Thus I have endeavoured, unreservedly and in plain words, to lay bare the actual state and condition of our merchant seamen, officers as well as men. Here, then, before passing on to the second part of the subject, in which I shall treat of our ships, I pause in order that I may be enabled briefly to suggest the remedy—or rather the remedies—calculated, in my opinion, at once to check the alarming decline in both the quality and the quantity of British seamen, and which also ultimately may resuscitate, or, perhaps I ought to say create, a powerful body of seamen, better trained, better disciplined, and, as I trust and believe, in every sense better men than ever before were possessed among her priceless treasures by Great Britain.

The first step, a step in every respect of paramount importance, if the regeneration of the national Mercantile Marine is any object to the nation, is the appointment of a responsible head,

whether in the shape of a "Director-General of the Mercantile Marine," or "Commissioners of Maritime Affairs" (of course under the presidency of a "Chief Commissioner"). Whatever arrangement may be held to be most advantageous, and therefore most desirable, thus much is certain—that matters cannot be expected to mend until there exists a member of the Government endowed with ample powers, who is responsible for the conduct and the well-being of our merchant navy. To appoint such an officer, and to make such an appointment immediately, is clearly the duty of the Government.

The next suggestion I desire to make is that Lord Campbell's Act, 9 and 10 Vic., cap. 93, be made to apply as clearly to loss of life at sea as it now does to such cases on land, so that the registered owner or owners—for, as I need scarcely say, no ship should be permitted to sail without a registered responsible owner—might at once be made to answer for any loss of life.

This is an expedient that appears, as indeed it is, extremely simple, as it is expressed in a very few extremely simple words. As in the instance of great inventions, however, so in the gravely important matter under our consideration, the simplicity of the legal provision I have just suggested is one essential element of its value. It would do far more, I am convinced, than any other form of legislation to improve both seamen and ships, because it would imply that ship-owners would take very good care to become personally acquainted with their ships' crews, as well as thoroughly to inspect each one of their ships before allowing her to sail. At present, of all proprietors ship-owners have the least real knowledge of their property, and in like manner they have less acquaintance with the persons who are engaged in their service than any other employers of labour in the kingdom. Strange, and perhaps almost incredible, as it may appear, it is by no means an uncommon case to find owners who never have even seen their ships, and who know no more of the men who serve on board those ships than if they lived in Timbuctoo.

Notwithstanding the fact that this measure would not directly affect the seamen, on a little reflection it becomes obvious that indirectly such a step must tend in more ways than one to their advantage. This much is unquestionably certain: it would ensure that constant contact between owner and men which speedily would bring about a mutually satisfactory, because mutually advantageous, settlement, and it would certainly at once put an end to the odious necessity felt by the Board of Trade of sending detectives to spy out the defects of merchant vessels.

Everyone must feel that the estrangement now so unhappily prevalent can have but one effect, that of aggravating existing evils.

Scarcely less important than either of the preceding, is my third proposal, the medical inspection of seamen—the compulsory medical examination, I mean, as set forth in the ninth clause of the petition I have just read to you, and which, as it is so important, I will repeat here:—

That a serious evil arises from the shipping of foreigners, generally the outcasts of their country, from the amount of disease they introduce on board ship in spite of the beneficial working of the Contagious Diseases Acts. Your petitioners therefore pray your Honourable House to
so legislate that a compulsory medical examination of sea
shall take place before the crew will be allowed to sail in a
ship under the British flag.

I have no hesitation in saying that no nation
the world treats its sick seamen so utterly d
gracefully as we do. Unless they suffer from so
accident, or can get a governor's ticket, they m
rot in the streets—for all Great Britain cares. H
different are these matters managed in ot
countries, take the United States, for instan
Although competition, scamp-work, and ch
sailing is quite as much practised there as in t
country, yet the following extract from the *La*
of 9th Jan., 1875, will give some idea of what
American government does:—

THE MARINE HOSPITAL SERVICE OF THE UNITE
STATES.

Our Transatlantic neighbours, ahead of us in many thi
are most decidedly in advance of the old country in provi
for the care of their sick sailors. We have before us a
elaborate and exhaustive report by Dr. John M. Woodw
the supervising surgeon of the Marine Hospital Servi
the United States—an office that was created only
three years ago. The United States Government pro
for the care of its sick seamen by the imposition of a t
40 cents per month upon every officer and sailor i
mercantile marine serving afloat. This tax not only su
to afford medical and surgical aid and hospital accomm
tion to the sick, but a sufficient margin is left to be exp
in the building of new hospitals at various ports as the
found to be required. Under present regulations
hospital tax is collected at the Custom-house in each
where also the sick sailors apply in the first instance f
lief. A medical officer is on duty at the Custom-
whose function it is to examine the candidates for adm
decide as to their eligibility, and send them off to ho
The duties of the supervising surgeon (who has his
quarters at Washington) are both numerous and impo
He has been charged with the construction of a code of
and regulations in consonance with the scope and int
the Act; to advise the establishment of a hospital, a
kind of building that should be erected; to collect, che
summarise the returns and statistics sent in by his colle
from the outports; and to direct generally the applicat
the Marine Hospital Fund for the relief of sick and di
seamen. Certain revised regulations, which came into
about four years ago, define very clearly the duties
medical as distinguished from the fiscal department, s
no clashing of officials can well occur. It is not nec
to quote many figures; but we may record, as an evide
the usefulness and success of the present system, that d
the year 1873, 13,529 sick and disabled seamen re
medical and surgical aid; 12,697 seamen were maintai
hospital 420,160 days, or an average of about 33 da
each hospital patient; and 832 others, who were su
from diseases and injuries of a character not requiring
ment in hospital, were relieved as out-patients. The a
daily number of patients in hospital throughout the ye
1,151, and the average cost of maintaining and treatin
patient was a fraction over 4s. per day. The hospi
produced last year £62,170. But the report is not v
only in a statistical sense. Besides including papers
natural history of yellow fever in the United States,
J. M. Toner (briefly noticed in the *Lancet* of the
June last), and some special operations performed
marine hospital, and on the general condition of the me
marine, by Drs. Minor, Ellmwood, Crampton, and
Smith, the supervising surgeon has contributed
valuable article on hospitals and hospital construc
which numerous sectional and other sketches are ap
It includes, among other useful matter, a detailed acc
the proposed marine hospital at San Francisco. M
the work described has been borrowed from the Herb
other British hospitals, as detailed by Colonel D
Galton in his address on hospital construction.
authorities, however, are all quoted, and the article,
as the entire report, evinces in its compilation a gre
of care and labour on the part of Dr. Woodworth, w
probably more than enough to do in superintendi
details of a service extending (as he remarks) fr

Atlantic to the Pacific, and from the Great Lakes to the Gulf.

The Marine Department of the Board of Trade, and our shipowners all over the kingdom, are now discussing the best means whereby to popularise our own merchant service, now considerably at a discount. Compulsory apprenticeship, training ships, and the abolition of advance notes are all proposed as remedial agents. Would it not be worth while to take a leaf out of the book that we have just briefly noticed, and extend systematically the useful practical work that has been done at Greenwich, for fifty years afloat and now ashore, by the Seamen's Hospital Society?

While by the above simple measures we may wonderfully improve the condition of seamen at sea, the great question of a future and constant supply of sailors must not be lost sight of, and to this part of my subject I have given close and earnest attention. My proposition is to insert a clause in the Education Act—without which, by the bye, that enactment for practical good is like the play of "Hamlet" without the principal character—extending Industrial Schools to every county in the kingdom, each supplying its quota of boys to a training-ship stationed on the coast as close to the school as possible. In England, Scotland, and Wales we have more than 60 desirable localities for these ships, and 20 at least in Ireland. Now let us assume 200 boys per annum for each ship—and be it remembered that there are upwards of 100,000 pauper boys in England and Wales alone under 16 years of age—we shall then have 16,000 trained and disciplined boys, the exact estimated loss in the merchant service per annum. The way to keep these boys attached to their profession, and, still more, attached to British ships, is an easy problem to solve, but too long to enter upon in any detail on the present occasion. I believe, however, that we have only to see that their lives are ensured, and that a substantial deferred annuity is provided for their old age, and we shall not fail to knit them to their country and their ships.

SHIPS.

That a change, no less palpable than decided, has taken place within the last few years in the form and proportions of our ships no one can well attempt to deny. It is not necessary to be a sailor in order to be led to observe and to note this change. Whoever now-a-days sees a ship is at once struck by her long, low, narrow appearance, commonly eight times her beam in length, often ten times—like the model on the table—and occasionally even eleven times her beam, so unlike the proportions of thirty years ago, when vessels in their length rarely, if ever, exceeded four times their beam. In those days, if well and substantially rigged, fairly fitted out, ably handed, and constructed without reference to "builder's tonnage," our ships were ready to face, and well fitted to surmount, whatever weather they might encounter, without—to use a sea phrase—starting a rope-yarn. These vessels were the result of an experience—an observant practical experience—extending over centuries. At all events with them our ancestors piled up an enormous treasure, at the same time carrying the English flag triumphantly to the uttermost parts of the world. And all this was achieved while the coasts of different countries were badly lighted, and their rocks and shoals, at best, were imperfectly surveyed and buoyed. They had no "Rule of the Road at Sea," whether to guide them faithfully or to mislead them disastrously. Lifeboats were unknown to them, even in their dreams; and of the many advantages now enjoyed by seafaring men, few, if any, in their days had been devised and provided. Notwithstanding disadvantages such as these, however, disadvantages equally affecting both the ships and the sailors of past times, the numbers of wrecks and collisions, with the consequent loss of life—irrespective of the casualties justly distinguished as the act of God—were absolutely insignificant when compared with the frightful, nay appalling, catastrophes which characterise the present day, a daily loss of three or four ships and ten or twelve men.

With antecedents such as these, and with history bringing with it from the past lessons fraught with admonitory suggestions for the future, an inquiry may well be made into the reasons which could have led to the radical change that has taken place in the form and character of our shipping. And the cause for all this—not a good cause, but one essentially bad—is easily discovered in the extreme faultiness of the laws regulating the measurement for tonnage, laws which have been more seriously tampered with, altered, and "amended" (as the legislative patching process is somewhat ironically styled) than any other enactments on the statute-book of this country. The *Moniteur de la Flotte*, the naval organ of our French neighbours, without hesitation, and in so many words, denounces our present tonnage law and the Bill for its amendment as enacting a "legal fraud;" and I myself do not hesitate to say of it, that it is an unjust and oppressive law:—

Extracts translated from an article in the "Moniteur de la Flotte."

"In a few years' time the people will not understand how such an official act as that of the present measurement of vessels could remain so long a legal fraud. And is it not really a fraud, this system of measurement applied by the constituted authorities according to law, and which gives a result hardly equal to *two-thirds of the truth*?

. . . .

"Must one think reform hopeless? A fear might exist on that score if one thought only of the *coup de force* of which the Suez Company was the victim, simply because the British Government would not allow the establishing of a maritime taxation founded on true tonnage. It is the characteristic of unjust acts to be obliged constantly to defend themselves. Right is indomitably tenacious; one never knows with what arms it will be provided on the first assault. The exclusive and selfish interest of shipowners has been the bulwark of official tonnage.

. . . .

"Take two cases. The first of a steamer of 796 tons of official tonnage, with a cargo of 1,671 tons of pyrites and 500 cases of oranges. The second, of 420 official tonnage, with a cargo of 850 tons of sulphur ore and 1,500 cases of oranges.

. . . .

"Statistics show that on an average steamers carry 50 per cent. above their registered official tonnage.

. . . .

"Fraud attracts fraud, even if anyone dares to give a legal character to it.

"There is but one solution. Renouncing the admitted error, the legislature ought simply to say that the official tonnage of ships, be they sailing ships, steamers, or packets, shall express the real capacity and the faculty of lading; and that every ton put on board above the official registered tonnage, which would be a dangerous surcharge for the crew, would entail the application of a very severe penalty. This would only be simple, true, and honest. When will this happen?"

When speaking in such strong terms of this law and of its effect upon our mercantile marine, I do not for one moment desire to confine myself to the objections raised by the writer in the *Moniteur de la Flotte*, or to be considered insensible to the existence of a few other dark spots which tarnish the escutcheon of our merchant navy, and to the existence of which but too justly must be assigned the loss of very many valuable lives and the waste of a vast amount of property. Unseaworthy ships and unshipworthy seamen are doubtless, to be found, and found far too frequently under the English flag. Still, I am prepared to assign to the unsafe and unhandy form of steamer now unhappily so prevalent, almost without an exception, the deplorable cases of foundering at sea with which we are now becoming more and more familiar.

But let me bring before you what Sir James Elphinstone, an old sailor, and the member for Portsmouth, has stated on this point in his evidence before the Tonnage Committee :—

> "I was coming home from Bombay, in the spring of 1870, in a ship 315 feet long of the new construction."—"She had a flush deck fore and aft."—"We had very bad weather indeed, and I was particularly interested in the behaviour of that ship, because I had never been in a ship so long before, and the action of the sea upon that ship showed me exactly what the action of the sea must be in heavy weather on ships of that length and that description."—"The effect of the sea upon a ship of that sharpness was this, instead of being thrown off, as it was in the old description of ship, the sea ran along the ship's side and fell on board in a mass, either just abaft the chessel-tree or about midships, just in the place where, if she had not been a flush-decked ship, the sea would have tumbled into her, and I attribute the losses of ships of that construction very much to that circumstance. I was on deck the whole time of that gale of wind, and I watched the thing most narrowly, and I was very much interested in seeing the behaviour of the ship. I am quite certain that we should have been in bodily danger if she had not been a flush-deck ship with her hatches battened down. This is one illustration which I think there is a good deal in."

The blame for this condition of things cannot be said to rest entirely with ship-builders, who simply comply to the best of their ability with the requirements of their customers, the shipowners. The shipowners are naturally influenced by a desire to make the largest possible amount of money upon the least possible amount of tonnage, a state of things fostered, if not expressly and directly encouraged by our present tonnage law, which, as I have just shown, by the *Moniteur de la Flotte* is designated a "legal fraud."

At this point it will be well to consider what this term "tonnage" rightly implies, for the question of tonnage of late years has been so overladen with empirical rules and grossly unfair exemptions that confusion and evasion reign supreme. To such an extent, indeed, does this disgraceful and deplorable condition of things prevail—and prevail, you will bear in mind, to the extreme degradation and debasement of the mercantile marine — that a counsel, no less able and eminent than Sir John Karslake, when engaged in a tonnage case at the beginning of last year, in open Court confessed his inability to understand the law; whereupon the judge who presided said that he would *endeavour* to understand it—a confession which conclusively demonstrated the state of the law upon tonnage to be, to say the least, signally unfortunate. But let us refer to the opinions of practical men, delivered in this very room, and to be found in the Transactions of the Institute of Naval Architects.

Transactions of the Institute of Naval Architects. Vol. ix. 1868.

ADMIRAL THE EARL OF HARDWICKE.

"I should not myself recommend that the mode of measuring tonnage according to the British rule should be adopted by all nations. Tonnage, as we use the term, is nothing more than a statement which represents the bulk of the cubic contents of the inside of a ship. By our mode of measurement the divisor is 100, and in stating that 100 cubic feet make a ton, we mean a ton of—what? Do 100 cubic feet make a ton of iron, a ton of lead, a ton of ladies' bonnets, or a ton of what article? Does that convey to you the slightest notion of what the tonnage of a ship is? The word implies the weight-carrying power of a ship, but the mode in which it is adopted gives us nothing of the kind. That, I think, is a great fault.

"If this mode of measurement were adopted by all nations, I should recommend that they should more nearly approach the weight of something than merely taking the number of cubic feet contained in the inside of the hull of a vessel, the divisor of which is 100. I would much rather see some number as a divisor which would give us the notion of some weight which we are accustomed to look at—water, for instance. Why should we not use 33 cubic feet per ton instead of 100?

"Why not approach the weight-carrying power of a ship to the element in which she floats?

"I undoubtedly should take from her all those parts which are employed in her propulsion, and in the means of conducting her safety, and I should be rather inclined to present the ship to the public with all her machinery on board necessary for her propulsion, with her spars and such other weights as are absolutely necessary for her conduct; and then I would place an indelible line along her hull, and then I would place another line above it, which should state to the public what the safety of that ship would be at sea, and then I would call the tonnage of that ship what existed between those two lines. Now that would be intelligible, it would be safe, and it would be useful. You might adopt that in all nations. You might give to all people a thorough knowledge of what they had, and of what they were making use of, and of what they were going to put their cargoes on board of, and of what the safety of their vessels depended upon."

MR. SCOTT RUSSELL.

"If you are to be quite fair, you should allow all the coal as well as all the engine-room. Now there is no making an honest allowance. There is no doing it, because if I want a ship with enormous tonnage to be measured I shall lay out my ship on the first voyage to go all round the world, and then she will get the whole inside of her allowed as room for fuel; and then, if on the next voyage I put her upon a short trip, it is quite plain that the law will have been utterly abused, and we all know how utterly the law is abused when it is possible.

"Lord Hardwicke, as I conceive, only expressed what we all feel—that the true light-line of a ship ought to be a legible quantity, either on the ship's papers, or on the outside of the ship herself. We all agree that the deepest load water-line ought to be a legible line, either on the ship's papers or on the ship herself. We all agree that there are enormous interests—and we often think them not very honest interests—which are opposed to that piece of daylight; but I do believe that for any actual national interest there is nothing so good as daylight, everything above board, and, if possible, everything put into the newspapers. Therefore I would strongly advocate, as the greatest boon that could be conferred upon the interests of this country, an indelible mark of the deep load-line of the ship; and as to the light line, perhaps that would take care of itself."

MR. HENRY LIGGINS.

"In some cases the system of allowance for tonnage acts very harshly and unjustly; I mean particularly with reference to the allowance to steamers. I speak rather from the dock point of view, which is a point that ought not to be forgotten in coming to any decision on a matter of such vast importance. There are certain allowances, of course, for engine-room space, which seem to be fair and reasonable. But then it may be argued by the dock company, that

ship that brings comparatively a small amount of cargo ought to pay a proportionately small amount as compared with the tonnage of the ship, and they argue that the steam ship could very well afford to pay for that engine space, which, if it had been a sailing ship, would have been filled with cargo.

"Of course, in a sailing ship the freight earned by the vessel would be, say £2 10s. a ton, whereas in the steamboat, which has brought the cargo at a quicker pace, it may be £7 a ton, and therefore the shipowner who has this large allowance made to him, is really quite as well able to pay the dock company on the whole space, as the sailing ship would be for her whole internal space. Then, again, as to the point about the space for cargo, and the space for the accommodation of the passengers and the crew. It should be remembered that in the large ocean steamers a very large proportion of the crew are really for the comfort of the passengers, who pay a very high charge for the accommodation in the ship which they enjoy, and I think it would be unjust and arbitrary to the dock company to deduct the space occupied by these servants, their sleeping accommodation, and so forth, from the tonnage paid to the dock company. Then it also frequently happens in large steamers that they fill the cabin space in the vessel which is not occupied with passengers, with cargo. I speak thus from my own knowledge, having travelled in the Cunard steamers, and the large Royal West India Mail steamers. I have crossed in the West India steamers, and I have seen in the cabins tobacco, bales of cotton, and so on. I have seen both crew space and passenger space occupied with cargo, and very often the stewards, whose berths were filled with cargo, have lodged in spare passenger cabins. It would, therefore, be a gross injustice to the dock companies to make a large deduction from ships capable of paying a fair and reasonable rate, because their earnings are large in proportion, on account of the excessive freight which they get. I think that in many cases the present system of Tonnage Laws act with great injustice, and require supervision and amendment."

One of the difficulties hitherto experienced in establishing a sound and proper Tonnage-law (though in fact the so-called difficulty has been purely imaginary), in a great degree, has arisen from an unwillingness to grapple effectually with the load-line question. But this very question, which embraces also the height of the vessel's freeboard, and has a most important direct bearing upon the safety of the crew, presses beyond all others for immediate settlement.

Now the true tonnage of a vessel is simply the number of tons of dead weight she is capable of carrying in safety, or her bulk between the light and the load water-lines—*i.e.*, the difference between her light and her load displacements given in tons. This difference used to be very correctly designated as the ship's "burden."

A vessel, with her equipment and crew, will have a certain line of flotation and a certain displacement; and, after taking a full cargo, she will have another and a deeper line of flotation, with a greater displacement; or, so to speak, her own deeper immersion will cause her to impress a deeper hole in the water. The cubic contents of that portion of the vessel contained between these two water-lines, measured externally, will be the same as the number of cubic feet of water which the cargo, by depressing her, has compelled the vessel to force out of its place. As the weight of one cubic foot of water is known, that weight multiplied by the number of cubic feet of water displaced by the greater immersion of the vessel, will give the weight of the volume of the water so displaced; and that weight will be the same as the weight of the cargo, the presence of which caused the displacement in question—that weight I therefore propose should constitute the tonnage of the vessel, since it is the weight, when expressed in tons, of the cargo which she can carry with safety to herself and her crew.

Simple as this statement is, I hope I may be pardoned for giving the following example in illustration of it, since it is the turning point of my present argument. I take a vessel with her complete equipment, but without any cargo, and will consider the whole to weigh 80 tons. I assume her to be afloat, and, accordingly, the line to which on her exterior surface the water rises, I entitle her "light water-line." Now, suppose the water in which this vessel is floating to become solid, so as to retain the impression (or hollow) made by her form when floating, after she had been lifted up and removed; and further suppose this hollow, or impression, so retained to be filled with water. If that water were taken out and weighed it would be found to weigh exactly 80 tons. Again, I now suppose 100 tons of cargo to have been placed on board this vessel, the vessel herself, as before, to be afloat. In this case her deeper immersion, caused by the presence of her cargo, will cause her to make a deeper impression, or a larger hollow, in the water; and the water, rising higher around her exterior, will give her "load water-line." If the former process be repeated, the result of the operation will show a larger hollow, or impression, which will contain exactly 180 tons of water,—or the weight of the water required to fill the larger hollow will exceed the weight of the water required to fill the, smaller hollow, by 100 tons, being the exact weight of the vessel's cargo—the exact measure in tons, therefore, of her capacity for carrying cargo, which is her "tonnage." The difference between the two supposed impressions, or the two real displacements, is marked upon the vessel herself by the space between her light and her load water-lines,—as, indeed, I have already said. It, therefore is evident (to repeat what I have just said in another form of words) that whatever weight a vessel may be—whether without a cargo, or with either a full or a partial cargo, that same weight will be identical with the weight of the water it will displace; whence it follows, that the displacement of a vessel with cargo on board, minus her displacement without it, gives the weight of the cargo, or the true tonnage of the vessel.

In former times this principle was well understood, it having been applied so long ago as 1694 by the 6 and 7 of William and Mary (in consequence of "divers new Frauds, Deceits, and Abuses") to the counties of Northumberland and Durham for the measuring and marking of keels; and subsequently it was extended under the 15th George III. to the collier trade at all other ports of Great Britain, in the following terms:—The vessels to "be admeasured by a dead weight of lead or iron, allowing twenty hundred-weight avoirdupois to the ton, and marked and nailed as aforesaid to denote what quantity of coals each will carry up to the mark set thereon." I question if this Act has ever been formally repealed. When this Act was passed, the vessels affected by it were comparatively small. This method of ascertaining their weight-carrying capacity could therefore easily be worked out, and was perfectly correct.

Another Act, differing entirely in principle (6th Geo. I.), was at the same time in force for vessels engaged in the spirit trade; it was enacted by it —"That the following rule shall be observed: (that is to say) take the length of the keel within board (so much as she treads on the ground), and the breadth within board by the midship beam, from plank to plank, and half the breadth for the depth, then multiply the length by the breadth, and that product by the depth, and divide the whole by 94; the quotient will give the true contents of the tonnage."

And this Act for the spirit trade, instead of that for the coal trade, formed the basis of the first general Act (13 Geo. III., c. 74); and later, an additional Act (59 Geo. III., c. 5) was afterwards passed for deducting the length of the engine-room in steam-vessels.

In the year 1821, so great was the dissatisfaction at the state of the law, that a Commission was appointed to investigate the subject; and this Commission reported:—"That there are sufficient reasons for being dissatisfied with the mode of measurement now legally employed, on account of the great occasional variation of its results from the actual proportionate capacities of the ships to be compared." Also, "They would have been desirous of removing all doubt upon the subject by proposing the admeasurement of that portion of the ship which is included between the light and heavy water-lines; but this method has been considered as liable to insuperable objections, on account of the impossibility of ascertaining the position of these lines in a satisfactory manner."

The Commissioners, therefore, recommended another method, which they admitted did not in all cases annihilate the errors; but the Government of the day did not adopt their recommendation.

A consolidation of the Tonnage Acts took place under 3 and 4 Will. IV., c. 55, and a second Commission was appointed in the year 1833, "to consider the best mode of measuring the tonnage of ships." This Commission reported, "That internal measurement will afford the most accurate and convenient method of ascertaining the capacity;" and their recommendation was carried out by an Act of Parliament, the 5 and 6 Will. IV., c. 56, afterwards amended by the 6 and 7 Vic., c. 84, and consolidated by 8 and 9 Vic., c. 89; but affording incorrect results, and being open to evasion, a third Commission was appointed in the year 1849, "for the purpose of inquiring into the defects of the method of measuring ships for tonnage." And this third Commission, determining apparently to be right at last, recommended the very opposite, namely, "that the equitable basis on which charges for dock, light, harbour, and other dues should be made, is that of the entire cubic contents of all vessels measured externally."

This recommendation was, however, unfavourably received by the shipping interest.

And now we have the Merchant Shipping Act, 1854 to 1873, in so far as it relates to the measurement of the tonnage of ships, requiring amendment by a fresh Act; and so it will ever be the case with any measure which departs from fundamental principles, and vainly endeavours to conciliate conflicting interests by enacting arbitrary rules of measurement.

The following list of factors will show at a glance the diversity of rules in force at various times for tonnage admeasurement, and it is worth notice that these very rules vary in their application at different ports under the same Government:—

England (year), 1720	94
„ „ 1773	94
1st Commission	560
2nd Commission	3500 92·4
3rd Commission	27 ·002
Present Act and recent Bill	100
France	94
Spain	41[illegible]
Portugal	67[illegible] 96[illegible]
Naples	94
Norway	242½
Russia	94
United States	95

As regards our tonnage laws, numerous and imperfect have been our attempts to improve them or to effect what we have been pleased to regard as improvements in them. The three Commissions specially appointed to investigate and report upon these laws differed widely from one another in their conclusions; and, to my regret, I am constrained to say that the same haziness appears to have prevailed to a most distressing extent in the report of the late Commission at Constantinople, so that without entering into the merits or demerits of M. de Lesseps claims, which are somewhat foreign to my present purpose, I believe that gentleman t[illegible] be in a position to find substantial grounds for complaint in the very report of the Commission itself.

In the case of the ships, it is no less true than i[illegible] that of the seamen, that the remedy may be brought into action with ease and readiness. An attentive consideration of this remedy will show that my assertion is well founded and correct. If we merely look back to the last thirty years, and attentively observe the effect of the different tonnage laws on the forms and characters of our merchant vessels and trace the numerous disasters which have occurred in the mercantile marine to their origin, we cannot fail to observe the evil influence the laws have exercised. This is no idle assertion; thousands of lives have been lost, and an untold amount of property has been sacrificed, through the loop-holes for evasion which arbitrary and faulty rules for estimating the tonnage have permitted.

If by building a vessel with any peculiarity of form, a greater capacity for carrying goods, while retaining the same nominal tonnage and the same outlay for motive-power, could be obtained, human nature unhappily is such that the vessel would be built, the prospect of larger cargoes and smaller tonnage dues offering a stronger temptation than safety and seaworthiness. It is, however, but fair to believe that the true liabilities of a ship at sea have never been thoroughly realised by the great body of naval architects and shipowners; for it cannot be supposed that any men, however clever or intelligent, could, without being practical seamen, fully estimate at their actual value all the risks and dangers to which their vessels would [illegible]

subjected; indeed, the present lamentable condition of our ships of war will show how millions can be thrown away when the architects employed are destitute of any practical experience of the sea. It is a poor consolation to the country to be told this, and to find from the evidence of Sir Sydney Dacres (the late Senior Sea-Lord of the Admiralty) before the Committee on Designs, "that our iron ships could not sail in company with safety;" and from Sir T. Symonds, the Admiral in command, "that a fleet composed of vessels like Mr. Reed's *Monarch* could not save themselves under the commonest circumstances."

The following extract from the report of the Committee on Designs will show how the old tonnage law, or "builders' measurement" (as it is termed), has affected the Navy:—

"We have been struck by the very misleading and inaccurate measure of the real size and displacement of a vessel afforded by the common mode of classifying ships according to what is termed 'builders' measurement.'

"We observe that, in order to obtain the requisite displacement within the prescribed limits of builders' measurement, forms which are manifestly disadvantageous have not unfrequently been adopted; we beg to recommend that the mass of a ship be described by displacement."

The method for obtaining the true tonnage which I beg to propose to you is extremely simple. It is as follows:—Take the area in square feet of the horizontal plane at which the vessel floats when fully equipped, with her masts and sails (or machinery and coals), and with her crew and provisions on board, and the area of the horizontal plane, at one foot above it; add the two areas together, and divide by 2, which will give the number of cubic feet. Then divide by 35 for the tonnage, repeating the operation, foot by foot, between the light and load lines (leaving to the owner the responsibility of fixing the latter).

The areas of one side only need be taken, and this could be done by a simple instrument, a model of which I hold in my hand, and which any hedge carpenter could make and work. But perhaps one of the greatest advantages of this mode of measurement is the making the foot tonnages coincide with the draught of water, so that nothing can be more simple than ascertaining at once the amount of tonnage or cargo on board.

The sum of all the foot tonnages will be the entire tonnage, and whether the vessels be three-deckers or boats, wedge-like or circular, or as dissimilar as human ingenuity can construct them, the same rule will equally apply, and the same weight, when placed on board, will give the same increase of displacement to each. As the cubical contents to be measured under this system are entirely confined to the space between the light and load lines, they will scarcely equal a fourth of all the numerous spaces included under the present Act. The model on my right has been made to illustrate the rule I have just proposed.

The immediate effect of such a law as I have suggested, besides supplying an exact and equitable system of measurement, will be the discontinuance of the withering influence of the long series of tonnage laws on the architecture of our mercantile marine, and it will break the fetters which now bind the hands and cramp the energies of naval architects, who thenceforward would find themselves free to devote their talents and experience to the construction of vessels in which sea worthiness and swiftness shall be dominant qualities, instead of applying their ingenuity to the evasion of the law. Such a system of tonnage, by leaving unfettered the construction of our vessels, would do more to improve the character of our mercantile marine, both externally and internally, and to preserve human life, than all Mr. Plimsoll's well-meant but ill-directed efforts; and I feel satisfied that all, whether they be shipbuilders, or shipowners and their crews (and I will also include insurers) will derive benefit from its adoption, in lieu of the present false and empirical system.

One of the greatest boons that could be conferred on the shipping interest would be freedom from the present paralysing effects of Board of Trade interference; and this interference would be diminished in its most offensive particulars by a law of limited displacement for tonnage, *i.e.*, the total load displacement minus the light (or a fixed proportion in lieu of the light), or else the displacement for the time being.

In what I have already said, I have endeavoured to bring before you a passing glance at the Merchant Marine of Great Britain, as it exists at the present moment. The time at my disposal, however, has by no means permitted me to deal with this great subject as its vast importance deserves, and indeed demands. I have not attempted, you will bear in mind, to execute even a comparatively finished picture; my highest aim, on the contrary, has been to produce what you might accept as a suggestive sketch. Still, even from a sketch slight and imperfect as this may be, I think you will be enabled clearly to discern the fact, that our Merchant Marine, in respect to both men and ships, is in a condition to be profoundly deplored—a condition, that imperatively demands prompt and earnest measures for its correction. The men we find to be ill-treated, ill-paid, and ill-found; their physique deteriorated, their seamanship fast disappearing, and their subordination almost at an end. And, if we turn to the shipping, the scene is scarcely less gloomy. The unseaworthiness of the ships, arising from culpable negligence on the part of their owners, is seen to be as nothing in comparison with their unseaworthiness, the inevitable result of inherent structural defects.

But hear what Mr. Augustus Creuze, a late Chief Surveyor at Lloyd's, asserts in the *Encyclopædia Britannica*:—

"The merchant princes of England, with their boundless wealth, proverbial generosity, and persevering enterprise, might surely have attracted the attention of men of science to the improvement of their argosies. That they have not done so is indisputable: the startling fact that one ship and a half is the average daily loss registered on the books of Lloyd's appears as a sad corroboration of the acknowledged truth, that the Mercantile Navy of England is the least speedy and the most unsafe that belongs to a civilised nation. . . . And when at length the injurious tendency of the tonnage laws was perceived, it was not until they had become so completely identified in men's mind with ships themselves, that years more were suffered to elapse before it was made manifest that the cause of the inferiority of the shipping was the absurdity of the law. Years more must elapse before the Mercantile Navy of Britain can recover from the state to which these laws have reduced it. . . . It must be remembered that the safety of a ship is not only dependent on her powers as a sea-boat, but is in inverse proportion to the time she is exposed to the dangers of the seas." Mr. Creuze believes "that England scarcely ever committed a greater error than when she first determined the existence of a law levying duties according to tonnage."

With the prospect of disaster after disaster thus looking us with threatening vividness in the face, the subject under our consideration is indeed one that is painful in the highest degree. But then it is this very painfulness of the subject that serves to enhance the culpable character of any hesitation on my part (when knowing the state and condition into which our merchant marine has been allowed to drift) in not boldly making the truth plainly, openly, and unreservedly known to those whom it most deeply concerns. Happily, it is not too late to apply the necessary remedies; and I believe that they may be applied easily, and without extravagant costliness. The first step towards remedying an evil is to recognise the existence of that evil, coupled with a clear discernment of its character; and then the next step, which consists in determining the true remedies required, easily leads on to the final step in the accomplishment of the required rectification. These steps will not be found difficult to be taken in the case of our merchant marine. We know both in what the evil consists and where it lies; we also know the proper remedies and how to apply them.

Nothing can be more true than the words used in the "Preamble of the report to the Queen's Most Excellent Majesty, by the Royal Commissioners on unseaworthy ships."

The safety of a ship at sea cannot be secured by any one precaution or set of precautions, but requires the unceasing application of skill, care, and vigilance from her first design to her unloading at the port of destination. She must be well designed, well constructed, well equipped, well stowed, or she is not seaworthy. She must be also well manned and well navigated, otherwise all precautions as to her construction and as to her stowage will be unavailing.

True, most true, but unfortunately, our ships as a rule are not "well designed, well constructed, well equipped, or well stowed," neither are they "well manned, or well navigated." Now what is to be done? Well, I think I cannot do better than briefly, very briefly, recapitulate the remedies I propose:—

1. A responsible head to the Mercantile Marine.
2. A Maritime Lord Campbell's Act.
3. A Mercantile Marine Medical Service, and compulsory medical examination of seamen.
4. Industrial Schools in every county, with training ships attached, the boys apprenticed, their lives insured, and deferred annuities secured for old age.
5. An honest tonnage law, with taxation removed from ship to cargo.

What is the cost, I may be asked, for all this? I reply, *nil*. Four of the remedies proposed would cost the nation absolutely nothing, and might be tried immediately; the remaining one, viz., a responsible head to the Mercantile Marine, ought to be the means of effecting a wonderful saving in more ways than one.

In conclusion, it remains for me, to the utmost of my power, to urge upon your serious reflection the supreme importance of the subject on which I have been speaking, an importance which receives fresh weight and increased urgency from the circumstances of the times in which I speak. It is not only in the vital interest of that magnificent commerce of our country, with a direct view to the maintenance of its supremacy, that I plead for the reformation of our mercantile marine. This, indeed, alone might well be sufficient, and more than sufficient, to command thoughtful regard, as a prelude to vigorous action. But that reformation of our mercantile marine which I am advocating, in its influence and also in its practical action, extends far beyond the range of actual commercial enterprise.

As our Royal Navy is the strong arm (assuming it to be strong, or at any rate to be in the act of receiving fresh strength) to which we look to adjust the balance between our numerically insignificant insular land forces and the vast armed hosts of the great continental powers, so to our merchant navy must we look as an important adjunct to our naval strength in time of peril. When armed with a single gun of formidable powers, its powerful steamers may sweep from the seas the merchantmen of the enemy, and at the same time do good service in paralysing the offensive action of his armed fleets. Just now we are informed of the resolution of one of the greatest of the great powers of the Continent of Europe to require military service from every man in the empire. What we have to do to meet and checkmate this gigantic land force is to resolve that our ships and our seamen, and as far as may be every one of them, shall be thoroughly efficient on the sea. It is recorded of Alexander of Macedon, that he first laid down the principle that "the command of the sea secures the possession of the land." In times much nearer our own, an illustrious English sailor, Sir Walter Raleigh, said, "He who commands the sea commands the trade of the world; and he who commands the trade of the world commands the riches of the world, and, consequently, the world itself."

We Englishmen have learned—and the lesson has come down to us, for many a year, from father to son—to apply the sentiment enshrined in the words of the Macedonian and our own great but hapless fellow-countryman, after a fashion of our own, in these four words, "Britannia rules the waves." If we are to transmit that significant saying, in its full force, to those who will come after us, without delay and in thorough earnest we must take in hand such a reformation of our merchant navy as now I have sketched out before you, and on behalf of which I lift up my voice.

DISCUSSION.

At the conclusion of the paper, **Captain Pim** showed, by a model of Atlantic waves, the dangers of excessively long ships such as he had already produced a model of. The wave model being on the same scale, represented a length of 400 ft. from crest to crest, with a height of 42 feet, the largest which had ever been measured; and comparing the vessel with these waves, it was evident that when on the crest of one she would, in seeking her natural displacement, sink so low that the wave would tumble in amidships on both sides of her, the weight of water varying from 20 to 50 tons, according to circumstances. The consequence would be that, unless she were battened down tightly, she would inevitably founder, however staunch she might be. The *La Plata* might have gone down in that way, though he did not say she had, because he knew nothing about her; and it was pretty evident that the sea was not so high as he had depicted, because, as had happened in several other

cases lately, heavily laden boats had lived, though the ship had gone down. This, however, showed the danger of unreasonably lengthy ships, which were so built for the sake of economising motive power. Indeed, they almost justified the sailors' saying, that they were "built by the mile and cut off in length as required."

Capt. George Peacock, F.R.G.S., asked to be allowed to say a few words as an old practical seaman and steam-officer. The important subject so ably brought forward by Captain Pim was not sufficiently attended to by the Legislature, which was not surprising considering its ignorance. Acts of Parliament were brought forward from time to time by parties knowing little or nothing of the subject, and when they were found impracticable others were brought in to amend them, and so it went on, until there were half a dozen or so in the maritime code, the last being entitled, "An Act to Amend an Act for Amending another Act, &c." This might be easily avoided by having practical seamen on the committee. Captain Pim had shown by models the dangerous class of steam-vessels in present use, and the strain to which they were exposed in heavy seas, and this he believed to be a tremendous evil. He did not wish to introduce anything like religious claptrap, but he had always considered the dimensions of the Ark the very beau ideal of a ship, either for steam or canvas; as a boy he had made a model on those proportions, and some twenty years ago he drafted and superintended the building of an iron ship of 800 tons with the same proportions, viz., the length six times the beam, and the depth one-tenth of the length. She answered admirably; sailed well; carried a large cargo on a light draught; was very smart in stays and in wearing, and became a great favourite as a liner in the New Zealand trade, where she still remained, as sound and good as the first day she was built. On the completion of her first twelve years she was strictly surveyed by Lloyd's, and re-classed, without shifting a rivet or a plate. If it were asked how this happened when so many iron vessels had to be re-classed and had to receive new plates after much less service, he could only say that he owed his success to his practical experience, first as an apprentice at sea, as an amateur stoker on board a steamer, as an amateur engineer at Messrs. Maudsley's, and subsequently as sailing master in the Royal Navy, and to his study of the principles of galvanic action. He found that iron did not agree with either copper or mercury, and therefore devised a plan for doing away with all holes and cocks in a steamer's bottom, having them all, feed-pipes, blow off, bilge water, injection pipes, &c., made of iron or white metal, communicating with iron boxes rivetted to the inside of the ship, one on each side, and the pipes brought up just outside the engineer's cabin, where they were always under the eye of the engineers of the watch, the cocks being all separate from each other, and marked so that no confusion or danger of leaving a sea cock open could possibly arise; for he had known instances of this being done inadvertently, and the water rising so high in the stokehole before it was discovered that the cock could not be shut off, and the vessel had gone to the bottom of the harbour. He had also carried out a series of experiments from 1837 to 1856 on plates of iron, and after discarding all preparations containing mercury or copper, which he always found ate off the rivet-heads and honey-combed the plates, he established a composition for protecting the rivets and plates, and keeping them clean, which, under the name of "Peacock and Buchan's," was now in use all over the world. This composition was applied to the iron ship he had already spoken of, which was coated with Day's cement inside, and it had been equally successful with the troop ship *Himalaya*, which was as sound now as when constructed in 1853. He feared that the use of mercury and copper, though not referred to by Captain Pim, had had something to do, coupled with their extreme length, with some of the recent distressing losses of iron steamers, and this had induced him, having had thirty years' experience at sea in every capacity, from apprentice to captain, to bring the matter forward.

Mr. Lemon, as a seaman of twenty-three years' experience, wished to say a few words as to the hardships endured by British sailors. To the seaman, the unworthiness of a ship was a secondary consideration, for being familiar with the dangers of the sea he thought but little of them, and was prepared to meet them. What he complained of was the wretched accommodation provided. If he called for a survey he had no chance but to back out of the ship altogether, and if, as frequently happened, his bunk was never dry, he could only make up his mind not to sail in the same vessel again. Then, when the voyage was over, he was not paid off for three or four days, during which time he had to live on credit at the mercy of crimps and sharks of all kinds, and the consequence was that when he went to the shipping office to get his money he was only too glad to sign articles again, if only to get rid of his creditors, especially if he had left a wife and family behind him who were indebted to the butcher, baker, and other tradesmen. He had known men sign fresh articles the very day after they were paid, after coming off a voyage of fifteen or sixteen months, and sometimes even before they received their money. If he made any complaint at the shipping office he was referred to a magistrate, and if he went there he had only his bare statement to put forward, so that practically he had no redress. Thus married men frequently could only spend some forty-eight hours with their families after working for them for eight or ten months. The natural result was that sailors were glad to turn to any other employment, and numbers of them became porters, lumpers, colliers, or anything rather than go to sea. In fact, if Jack only had reasoning power, and could put this and that together, there would very soon be no seamen at all. The hardships they endured from cold and wet, being turned out of bed steaming to go shivering to the wheel, were enough to ruin the constitution of anyone, and often the men were not really in a condition to discharge the duties of their calling. As to bringing up boys as sailors, it was only introducing them to a life worse than that of a convict. If they complained to the master he told them he was obliged to work the ship; they had signed articles, and if they did not obey orders he would put them in irons. He might be a kind man or a harsh one, but he really could not help himself. He did not think any vessel should be considered seaworthy if there were not proper accommodation for the men, and good food. The latter was often deficient, only barely enough being put on board, according to the Act of Parliament, for the expected length of voyage. The sailor could go aft to see the food weighed out, but it was done by a spring balance which was often out of order, so that he had no certainty of getting his allowance. Such a state of things was discreditable to the shipowners who allowed it, and though some provided for the comfort of their men, many never took it into consideration at all. If they did, he was sure the men would serve them much better, and that if closer relations existed between owners and seamen, the former would not be out of pocket by it, for Jack was as grateful for kindness as anyone.

Mr. Grazebrook said Captain Pim had divided his subject into two parts, the first of which—construction—he did not propose to say much upon, further than to remind the meeting that in former days England captured her models from the Spaniards, French, and others, and found them much better than her own build. There was another point, however, of much more importance, for, though it was sad to lose valuable lives from the unseaworthiness of ships, others would take their place; but if the lives of the men were made so miserable that no sailors could be obtained, the results would be infinitely more disastrous. Brave lives had been lost before now,

in battle as well as on the seas, and their places were supplied, but if the spirit of the English tars was lost, then, indeed, England would lose all that had made her great. History always reproduced itself, and the time might come when England would again have to fight for the supremacy of the sea. If she lost command of the Channel, if her fleets were beaten by the foe, or destroyed by the elements, it would mean simply starvation, because in a few months all her supplies could be cut off, and she would be immediately subjugated. It was therefore a matter of vital consequence to keep up the race of seamen, but to do so they must be better paid and more comfortably provided for. It was no use bringing in apprentices if trade were not made sufficiently attractive to keep them in it, instead of becoming labourers and colliers, as they now did in large numbers.

Mr. Norwood, M.P., said this subject, like all others, admitted of a good deal being said on both sides, and to allow of this being done he begged leave to move the adjournment of the discussion to Friday evening, February 5th.

The motion was carried unanimously.

MISCELLANEOUS.

THE PROPOSED ALTERATIONS IN THE RAILWAY SYSTEM OF THE GERMAN EMPIRE.

(*Continued from page* 154.)

It unfortunately cannot be denied that very few German States have, as regards the question whether State or private railways were to prevail, acted with any consistency, nor that even those who have decided in favour of State railways have not sometimes permitted private lines to be constructed for some cause or other. But we believe we are correct in saying that they have generally repented doing so, and that the respective States would not now, with their present experience, have granted any such concessions to trading companies. But there cannot be said to exist a mixed State and private railway "system." It was not a principle, but an absence of principle arising from changes of views and the results of experiment, which produced such a mixture of private and Government railways. Even in Prussia it was not the result of a system, but of a change of systems. From want of experience, and from the example of England and America, nothing was thought of at first in Germany but giving over the railways into the hands of companies, and in Prussia the first railways were consequently constructed independently of State control. The productive lines were of course seized upon by private companies, and it was not until the construction of less favourable lines was projected, that the State was called in. But as the feeling gradually gained ground that the State ought not to undertake all the unprofitable lines, and leave the profitable ones in the hands of private speculators, the Prussian Government began to construct the railways itself, and proved it to be anything but an unproductive enterprise. Since that time certainly a number of private companies have been permitted, and the rage for speculation which arose from these concessions caused great scandal at the time, and gave rise to Herr Lasker's admirable speech of the 4th April, 1873, in the Imperial Parliament; but lately the Prussian Government has again commenced the construction of State railways on a large scale, and in the measure passed through the Prussian Parliament on January 5 to 8, 1874, though concessions to joint-stock companies were not absolutely prohibited, yet they are saddled with the condition that the Government is entitled to buy the lines after a period of 30 years, at a fixed price, and if not purchased that the concession lapses again into the hands of the State after a period of 90 years. Though this measure is of course not retrospective, yet the action of the Prussian Government on the matter shows conclusively that its object was to assume gradually the entire control over the railways, and not to rest content with a mixed system of Government and private lines, yet by this new measure a system it to be fostered which would destroy the profit of about 2½ milliard florins, invested by the Governments in the railways of various German States—not to mention the ruin of many private lines—for such assuredly would be the result of giving to each Government line a rival in the shape of a private line, and *vice-versa*. That the private lines are often managed more economically than the State lines is true, but we must set against that the losses which have been caused to the public in the railway companies by the speculation, by jobbing, by the profits of bankers, of brokers, of contractors, which are partly lost to the undertaking altogether, partly taken out of the hands of individuals who subscribed shares to be paid in full, or obligation shares to the newly formed companies, and of the public, who buy these shares and stocks at the exchange from financiering branches, and contractors who are paid in shares. How much of the profits of paying lines goes into the pockets of jobbing speculators, whilst the moderate profits of less remunerative lines are turned to the ruin of the deluded shareholders? How often it has occurred in the last 20 years that the cost of establishing a private railway has far exceeded the actual cost of execution, and why? First, because they can only obtain capital at a much greater price than would be the case if Government were the promoter of the undertaking. Secondly, because stockbrokers, finance and building committees, boards of directors, and contractors all strive to fill their pockets, quite regardless of the interest of the general public. This latter evil can never be eradicated from private railway companies, for all laws, however strict, can be and are evaded. How the commercial public has been defiled and corrupted by the speculation mania, and what a demoralising effect these illgotten gains and sudden fortunes have had upon every class of society, is too well known. They have fostered the feeling that honest work and thrift lead to nothing. Speculation is now the watchword of the world, and how many innocent persons have gone down in this whirlpool of speculation, and the consequent crash? Let us see how the German States would be affected by the plan of the Railway Department for gathering together all the railways under Imperial control.

* Note by E. Chadwick.—The President of the India Board seems to have made an independent discovery of the financial principle so often propounded here, of the use for all public works of cheap public capital obtainable on public security, instead of the dear capital, which is the only capital obtainable by private security. The Marquis of Salisbury, in his recent address to the Manchester Chamber of Commerce, is reported to have made the following statement:—"There is a popular notion that railways in India have not paid at all, or paid exceedingly badly, and as a financial fact there is no doubt that we have to pay a guaranteed interest of some £1,500,000 or £1,700,000 every year to make up the deficiency. I believe that result is in a great measure due to the mistakes which attended the original construction of the railways. It was a new matter; many blunders were made, and though many men gave all their earnestness and all their ability to the task, still it was not to be hoped that they should escape from every kind of error; and to show how much of the comparative failure of railways is due to accidental causes, I will mention just one fact which I had brought out by calculations made the other day. The money for all these railways in India was raised by a guaranteed interest at 5 per cent. I inquired what the difference would have been if, instead of raising the money by guaranteed interest the Indian Government had raised the money by borrowing from time to time as its credit stood at the time in the open market. I found that we should have saved the payment of £600,000 a year by simply altering the form of our financial action. If, instead of adopting the system of guarantees, we had adopted the more orderly system of borrowing money as we wanted it, we should have saved that enormous sum. At the present rate of interest that represents a capital of £15,000,000, and my impression is that that £15,000,000 would go very far to supply all the railways which India now wants." It is of great importance that the principle should be known and applied in the Treasury as a means of stopping waste.

In the "motifs" of the Bill a list is given of the German lines up to the end of 1873. They amounted to:—

	Miles (German).
State lines	1,357·85
Private lines under State supervision	411·44
	1,769·29
Private lines	1,451·03
Total	3,220·32

Of these—

	Miles.
Elsass-Lothringen had	115·12
Prussia (542 State; 341 private, under State supervision; 1,053·19 private lines)	1,937·29
Bavaria (246·80 State; 40·45 private, under State supervision; 159·02 private)	446·27
Wurtemberg (152·10 State lines; 0·87 private)	152·97
Baden (135·79 State; 12·62 private, under State control)	148·41
Grand Duchy Hessen (11·82 State; 86·64 private)................	98·46
Saxony (128 State; 17·13 under State control; 43·72 private)........	188·85
Oldenburg (25·36 State; 4·40 private)	29·76
Mecklenburg (private)	42·61
Brunswick	45·91
Lübeck.........................	14·60
	3,220·32

Thus in almost all the German States except Prussia the Government railways predominate, and even in Prussia they form—together with the private lines under State control—nearly one-half of the whole number; moreover, the Prussian Government is in the act of enlarging its network of lines, whilst it is doubtful how far some of the private lines will reach completion.

In Elsass-Lothringen the Empire purchased all the lines, with the exception of some branch lines, which were in course of construction by a company at the time of the war (for example, the lines of Courcelles Bolchen to Saarlouis). But it is certain that sooner or later the Imperial Government will purchase these also. The German Government has expended on these railways 144 millions of thalers, and far from viewing this as an unproductive expenditure, every reasonable German will rejoice that it has been undertaken; firstly, because for strategic purposes it is most important that all these lines should be under Government control, but secondly, and chiefly, because the State is thereby enabled to render the greatest services to the commercial and agricultural interests of Elsass-Lothringen (as, for example, by the cheaper transit of coals, &c.). We do not wish to express, however, any opinion concerning the tariff system on these lines. The fact that the Elsass-Lothringen railways have in the first year of their State management only yielded a profit of about 2 per cent. cannot be taken as conclusive for various reasons; if, however, further experience shows that the profits of these lines still continue insufficient, it would go far to prove that the new tariff system is at fault. No one can expect the Government to carry him and his goods at a loss, and the neighbouring German States may fairly complain of the Imperial Government making up ruinously cheap lines at the public expense. But who could approve the establishment on every main route in Elsass-Lothringen of competing private lines which might draw the traffic away from the Imperial lines, and thus ruin the State railways. This might, however, easily occur if the supreme control over the railways fell into the hands of a board which considered the first principle of healthy traffic to be "the co-existence on all main lines of State and private railways."

In Baden again, the Rhine Valley and the adjoining Black Forest lines are very favourable for the construction and favourable working of railways; but in the middle and southern parts of the Duchy the mountainous character of the country places great difficulties in the way of railway construction. From these circumstances it is absolutely necessary that the Government should hold all the Baden railways in its hands, and by working the profitable Rhine Valley line be enabled to open out the lines into the interior of the country which, though much less profitable, are indispensable to the development and welfare of the country and its resources. Will Baden expose itself to the danger of the railway board working out its theories of a healthy development of traffic by giving it competitors on all the profitable State lines?

The same is the case in Würtemburg and in most of those States where it is only by possessing the paying lines that the Government has been able to extend to the whole country the blessings of an easy and cheap transport of goods and persons.

The following corrections should be made in the first portion of this article, which appeared Jan. 15. Page 151, right hand column, ninth line from the bottom, for "narrow" read "uniform." Page 153, left-hand column, thirteenth line from the bottom, for "Liberal" read "Federal." Page 154, fourth line from bottom end, for "series" read "influence."

(To be continued.)

FIREMEN'S RESPIRATORS

The following communication has been received from Professor Tyndall with regard to the newest form of his improved respirator:—

The latest form of smoke respirator consists (with exception of a tin cylinder containing the filtering materials, and the goggles for the eyes) entirely of vulcanised india-rubber.

A sheet of vulcanised india-rubber, about ten inches long and seven inches wide, has (at about two inches from one edge, and midway from each end) an aperture cut, of such shape and dimensions as to allow the lips to protrude. Above this another aperture is cut, which allows the nose to pass easily through it. On each side of the nose apparatus, and a little above it, two circular holes are cut, corresponding to the position of the eyes.

A bent tin cylinder, 4½ inches long and 2 inches diameter (having a curvature nearly corresponding to the curvature of the face), is firmly and securely fixed opposite to and entirely closing the mouth aperture, by means of strips of india-rubber. The nose aperture is closed with sheet rubber, forming a chamber sufficiently large for the protruding nose. The lower ends of the nose cover are attached to the rubber sheet supports of the tin cylinder, in such a manner as to connect the nose and mouth apertures by a small chamber.

Into each hole corresponding to the eyes a circular curved glass about 1½ diameter (similar to a watch glass) held in a suitable fitting, is inserted.

One end of the tin cylinder is closed by an india-rubber valve, opening outwards. This valve is protected by a moveable wire gauze covering.

The side of the tin cylinder, a little below the valve, is pierced by a hole, covered with wire gauze, which opens into the mouth chamber. The other end of the tin cylinder is fitted with a moveable wire gauze covering, which prevents the filtering materials from falling out.

The filtering materials are the same as previously employed.

The apparatus when in use is secured to the head of the wearer by two narrow elastic straps, one of which

passes from the upper part of the apparatus round the head; the other passes from the lower part of the apparatus round the neck. With a little pressure of the straps, the flexible sheet india-rubber of the face piece is drawn air-tight into the indentations of the face, and around the mouth and nose.

During inspiration the valve is closed by the atmospheric pressure, and the air passes through the filtering materials in the tin cylinder through the hole (below the valve) opening into the mouth chamber to the mouth and nose. During expiration the air is ejected from the lungs through the outward opening valve.

The total weight of the apparatus when charged with the filtering materials is about nine ounces.

Its advantages over previous forms are its lightness, simplicity of construction, and cheapness; the ease and rapidity of adjustment; no undue heating of the head, the face only being covered; no chance of derangement by the bursting of water tubes, &c., as none are used. The supply of air to the mouth and nose being perfectly free, there is therefore no excessive secretion of saliva.

THE INDUSTRIAL USES OF BISULPHIDE OF CARBON.

Up to the year 1850 the sole industrial application of bisulphide of carbon was in the vulcanisation and dissolution of caoutchouc; but since later invention has found means of producing the material at low price, it has been applied to a multiplicity of uses in a large number of the arts. The extraction of oils from grains, the wholesale removal of fatty matter from wool, the treatment of spices to obtain the same in soluble form, the fabrication of prussiate of potash by the Gêles process, and of sulphocyanide of ammonia for the preparation of the toys called Pharaoh's serpents, the purification of crude paraffin, the manufacture of liquid fire for incendiary projectiles, and as a means of destruction of vermin, are a few of the principal employments of bisulphide of carbon. As respects magnitude, however, and future influence upon manufactures, its adaptation to the utilisation of waste residues is of chief importance, and is fast forming the groundwork of a new and distinct industry. The credit of first extracting the fatty matters from these refuse products is due to M. Deiss, of Belgium, and by the aid of the bisulphide the former are obtained in quantities sufficient to serve for the lubrication of machinery or the fabrication of soaps and candles. In order to show the rapidly increasing value of this useful substance, we have gathered quite a number of its most recent as well as most important applications, and are thus enabled to present a fair view of the various refuse matters in connection with which it is now employed. In the manufacture of fatty acids brown compact deposits are precipitated. These, mixed with sawdust, in order to facilitate the action of the bisulphide, and treated with the latter, yield up to 20 per cent. of acids, which otherwise would go to waste. The pasty mass of metal filings, dirt, grease, &c., taken from car and wagon axles, is first treated with hot sulphuric acid, then with bisulphide, and lastly, washed and dried. This isolates the grease in a saponified state. Cotton waste, employed in or about machinery, is freed from its grease by sulphide and is again available for use. Residues of the manufacture of beeswax, which formerly found no sale except as manure, selling at about eight shillings a hundred-weight in France, are now subjected to the action of bisulphide, and an excellent yellow wax is extracted; the final residue is still useful as a fertiliser. Sawdust which has served to filter oils purified by sulphuric acid, yields, after pressure, 15 per cent. of oil; again, 50 per cent. of oil is obtained from the muddy deposits due to the mingling of oils with sulphuric acid. These are washed in boiling water, dried, mixed with sawdust, and, lastly, treated with bisulphide. Balls of oleaginous grain, when they cannot be used as food for cattle, yield fatty matters; and their residue is an excellent fertiliser, as it contains large proportions of nitrogenised substances and phosphates. Bisulphide is also used to extract the grease from olives after they have been pressed, and from residues of tallow and suet after melting and pressure, also from the residues of the manufacture of cocoa. Bone fragments, when treated with bisulphide at 104° Fahrenheit, yield 12 per cent. of grease; they are subsequently unfit for the manufacture of gelatine, but answer excellently for the fabrication of bone black. The cleanings of wool cards, when acted upon by bisulphide, give about 30 per cent. of fatty substances, utilisable for the manufacture of soaps. It is evident from the great number of waste products, and the abundance of some of them, that a very considerable amount of greasy and oleaginous matter can be returned to the various industries through the new processes involving the use of bisulphide. The material has also been successfully employed in the scouring of wool and in the extraction of bitumen from schists and bitumeniferous sandstones. In the latter case the quantity of bitumen obtained is from 4 to 5 per cent. superior to that furnished by distillation, which only gives in all from 7 to 8 per cent. MM. Van Haecht, Emile, and Co., of Belgium, exhibited in the Vienna Exhibition a number of improved machines for carrying on these processes, and in which all species of fatty residues could be treated. The price of manufacture does not exceed, for certain purposes, 12s. per ton; about half a ton per hour can be treated. The loss of bisulphide is reduced to barely one-half per cent.—*Journal of Applied Science.*

CORRESPONDENCE.

FOG-SIGNALING APPARATUS.

SIR,—With reference to my remarks in my communication to your *Journal*, "that trains cannot be heard so distinctly in foggy as in clear weather," I do not think it is generally known (although a well-known fact amongst railway men) that after a slight shower of rain, or on a dewy or frosty morning, trains cannot be heard at so great a distance as they can on a dry clear day, because, at such times the metals are what is termed greasy, and as fog makes the metals more greasy than rain or dew, I think the above will be sufficient to prove that I am correct in what I stated, for there is as much difference in the noise that a train makes on a dry day and what is termed a greasy one, as there would be in a man running or sliding over a pond covered with ice—the running would represent the dry day and the sliding the greasy one. Now, sir, independent of the above causes, I do not believe that sounds are more audible in foggy than in clear weather, for the following reasons:—About two years ago I was stationed at the mouth of a tunnel to protect trains, in consequence of a large stream of water having forced itself through the wall, at a distance of about a quarter of a mile from the mouth of the tunnel. I could distinctly hear the water running, also I could hear the men at work trying to prevent it; but one morning a dense fog came over, and I could neither hear the running of the water nor the men at work, so I came to the conclusion that the water had ceased, but when the man came out of the tunnel, who had to inform me as to the state of the roads, I remarked to him that I supposed the water had stopped, but, to my surprise, he said it was running faster if anything! I called his attention to the fact that I could not hear it, and we could neither of us ma

not the cause, but when the fog cleared away we could hear the noise as distinctly as before, but it was not until the above occurred three or four times that we came to the conclusion that it was owing to the mouth of the tunnel being blocked up with fog that we could not hear the water running. Then again, sir, I don't know whether you have noticed it or not, but fog is very deceptive, for I have heard old railway men say that they have heard a train coming when it had been foggy, but for the life of them they could not tell whether it was an up or down train! I do not doubt but what I can supply you with other instances, if you require them, to prove that fog tends to deaden rather than assist sound.—I am, &c.,

OLIVER CULLIS.

[illegible], Cranbrook-street, New-town, Deptford, S.E.
January, 1875.

GENERAL NOTES.

Improved Cabs.—With regard to the recent action of the Society on this subject, it may be interesting to notice that it is the intention of the Directors of the Alexandra Palace Company to hold, in the course of the ensuing season, at the Alexandra-park, an exhibition of cab-horses and cabs, and to appropriate a sum of £200 to be distributed in prizes for cabs in the best condition, and to drivers who have been longest in the employment of one master, and who have never been charged with cruelty to their horses, reckless driving, drunkenness, insolence, or other offences. It will be held at the close of the London season, when cab-drivers will be able to attend in large numbers. The stables of the Alexandra-park, which will afford accommodation for 400 horses, will give special facilities for the intended show.

Relics of George Stephenson.—There is now at the Patent-office Museum, South Kensington, a number of relics of the late George Stephenson. These include a safety-lamp; a box of watchmaker's tools; the medal of Leopold, King of the Belgians, presented to Mr. Stephenson by the engineers on the laying of the first stone of the first railway there, 1834; foot rule, always carried by him; a hone; two plated metal boxes, with inlaid bronze medal—one containing a silver medal presented to Stephenson by a Flanders railway, the other containing five railway passes; two snuff-boxes, the larger one containing a little snuff; magnifying glass; pocket compass; two pairs of silver studs (initials on one pair), one gold seal, with device of safety-lamp; silver repeater; four autograph letters of G. Stephenson; three autographs of ditto; three autograph letters of Robert Stephenson; some hair of George Stephenson; some hair of Mrs. Stephenson (Fanny Henderson), and various other articles.

Mineral Statistics.—According to Mr. Robert Hunt's "Mineral Statistics of the United Kingdom for 1873," the mineral produce of the kingdom in 1873 was as follows:—Coal, 127,016,747 tons, of the value of £47,631,280; iron ore, [illegible] tons, of the value of £7,573,676; copper ore, 80,188 tons [illegible] cwt., of the value of £342,708; tin ore, 14,884 tons [illegible] cwt., of the value of £1,056,835; lead ore, 73,500 tons 10 cwt., of the value of £1,131,907; zinc ore, 15,969 tons, of the value of £61,166; iron pyrites, 58,924 tons 3 cwt., of the value of £26,485; arsenic, 5,448 tons 17 cwt., of the value of £[illegible]; bismuth, 1 ton 4 cwt., of the value of £68; cobalt, [illegible] cwt., of the value of £12; manganese, 8,671 tons [illegible] cwt., of the value of £57,766; ochre and umber, 6,368 tons [illegible] cwt., of the value of £5,410; wolfram, 49 tons 19 cwt., of the value of £526; clay, fine and fire, and shale (estimated), [illegible] tons, of the value of £656,300; salt, 1,785,000 tons, of the value of £892,500; barytes, 10,269 tons 11 cwt., of the value of £7,993; other earthy minerals (estimated) of the value of £3,000; total value £59,479,486. The total value exceeds that for 1872 by upwards of half a million. The metals obtained from the ores was as follows:—Pig-iron, [illegible] tons, of the value of £18,057,739; tin, 9,972 tons, of the value of £1,329,766; copper, 5,240 tons, of the value of £[illegible]; lead, 54,235 tons, of the value of £1,263,375; silver, [illegible] ozs., of the value of £131,077; zinc, 4,471 tons, of the value of £120,099; other metals estimated at £5,000; making £21,409,878, the total value of metals produced from British ores in 1873 being £660,000 less than in the statement for the preceding year. Mr. Hunt adds to this total £47,629,787 as the value of coal raised, and £1,681,834 for minerals, earthy, &c., and the result is £70,722,992, being £529,576 more than the corresponding total given in his summary for the preceding year. The increase is entirely in the item of coal.

Paris Mud.—With regard to the experiments on road traction and street pavements now being carried on by a committee of the Society, the following particulars respecting the value of the mud of Paris may be worth notice. A French journal states that the contractors pay 600,000 fr. annually to the municipality for the right of taking it away. It is sold for manure at from three to five francs per cubic metre, and thus yields a revenue of about 3,000,000 fr. Out of this amount the expenses of sweeping the streets and carting away the mud must be deducted. The scavengers and other employés of the contractors are under the superintendence of the authorities, the entire staff being composed of several thousand persons. In 1823 the amount paid for the right of collecting the mud of Paris was only 75,000 fr.; in 1831 it was let for 166,000 fr., and in 1845 it reached the sum of half a million of francs.

Rhubarb Production in China.—The best rhubarb is still produced in Kansuh, but one of the principal marts for the sale of the drug is, it appears, Sanyiian, in Shensi, in which province also rhubarb is grown to a considerable extent. The cultivation in both provinces has, however, it is said, been seriously affected by the Mohammedan rebellion. Consul Hughes, of Hankow, states that much of the rhubarb which reaches that port comes from Szechuan, and is generally of very common quality, being usually quoted in the market at from 5 to 8 taels per picul (2½d. to 4d. per lb.) while the kind known as Shensi is usually quoted at from 15 to 50 taels (8d. to 2s. 2d. per lb.) This inferiority of the Szechuan drug is said to result from the moist heat of the province, which is injurious to the preparation of the root. In both the provinces of Kansuh and Szechuan the rhubarb is grown in mountainous districts. The plants, when grown, are cut down and thrown in heaps; they are then taken to the farmer's house, where the roots are pared and scraped. In Kansuh the roots are then tied together, and hung up from poles covered with matting; but in Szechuan the roots are obliged to be dried in the sun, and as a consequence, they are not like those of Kansuh, of firm substance throughout. One of the Chinese merchants supplied Consul Hughes with the substance of the following information respecting the qualities of rhubarb, price, and places of production. Province of Kansuh, Sining, average value, say 80 taels per picul (133⅓ lbs.). Same province, Liang-chow, very nearly as good, 75 taels. Szechuan, Mien-chow, 30 per cent. worse, 55 taels. Kansuh, Kiaichow, 50 per cent. worse. Kansuh, and North-West border of Szechuan, 60 per cent. worse; if well made, 40 taels, if common, 20 taels. Szechuan, Kuan Hien, 60 per cent. worse; better quality, 30 taels; common, 20 taels. The very common, at 5 to 8 taels per picul, comes, as has been said, from Szechuan. The rhubarb from Sining and Liang-chow, of the finest quality, does not at present reach Hankow, and it is probable that it finds its way overland to Russia *via* Kiachta. Very little of the rhubarb from Mien-chow goes to Hankow, and the requirements of the market are supplied from the other districts.

NOTICES.

TICKETS FOR THE SECTIONAL MEETINGS.

As the arrangements for these meetings are necessarily liable to alteration, the tickets are issued to members without being dated. The dates are duly announced from time to time in the *Journal*, and members are particularly requested, when issuing tickets, to fill in the date in the space left on the tickets for that purpose. Considerable inconvenience has already been experienced by visitors to these meetings from the neglect of this regulation.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

FEB. 3.—"The Protection of Buildings and Ships from Fire, with Arrangements for the Ventilation of Ships," by J. A. COLEMAN, Esq., C.E.

FEB. 10.—"The Sandblast and its Adaptation to Industrial Purposes," by WM. NEWTON, Esq.

FEB. 17.—"Description of M. Kastner's New Musical Instrument, the Pyrophone," by M. DUNANT. The instrument will be exhibited.

FEB. 24.—"The Art of Illustration as applied to the Printing Press," by HENRY BLACKBURN, Esq.

In order to suit alterations in the arrangements for the evening meetings, Mr. Newton has consented to postpone the reading of his paper on "The Sand-blast and its Adaptation to Industrial Purposes" till the 10th February.

EXTRA MEETING.

FEB. 5.—Adjourned Discussion of Capt. BEDFORD PIM'S Paper on "The Mercantile Marine of Great Britain."

AFRICAN SECTION.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

FEBRUARY 9.—"A General Description of the Trade on the West Coast of Africa," by W. BARINGTON, Esq.

FEBRUARY 23.—"The Slavery of the West Coast, and its Influence upon Commercial Progress," by CONSUL HUTCHINSON.

INDIAN SECTION.

Friday Evenings, at 8 o'clock. The following arrangements have been made:—

FEBRUARY 12.—"The Possibility of Adapting the Roman Alphabet for the Languages of India," by FREDERICK DREW, Esq.

CANTOR LECTURES.

The first course of Cantor Lectures is on "Alcohol: Its Action and its Use," by Dr. B. W. RICHARDSON, F.R.S. The following are the remaining lectures of this course:—

LECTURE VI.—MONDAY, FEBRUARY 1ST.

Influence of Alcohol on the nervous organisation, with special reference to the mental phenomena induced by its use.—Summary.

The Second Course of Cantor Lectures will be delivered by the Rev. ARTHUR RIGG, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

LECTURE I.—MONDAY, 8TH FEBRUARY, 1875.

Tools used in very Early Times, evidenced in prehistoric Implements, as well as in Sculpture and Drawings of ancient date; also Tools used in Recent Times amongst (so-called) savage races.

LECTURE II.—MONDAY, 15TH FEBRUARY, 1875.

Hammers.

LECTURE III.—MONDAY, 22ND FEBRUARY, 1875.

Hammers (continued).

LECTURE IV.—MONDAY, 1ST MARCH, 1875.

Picks, Axes, Adzes, Chisels.

LECTURE V.—MONDAY, 8TH MARCH, 1875.

Planes, Knives, Shears, Saws.

LECTURE VI.—MONDAY, 15TH MARCH, 1875.

Saws and Dove-tailing Tools.

Tickets for this course will be issued with next week's *Journal*.

The Third Course will be "On some of th Forms of the Modern Steam Engine," by F. J BRAMWELL, Esq., F.R.S., President of the Insti tution of Mechanical Engineers.

Members are privileged to introduce *two* friend to each of the Ordinary and Sectional Meetings the Society, and *one* friend to each Cantor Lectur

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SCIENTIFIC MEETINGS FOR THE ENSUING WEE

MON. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p (Cantor Lectures.) Dr. B. W. Richardson, "Alcoho its Action and its Use." (Lecture VI.)
Farmers' Club, Salisbury-square, E.C., 5½ p.m. M J. B. Lawes, "The more Frequent Growth of Barley
Royal Institution, Albemarle-street, W., 2 p.m. Gen Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p Mr. John Henry Adams, "Inaugural Address."
Royal United Service Institution, Whitehall-yard, 8½ p Staff Commander T. A. Hull, R.N., "The Unsurvey World, 1874."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Professor T. R. Birks, M.A. (Cambridge), "The destructibility of Force." 2. Rev. S. Wainwright, D "The Philosophy of Human Consciousness."
London Institution, Finsbury-circus, E.C., 5 p.m. P fessor Ferrier, "Functions of the Brain."

TUES. ...Royal Institution, Albemarle-street, W., 3 p.m. Mr Ray Lankester, on "The Pedigree of the Animal Ki dom."
Civil Engineers, 25, Great George-street, Westmin S.W., 8 p.m. Prof. Joseph Prestwich, "On the Or of the Chesil Bank, and on the relation of the ex Beaches to past Geological changes independent of present Coast Action."
Pathological, 53, Berners-street, Oxford-street, W., 8 p
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Royal Colonial (at the HOUSE OF THE SOCIETY OF AR 8 p.m. Adjourned Discussion on Mr. Eddy's and Labilliere's Papers will be resumed.

WED. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p Mr. J. A. Coleman, "Protection of Buildings Ships from Fire, with arrangements for the Ventila of Ships."
Microscopical, King's College, W.C., 8 p.m. Ann Meeting.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, W. 4½ p.m. Mr. Walter de Grey Birch, "On the Class cation of MSS., chiefly in relation to the Cla Catalogue in the British Museum."
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p

THURS....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Rev. G Henslow, "On the Origin of Prevailing System Phyllotaxis." 2. Mr. H. N. Mosely, "On the Fl and Insects of Kerguelen's Land." 3. Mr. J. Gam "On Ariscema Speciosum."
Chemical, Burlington House, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Zerffi, "The Grotesque in Indian Art."
Society for the Encouragement of the Fine Arts, 9, C duit-street, W., 8 p.m. Mr. F. R. Dalby, "Pri in connection with early Art."
Royal Institution, Albemarle-street, W., 3 p.m. P Tyndall, "On Subjects connected with Electricity."
Royal Society Club, Willis's Rooms, St. James's, 6. p.m.

FRI.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p Adjourned Discussion on Captain Pim's Paper " the Mercantile Marine of Great Britain."
Royal Institution, Albemarle-street, W., 8 p.m. We Meeting, 9 p.m. Mr. J. Dewar, "On the Physiolog Action of Light."
Geologists' Association, University College, W.C., 7½ p Annual Meeting.
Philological, University College, W.C., 8 p.m. Prof Mayor, "Rhythm."
Archæological Institution, 16, New Burlington-street, 4 p.m.

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Mr T. Wood, on "The Discovery of the Temple of Dia and other Results of the Government Excavations Ephesus."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,159. Vol. XXIII.

FRIDAY, FEBRUARY 5, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Alkali Examination is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

CANTOR LECTURES.

The fifth lecture of the course of Cantor Lectures on "Alcohol, its Action and its Uses," by Benjamin W. Richardson, M.D., F.R.S., F.R.C.P., was delivered on Monday, January 25th, 1875, as follows:—

Lecture V.

On the secondary action of alcohol on the animal functions, and on the physical deteriorations of structure incident to its excessive use.

It is my business in this course of lectures to treat upon the specific action of absolute alcohol. I have therefore specially avoided all reference to the spirituous drinks of which it forms a part. As a rule in every form of strong drink the source of the action of it, for good or for evil, is the spirit it contains, and the influence of the drink is potent according to the amount of that spirit present in it. To put the matter simply, if all the liquors sold under the name of wine, brandy, gin, rum, whisky, ale, stout, perry, cider, and so forth, were divested of their alcoholic spirit, they would contain comparatively little of anything that would affect those who partook of them.

Deleterious Additions to Alcoholic Drinks.

But as I am about to night to speak of the deleterious action of alcohol, it is fair I should admit that some bad effects do spring from so-called wine and kindred drinks independently of the pure spirit they contain. Something less of evil than now obtains would be secured if none but natural wines and ales were drunk by the people. To return to the times before Brantwein was distilled, and to have no intoxicating beverages save pure wine and sound ale, were doubtless an improvement on the state of things which now exists; for in truth at the present time the characters of pure ethylic wine are hardly known. A *bona-fide* wine derived from the fermentation of the grape purely, cannot contain more then seventeen per cent. of alcohol, yet our staple wines, by an artificial process of fortifying and brandying, which means the adding of spirit, are brought up in sherries to twenty and in ports to even twenty-five per cent. Some wines and spirits are believed to be charged with amylic alcohol. Other wines are charged with foreign volatile substances to impart what is called bouquet, and still other so-called wines—I allude specially to the effervescing liquids sold under that name—are actually often undergoing the fermenting process at the time they are drunk, and thus are invited to complete their fermentation in that sensitive bottle, the human stomach.

If the subject were specially looked into, a very important chapter of facts might be collected bearing upon the injurious effects of these additions to ales, wines, and spirits. I have noticed the evils that follow upon the administration of an alcoholic drink that has been adulterated with amylic alcohol, and have shown that they are exceedingly serious. The disturbances excited by the other faults, when they do not arise from excess of absolute alcohol, are shown in symptoms of indigestion and in the promotion of an acid condition of the secretions of the body, beyond what is natural.

Presuming therefore it be actually determined by any one that he will take some alcoholic fluid, he will do nearest to that which is most wise if he take wines or other spirituous drinks in which the quantity of alcohol is simply confined to the natural amount, in which the process of fermentation has ceased, and in which no foreign substance has been introduced to add either bouquet, body, piquancy, narcotising influence, or other artificial quality.

Absinthe.

The admitted addition of some actively poisonous substances to alcohol, in order to produce a new luxury, is the evil most disastrous. The drink sold under the name of *absinthe* is peculiarly formidable. In this liquor five drachms of the essence of absinthum, or wormwood, are added to one hundred quarts of alcohol. Thus the liquor is not only very strong as a mere alcoholic drink, but it is charged with another agent which has been discovered to exert the most powerful and dangerous action upon the nervous functions. The essence of absinthum in doses of from thirty to fifty grains produces, in dogs and rabbits, signs of extreme terror and trembling, followed by stupor and insensibility. In larger doses it causes epileptiform convulsions, foaming at the mouth, and stertor of the breathing. Its effects, as they occur from the taking of it in the form of absinthe in man, have been most ably described to me by one who indulged in it until it induced in him the peculiar epileptiform seizure. He described the effects as resembling those produced by *haschish*, the narcotic of the East which has been known for so many ages as the *nepenthes* of Homer, and which owes its properties to extract of Indian hemp or *Cannabis indica*. The partial insensibility caused by the absinthe is attended with the ideal existence of long intervals of time, in which the events of a whole life are arrayed and appreciated, to be succeeded by terrific hallucinations and intellectual weakness, ending in unconscious struggling as if for life. In time, if the use of the absinthe be continued, these phenomena become permanently established and the result is inevitably fatal.

The doubly poisonous absinthe is made the more seductive to its victims by the fact that it excites a morbid craving for food which is never felt except when it is tempted by the destroying agent. Indeed, such are the terrible consequences incident to this agent, that I agree with Dr. Decaisne in maintaining that it ought, by legal provision, to be forbidden as an article for human consumption in all civilised communities. Even in small quantities taken daily, say one or two wine-glassfuls, it causes quickly a permanent dyspepsia, and what is of still more consequence it tempts its victims on and on, so that they cannot take food until absinthe has prompted the desire for it, by which time they are too often hopelessly and mortally in its power.

Until recently absinthe has not been publicly offered for sale in this country on a large scale. But now unhappily the poison is openly announced even here, and the consumption is on the increase; I am doing therefore a public duty in denouncing its use solemnly from

this platform, whence so much that is beneficial to society has for a century past been spoken.

Addition of other Agents.

The intentional additions of poisonous agents to the alcohol of ales, wines, and spirits, pale when absinthe appears in sight, but they are not to be ignored. It is true that we very often hear accounts of the effects for evil of bad wine, when, in fact, the evil is due to the excess of ordinary alcohol that has been taken by the complainant. At the same time it is not to be denied that there exists in our midst a system of mixing, compounding, blending, and reducing wines and spirits, which, carried even to artistic perfection, is additionally prejudicial to the business of selling the various alcoholic beverages.

To be just to our own age, this artistic performance is not an invention of it. The adulteration of wine is indeed one of the oldest devices, extending from the Greeks and Romans onwards to this day. In the Middle Ages many prohibitory acts were passed against it by various governments. As late as the close of the seventeenth century an act was passed by Duke Everhard Louis of Wurtemberg making it an offence punishable with death and confiscation of property to adulterate wine with bismuth, sulphur, or the salt of lead called litharge, now known as the yellow protoxide of lead. In the year 1705-6, John Jacob Ernhi of Eslingen was actually beheaded for carrying out adulteration with the forbidden poisonous lead compound.

Into our modern civilisation a different system of treating strong drinks, in order to rectify bad qualities or to impart new, is as a rule followed. The plan of using gypsum or sulphate of lime to remove the acidity of wine, a practice that was followed both by the Greeks and Romans, is however still resorted to; so also is the practice of using lime for the same purpose, and for which Jack Falstaff so severely criticizes the landlord of the "Boar's Head":—

"You rogue, here's lime in this sack: There is nothing but roguery to be found in villanous man: yet a coward is worse than a cup of sack with lime in it; a villanous coward."

But, on the whole, the new day has brought new plans and new intentions, having reference to the different forms of drinks, namely, ales, wines, and spirits, which pass from the hands of the vendor to the consumer.

Ales.

The practice of adulteration the least hurtful is carried on in ales; that at all events is my experience of the ales sold in London, and I speak from a practical knowledge of the facts. A few years ago a well-known statist asked me to undertake for him a research on the ales sold in London, with a view to the detection of the adulterations in them. For many weeks this gentleman himself collected beers and ales from different retail houses in the most diverse parts of this metropolis, and neither trouble nor expense was spared in the examination of these samples, in order to arrive at correct results as to the composition of the fluids thus retailed. I may state at once that I did not in any one instance find a truly dangerous adulteration. I found that to many samples common salt had been added, and to some sugar; but the grand adulteration was water, by which the consumer was, if I may so express it, fraudulently benefited and the government proportionately defrauded. If this aqueous adulteration were not carried on, our Registrars of deaths, and Collectors of revenues, would both show heavier totals.

There is a prevailing notion that to malt liquor, bitter substances, such as strychnine, or narcotic substances, such as *cocculus indicus*, are added. Neumann says that in his time, that is just one hundred years ago, *clary*, *cocculus indicus*, and *Bohemian rosemary* were added to malt liquors in order to increase their intoxicating powers, and he states that the last-named substance, Bohemian rosemary, produced a raving intoxication. I know it is also urged, in this day, that there is no known application for the quantity of *cocculus indicus* that is sold except it be for the adulteration of malt liquors. I will not dispute the matter, but I content myself with stating that I have never detected any foreign body of the kind, and that in the whole of my experience of the effect of malt liquors on man, I have never known a symptom produced indicative of the effects of such substances.

The stronger ales and stouts are injurious mainly from the alcohol they contain. Those which have not ceased fermenting, and from which gas is escaping, produce a persistent dyspepsia in those who indulge in them, a dyspepsia attended with flatulency, painful distention of the stomach, and with loss of proper muscular power of the stomach by which deficiency the trituration of food is impeded and rendered imperfect. At the same time the action of the gastric fluids upon the food is made less effective. There is at the present time in the market a substance used as an addition to ales, which is called *saccharina*. It is sold in the form of the ordinary sugar loaf. It is made by the action of diluted sulphuric acid upon starchy matter, and it is in fact a grape sugar. It gives to the ale body and sweetness. It is in itself a fattening food and as it is the same as that form of sugar which is found in those who suffer from the disease called diabetes, and which produces the symptoms of that disease, it cannot be taken in quantity without some indirect risk of danger.

Wines.

The evils arising from wines, apart from those which are due to the natural ethylic alcohol they should contain are derived from several sources. The wine that has not ceased to ferment, and when uncorked is found to be charged with gas, is often as injurious as beer in which the fermentation has not ended. It produces a fermenting process within the body, and gives rise to those phenomena of dyspepsia to which allusion has already been made. Wine that has once been acid and has been treated with lime in order that the acidity may be neutralised, is open to the objection of an excess of salt of lime. It has been urged against wines treated in this manner that they lead to calculous disease when they are taken in quantity for long periods. I must answer to this suggestion that I have not had experience of the slightest evidence that would support it, nor do I think there is sufficient of such wine consumed to warrant any conclusion of the kind. Wine if adulterated with amylic alcohol is unquestionably dangerous, owing to those physiological effects produced by the adulterant to which I specially directed your attention at the second lecture of this course. Wines that are beaded, are injurious owing to the foreign mixture for beading that has been added to them, and which I shall describe in due course.

Some substances that form in natural wines exert an effect on the animal body when they are taken into it. These substances are principally aldehyde and acetic acid. Aldehyde when it is present in wine communicates to it a natural bouquet. You will find on the table a pure specimen of aldehyde, and you will also find specimens of natural wines, kindly lent to me by Mr. Denman, in which this change of alcohol by oxidation has taken place. In the year 1848 the late Sir James Simpson, of Edinburgh, discovered that aldehyde would produce anæsthetic sleep when its vapour was inhaled, and I have since submitted it to experiment with the view of testing its action on the living body. I find it is a rapidly intoxicating agent, sharp to the nerves of sense and acting with greater rapidity than alcohol, and with a less prolonged effect, for it is soluble in water, and is so volatile that it boils at 72° F. It is therefore quickly diffused and quickly eliminated from the body. The action of aldehyde upon the living body has been as yet insufficiently studied. It has a close relation to the narcotic action of alcohol, and the symptoms it produces are so similar I am inclined to believe that the

narcotism which follows the administration of alcoholic spirit is partly due to its production.

The presence of acetic acid in wines is on the whole not injurious, if the wine in other respects be free of adulteration. The tendency of this acid itself is to promote the digestion of albuminous foods, and I have sometimes observed in persons whose digestive power is feeble, signs of improvement under its use. In saying this I do not however wish to convey that therefore a rough acid wine should be taken for indigestion, for the acid in such instances may be administered without the wine and perhaps with greater advantage. I only wish to record that acidity of wine, in which fermentation has ceased, is not a source of additional injury. The astringent acid of some wines—called tannic—has been advanced as useful in the cases of certain persons who suffer from laxity of body, and who require astringent remedies. It would be wrong to dispute that there may be in wines a virtue of this kind; but it is not peculiar to wine. It can be secured when it is wanted without wine at all, and in a more certain way. This remark holds equally good in respect to what may be favourably spoken of the saline substances which some wines naturally present. I mean to say that the saline constituents can be administered with more certain and therefore with better effect, independently of wine.

Spirits.

Into the different spirits commonly sold, several substances are introduced which exert more or less of baneful influence on the body that receives them. The addition of amylic alcohol has been already mentioned and need not again be mentioned, and I omit intentionally, for the sake of brevity, a great number of other added substances which do not seem to me to be active for evil, though they were possibly better left out of the animal organism. After these are withdrawn there remain many other agents which cannot fairly be omitted from our consideration. There is oil of juniper, and oil of bitter almonds, potassa, alum, nitric acid, oil of vitriol or sulphuric acid, and butyric acid. In even small quantities everyone of these agents is injurious to the body if it be taken for any long continued period of time. The oil of juniper is an active diuretic, and thereby is injurious to the excreting power of one of the most important of the vital organs. The oil of bitter almonds contains, unless it be specially purified, hydrocyanic or prussic acid, and exerts then in small and often repeated quantities a prejudicial influence on the nervous functions. Potassa causes a dry and caustic action upon the mucous membrane of the mouth, throat, and stomach, for the production of which action it is actually added systematically, that it may give the peculiar sharpness called "biting the palate."

Alum is a powerful astringent, producing constipation, and sustaining a persistent dyspepsia so long as it is being swallowed. Nitric acid is an astringent, exerting also a physiological action on the liver. Sulphuric acid is an astringent; and butyric acid, as I found in an original research which I once conducted with it, causes a congested or inflammatory condition of the whole track of the mucous membrane.

Thus each one of these agents added to the alcoholic drinks increases the evils that are likely to arise from the alcohol itself. Let us admit that the added evils are small, nay, I had nearly said, infinitesimal, when considered by the measurement of one administration. But who can measure by that standard? When once the taste for one of these unnatural substances is acquired it grows by what it feeds on, and that which was infinitesimal at the beginning becomes after long continuance a serious charge for the body to bear daily.

The spirit in common use that is most subjected to the chemicals I have named is gin. Gin has to be made cordial, to be sweetened, to be rendered creamy and smooth, to be flavoured, to be made biting to the palate, to be beaded, and what not else. To be made "cordial" it must be charged with oil of juniper, with essence of angelica, with oil of bitter almonds, with oil of coriander, and with oil of carraway. To sweeten it, it must be treated with oil of vitriol, oil of almonds, oil of juniper, spirits of wine and loaf sugar; to "force down" the same it must be further treated with a solution of alum and carbonate of potassa. To be rendered creamy and smooth, it must be sweetened with sugar, and lightly charged with a small quantity of garlic, Canadian balsam, or Strasbourg turpentine. To give it piquancy, it must have digested in it shreds of horse-radish. To be made biting to the palate, it must receive that touch of caustic potash of which I have spoken.

As you see the habituated gin drinker partaking of his favourite drink you observe, often, that he enjoys it the more if it be what he calls "pearly," or "beaded." He holds up the precious liquid in his glass, and as he sees the oily fluid as beads roll down the side, leaving each a creamy train behind it, he rejoices in his treasure. It is *crême de la crême* of gin. Those wicked pearly drops are, to his flushed eyes, the proofs of the purity and excellence of what he would probably tell you was, without mistake, the genuine article. The genuineness consists in the fact that our enthusiastic friend's gin has been beaded by the addition of the following artistic mixture:—An ounce of oil of sweet almonds has been added to an ounce of oil of vitriol. These have been rubbed together in a mortar with two ounces of loaf sugar until a paste has been formed. The paste has next been dissolved in spirit of wine until a thin liquid has been produced; and this, added to one hundred gallons of gin, has given the fine pearly bead that is so much admired.

Redding, in his history and description of modern wines, narrated in his day the many receipts that were openly published in the then existing publicans' guides and licensed victuallers' directories for the artificial manufacturing of wines, and for modifying spirituous liquors. I have gone for my information to a similar work of the present day, "The New Mixing and Reducing Book," which is, I understand, one of the handbooks of the retailer, the same to him as the pharmacopœia is to the druggist, and to be followed in all the varied arts as implicitly. I cannot leave this book without reading from it a quotation that bears directly on the health of the poorer classes, who indulge in gin.

"Gin, it may be observed, is of all the spirits ordinarily kept by a publican the one which, when cleverly managed, yields him the greatest and securest profit. The reason of this is that there is hardly any definite selling strength for gin, especially if it be sweetened. Within very wide limits no complaint is made by customers on the score of weakness, provided only the gin is creamy, palatable, and sharp tasted. But the slightest taint, or the slightest fault of colour, or a sensible difference in the usual flavour, will lead to dissatisfaction and loss of custom. Strong or unsweetened gin is in comparatively little request, and then with few exceptions only amongst the respectable or monied classes. At least three-fourths of the spirit sold over the counter of a public house consists of sweetened or made-up gin; and as the sugar greatly alters the character of the liquor and deadens the original strength, it is possible for the retailer to consult his own interests by a liberal addition of water without in any degree exciting the disapprobation, or injuring the health of those who patronise his establishment.

"As a tolerably safe general rule there will be no occasion to fear dissatisfaction when sweetened gin is not brought below 35 or even 40 per cent. U.P. It is then nearly five times as strong as old ale. Much more is thought of a pleasant warming aromatic taste or smack than of simple alcoholic strength. But as the most careful man may sometimes overshoot the mark in reducing, it is advisable to know how to restore the requisite degree of pungency and sharpness, without having recourse to the use of so expensive an agent as spirits of wine. Supposing, then, that by accident the strength of a parce

of gin has been lowered rather too far, a good and cheap remedy is the following:—For 100 gallons, 1 ounce of cassia, ½ ounce of chilies. Steep for a week in a pint of spirits of wine; then mix well with the gin."

The other spirituous liquors, rum, whisky, and brandy, are less falsified than gin. Rum is occasionally adulterated with an essential oil like butyrin and with butyric acid, these two substances being present in some natural rum, giving to it a special flavour and taste. Whisky is modified by blending, so as to communicate qualities of smoothness and softness. The yellowish colour given to whisky is produced by pouring the spirit into sherry casks, or by stirring it up with the lees of wine. These refined whiskies are prepared for the rich and sumptuous; for the poor it is recommended that they should be treated with the spirit they understand best; a sharp and potent drink, that brings the tear into the eyes, and makes the throat smart as it goes down.

Brandy, except when treated with fusel oil, is not, I believe, adulterated with any injurious compound. But it carries with it naturally a peculiar ether, which gives to it a special odour. This ether, a specimen of which is on the table, is very heavy when compared with ethylic ether. Its specific gravity is 862, taking water at 1,000, and its boiling point is 479° on Fahrenheit's scale. It is all but insoluble in water, to which, however, it communicates its peculiar odour. It exerts on the body an injurious influence; it causes nausea, thirst, and pain in the stomach. It seems also to arrest the due secretion of bile.

SECONDARY PHYSIOLOGICAL ACTION OF SIMPLE ALCOHOL.

I leave now the consideration of the evils arising from the action of the different extraneous substances that are present in alcoholic drinks to resume the study of the action of ethylic alcohol itself when it is free of any such combinations. I have to consider under this head the effect of the consumption of alcohol in its slow and progressive course, in what may be called its secondary manifestations of effect upon those who for long periods of their lives submit themselves to its influence.

I have shown that in the course of acute intoxication from this spirit there are four degrees or stages, each degree marked by different series of phenomena. In the secondary, or, technically speaking, chronic intoxication, from the same agent, there are in like manner four distinct degrees, each presenting distinct phenomena. A minority of persons who habitually take alcohol escape with impunity from injury. Some of these escape because they only subject themselves to it on a scale so moderate they can scarcely be said to be under its spell. If they take it regularly they never exceed an ounce to an ounce and a-half of the pure spirit in the day; and if they indulge in a little more than this, it is only at recreative seasons, after which they atone for what they have done by a temporary total abstinence. Others take more freely than the above, but escape because they are physiologically constituted in such manner that they can rapidly eliminate the fluid from their bodies. These, if they are moderately prudent, may even go so far as to indulge in alcohol and yet suffer no material harm. But they are a limited few who are thus privileged, if the term may be applied to them. The large majority of those who drink alcohol in any of its disguises are injured by it. As a cause of disease it gives origin to great populations of afflicted persons, many of whom suffer even to death without suspecting of what they suffer and unsuspected. Some of these live just short of the first stage of natural old age; others to ripe middle age; others only to ripe adolescence.

DETERIORATION OF THE BODY UNDER THE FIRST DEGREE.

The first degree of the secondary action of alcohol is evidenced in those who by constant habit imbibe an alcoholic stimulant to the simple extent of producing arterial relaxation, and of setting the heart at liberty to perform an increased series of motive contractions. They do not, as a rule, receive what is commonly cal[illegible]
an excess of any alcoholic drink, but they become trai[illegible]
to a sensation of want for it, to an appetite wh[illegible]
while all seems to go well, they have no desir[illegible]
resist, though they may keep it within what t[illegible]
conceive are its due limits. Such persons confine th[illegible]
libations to four or six ounces of alcohol per day[illegible]
couple of glasses of sherry or of ale at luncheon, thre[illegible]
four glasses of wine at dinner, one or two at dessert, [illegible]
a mixture of spirit and water before going to bed; [illegible]
is a common and a "temperate day," but reckoned [illegible]
means at least from four to six ounces of alcohol. [illegible]
primary effect of such a quantity we know. Contin[illegible]
daily it induces a new physiological and altogether [illegible]
natural condition, in which the sense of acquired nece[illegible]
enforces desire, until at last the spirit is made to be[illegible]
a positive requirement of the organic and the m[illegible]
life. Every extra effort must be preceded by the r[illegible]
to the stimulant. Every prolonged weariness mus[illegible]
relieved by the same measure; but when the effect of[illegible]
measure has speedily subsided, there is left a gre[illegible]
exhaustion than before. Another resource to [illegible]
artificial aid completes the exhaustion, and makes it[illegible]
into dullness and drowsiness without natural and s[illegible]
sleep, and with an unbearable sense of after prostra[illegible]

For many years, in the young and adolescent, [illegible]
alcoholic life may be carried on without any evid[illegible]
being rendered of the progress of physical deteriora[illegible]
In the young the processes of assimilation, of secre[illegible]
and of excretion, are in their full activity, and the po[illegible]
ous agent with which the blood and tissues is saturat[illegible]
disposed of so readily and promptly, it does not [illegible]
long enough in contact with these parts to vitiate t[illegible]
This is a very homely way of putting the fact, but[illegible]
scientifically true. The young, therefore, seem to e[illegible]
and I believe that up to the close of the first term o[illegible]
natural life, that is to say, to the close of that peri[illegible]
full growth and development which extends to t[illegible]
years, they sometimes escape so successfully that if [illegible]
could but stop in their course at that point they mig[illegible]
through the remaining terms of existence without [illegible]
important modification of function.

Unfortunately it is the rarest of events that a p[illegible]
artificially stimulated by alcohol to the period n[illegible]
gives up the practice. The majority are utterly i[illegible]
rant of the dangers that are ahead, and the se[illegible]
support to which they have been educated by the p[illegible]
tice leads them on to pursue it with even a gre[illegible]
reliance upon it than before, and with a feeling of n[illegible]
urgent demand. In a word, the sensation that [illegible]
cannot do without it, the sensation of lowness and[illegible]
pression when it is by any accident withheld, and[illegible]
contrast of lightness and activity when it is regai[illegible]
are so powerful, in their influences upon the mind, [illegible]
is no resisting the belief of the absolute necessity.

But when the body is fully developed; when [illegible]
extra vital capacity which attended youth is expend[illegible]
growth and development; when all the organs [illegible]
assumed their full size and activity; when the bal[illegible]
of secretion is so nicely set in all parts that not on[illegible]
cretion can be disturbed without a disturbance of[illegible]
whole; when the spring of the elastic tissues is redu[illegible]
when the lungs cannot fail ever so little in their [illegible]
tion of throwing off the gaseous products of combu[illegible]
without a vicarious extrusion of gases into the ali[illegible]
mentary canal; when the completed organic mo[illegible]
parts become encumbered with fatty matter interp[illegible]
between them, or laid out around them; then the [illegible]
of alcoholic spirit begins to be realised. The flui[illegible]
now retained longer in the living house; is decomp[illegible]
less quickly; is thrown out by primary or secon[illegible]
elimination less speedily.

The action of alcohol under these new condition[illegible]
favourable in every sense to the series of changes [illegible]
capable of effecting, is twofold. The action in the [illegible]
place is purely mechanical. We are aware that it l[illegible]
to temporary paralysis of the vessels of the minute[illegible]

ulation, and that upon this the heart responds with a quicker propelling stroke. Thus the vessels throughout the whole of the body are dilated, and are held in a state of unnatural relaxation and unnatural tension. Under this persistent pressure their diameters change in course of time, and the whole of the marvellous webwork of blood, upon which the organs of the body are constructed, is deranged, in its mechanical distribution, over its extended surface. During this time, too, the function of the heart becomes perverted. The heart is truly an automatic organ, but it is still an organ which feels none the less severely the effect of stimulus. If it make to-day an unnatural number of one hundred and twenty-five thousand strokes, it cannot to-morrow sink back, from absence of its stimulus, to the normal one hundred thousand without evidencing some disturbance of action, some feebleness, some hesitation, or some palpitation. In fact, as it is an organ which by its own stroke feeds its own structure with blood, it is the first to suffer from irregular supplies of blood. Thus under alcohol the nutrition of the heart is mechanically modified. Whipped into undue work, it becomes, like the muscles of the blacksmith's arm or the opera dancer's leg, of undue size and power; and in proportion as this evil increases the necessity for the stimulus it calls for grows more urgent.

In turn this extreme power and force of the heart tells upon the vessels that are fed by its impulsive stroke, and so all the organs that are constructed upon those vessels appreciate with abnormal sensitiveness the whip of the stimulus, and the languor when the whip is withheld.

Of itself this extreme sensitiveness of the heart is sufficiently momentous, but the ultimate results upon the body at large are perhaps more important than the pure local change that is instituted in that perfect and elaborate pulsating mechanism. The heart not only becomes enlarged, but its various valvular and other mechanical parts subjected to undue strain are thrown out of proportion. The orifices in it, through which the great floods of blood issue in their courses, are dilated. The exquisite valves become stretched, and prevented from assuming their refined adaptations. The minute filamentous cords which hold the valves in due position and tension are elongated, and the walls of the ventricles or forcing chambers are thickened, or as we say, technically, are hypertrophied. Throughout the whole of its structures the central throbbing organ is modified both in its mechanism and in its action.

But such central modification cannot possibly go on long without the institution of other changes at the opposite extremity or circumference of the circuit of the blood. At one moment the vital organs feel the pressure of the too powerful stroke of blood; at another moment they are suddenly aware of an enfeebled stroke. The brain is, for the instant, conscious of a flicker of power; it is like the faintest flicker of gas, which is observed when, by an accident, the pressure is disturbed at the main, but it is there, and the person who experiences it is cognisant of its central origin. So matters progress often for months, or for years, without further evidence of subjective or objective sign of increasing evil. The worst evidence that exists is, probably, the necessity for a more frequent repetition of the stimulus under additional stress of work or excitement.

While these changes in the simple mechanism of the circulation are in course of advancement, there are also in development certain other changes which are much more delicate and minute, yet not less important. These consist of direct deteriorations of structure of the organic tissues themselves. We are, at the present time, only on the borderland of a new knowledge on this subject, and I myself am, in this matter, a mere outpost wandering wonderingly, and trying to observe what is going on, but as yet, though thus advanced, unprepared to speak with so much precision and fulness of detail as I would desire. The following, however, simply spoken, seems near the truth in respect to the degenerative changes of organic structure from the continued use of alcohol. Alcohol produces physical deterioration by destroying the integrity of the colloidal matter of which the tissues are composed. I have explained that all the organic parts are constructed out of colloidal substance; that every part, including the blood vessels, to their minutest ramifications, are composed of this colloid material arranged in different forms and plans to suit the design of the part, whether it be a tube, like an artery, a bundle of cross-cut fibres like a muscle, or a refracting globe like the crystalline lens of the eyeball. That these parts should be kept in their integrity, in the midst of their diversity, the ultimate structure of which they are composed must be held in proper measure of construction with water. Disturb the relationship that should exist between the colloid and its combining water, and the character of the colloid is at once changed. Here, for example, is a colloidal fluid, called albumen. I pour a little of it on to a glass plate as a thin watery film. I spread over it a little finely powdered caustic soda, by which I remove and fix some of the water which previously held it as a liquid. Now observe what has occurred. The thin liquid is transformed into a transparent membrane which possesses elasticity. Again, into this little porcelain cup I pour a small quantity of the same solution, and then I drop into the solution a bead of soda and soon I can lift the solution from the cup in a solid mass, shaped like a concavo-convex transparent lens. I could multiply these facts indefinitely, but I am anxious to indicate only one particular fact, viz., that alcohol and its derivative aldehyde possess also by their affinity for water, the property of destroying the integrity of the colloidal form of matter. Thus they solidify, or render pectous the colloidal structures. Here is a solution of albumen. I add to it alcohol. The albumen is rendered thick or pectous. Here is a solution of caseine; I add to it aldehyde; the caseine is rendered thick or pectous.

Animal tissues subjected to alcohol can be perverted to any degree, and in the most diverse and apparently contradictory ways. I can hold blood permanently fluid with alcohol; I can solidify it with the same agent. I can reduce the size and modify the shape of the blood corpuscles, and I can so modify those fine and delicate animal membranes which dialyse or allow to pass through them the saline matter of the blood and secretions, that the process of dialysis shall be impeded, and that which should pass through shall be left in combination with the membrane. I can destroy the elasticity of the blood vessels in the same way, for that depends upon the presence in them of a gelatinous colloid substance called elasticin.

When, therefore, alcohol holds long-continued contact with the perfectly developed colloidal tissues, its action upon them to produce physical deterioration is simply inevitable, and from this cause arise those fatal lesions of local organs which mark the different phases and stages of alcoholic disease. The commencement of the change sometimes shows itself visibly on the surface of the body. The vessels of the face become permanently enlarged and suffused with blood. In cold weather, the blood circulating imperfectly through these vessels, and, not fully aërated, gives to the skin that dull leaden hue which is so characteristically significant of prolonged indulgence; in hot weather, the blood circulating more freely and purely, gives to the skin a red hue, and often a deep red blotch, which is hardly less demonstrative.

In this stage of alcoholic disease eruptions upon the skin occur to declare the injurious action of the spirit upon the colloidal gelatinous textures. The epidermis or scarf skin is imperfectly thrown off; it dies upon the surface, but owing to deficient vascular and nervous tone beneath, it is not replaced so quickly as is natural. Thus the dead debris, in form of scale and sometimes with fluid beneath, accumulates; the superficial nervous surface which should be protected by the

newly formed epidermis is exposed, and irritation and pain follow as a consequence.

These evils, in these the slighter stages of alcoholic disease, are often connected with others, which are perhaps passing, but which give rise to very unpleasant phenomena. There is what is called a dyspepsia or indigestion, to relieve which the sufferer too frequently resorts to the actual cause of it as the cure for it. There is thirst, there is uneasiness of the stomach, flatulency, and a set of so-called nervous phenomena, which keep the mind irritable, and make trifling cares and anxieties assume an exaggerated and unnatural character. From the earliest period in the history of the drinking of alcohol these phenomena have been observed. "Who," says Solomon, referring to this action, "Who hath woe? Who hath contentions? Who hath babbling? Who hath wounds without cause? Who hath redness of the eyes?"

What modern physiologist could define better the steady and progressive effect of alcohol upon those who even under the guise of temperate men trust to it as a support? And yet these evils are minor, compared with certain I have to bring before you in my next and concluding lecture.

EIGHTH ORDINARY MEETING.

Wednesday, February 3rd, 1875; Lord ALFRED S. CHURCHILL, Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Addison, William, Broxbourne, Herts.
Anderson, Richard, F.C.S., 130, Strand, W.C.
Kirk, Benjamin Reed, M.R.C.V.S., Huddersfield.
Leigh, William, Stone Leigh-house, Heaton Chapel, Stockport.

The following candidates were balloted for and duly elected members of the Society:—

Austin, Richard Barnes, the Cottage, Bodicott, near Banbury.
Bell, Thomas, Canwick-road, Lincoln.
Birdwood, George, M.D., 7, Apsley-terrace, Acton, W.
Bowes, James L., Liverpool.
Brabazon, Lord, Rivermead, Sunbury-on-Thames.
Brand, The Hon. John Henry, President of the Orange River Free State.
Brown, Alexander, 5, Spring-gardens, Charing-cross, S.W.
Cannon, Matthew, Lavender-hill, Wandsworth, S.W.
Chave, Rev. Edward, D.D., Vicarage, Wandsworth, S.W.
Church, Walter Charles, 8, Victoria-chambers, Westminster, S.W.
Ellis, Alderman and Sheriff John Whittaker, 18, Old Broad-street, E.C.
Everett, G. A., 120, Chancery-lane, W.C.
Gössell, Otto, 22, Moorgate-street, E.C.
Hill, Samuel, 233, Camden-road, N.
Hutchinson, Edward, Skerne Iron Works Company, Darlington.
Knight, Alderman Henry Edmund, 10, Love-lane, Wood-street, E.C.
Lamb, Robert, Darlington.
Leoni, Sigismund, 128, Englefield-road, Islington, N.
Macpherson, Joseph, Sydney, New South Wales; and Verulam Club, 54, St. James's-street, S.W.
Manning, Miss Elizabeth Adelaide, 35, Blomfield-road, Maida-hill, W.
Marriott, Major-General W. F., 41, West Cromwell-road, S.W.
Martin, Lieut.-Colonel, Box-grove, Guildford.
Masterman, Edward, Leyton, Essex.
Morrell, James Conyers, C.E., Leyland, near Preston.
Pickersgill, Edward Hare, B.A., 44, Neville-road, Stoke Newington, N.
Pope, Robert Philip, 8, King's-road, Gray's-inn, W.C
Proskauer, Hugo, 309, Regent-street, W.
Rothschild, Alfred de, New-court, St. Swithin's-la E.C.
Sinclair, B. J., 9, Grove-road, Highgate-road, N.
Soward, Alfred Walter, 5, Serjeant's-inn, E.C., and Essex-street, Strand, W.C.
Taylor, Richard, 6, Gledhow-gardens, South Kensin ton, S.W.
Thom, John, Larkhill, Chorley, Lancashire.
Wilkinson, John Sheldon, C.E., 108, King-street, Ma chester.

AND AS HONORARY CORRESPONDING MEMBER.

Bernardin, Professor, College of Melle, near Ghent.

The paper read was—

AN APPARATUS FOR THE PROTECTI OF BUILDINGS AND SHIPS FROM FIRE, A FOR THE VENTILATION OF SHIPS.

By J. A. Coleman, C.E. (U.S.A.)

I am sure it is quite unnecessary to attempt
impress upon the minds of this audience the m
nitude of the daily losses caused by the ravages
fire. We have become familiar with the subje
either through our own observation or by the
ports of conflagrations in the daily press; a
occasionally a great disaster occurs with terri
loss of life and property, either upon the land
sea, which shocks the whole civilised world.
Great Britain and America alone the annual los
property is represented to be over fifty mill
pounds sterling, or something like ten shillings
every man, woman, and child in both countri
With the further statement that additional taxati
upon the public in the shape of insurance must
a sum very much greater than these losses, I w
leave that portion of the subject.

As I witnessed the great fire in Boston, and s
that amongst the solid granite buildings, appro
mating more closely to the substantial character
the structures of this country than any others
America, it was almost as impossible to stay t
ravages of fire, as it was in the midst of the wood
buildings where the fire originated in Chicago,
began to consider why we were so powerless agai
fire. Engineering ability had been successfu
brought to bear upon almost every other great p
blem, but it was evident that far less thought h
been devoted to this important subject. While lo
motion had in fifty years made an advance of 6 t
in point of speed, the ocean traversed in d
instead of months, and time and space annihilat
in the transmission of thought by the electric te
graph, no corresponding advance had been m
in the art of extinguishing fires. True, we h
made some important improvements in the sub
tution of steam for manual power to work our fi
engines, and in some minor details; but whilst
engines have received the assistance of a mo
whose power is almost without limit, the means
conducting water to a fire remains unchang
The effect of the engine is crippled by the ho
which, from its nature, can bear but a limit
pressure. The improved engine of to-day can
throw an effective stream of water to double t
height attained by the first fire-engine, co
structed over three hundred years ago. All
have gained over the old engine is the ability
throw a larger volume of water continuously
only a moderately increased height. To t

that only has the situation been improved. The theory for putting out fires, in all essential features, remains unchanged, while the difficulties of the old system have increased.

Every year land becomes scarcer and more valuable, while the swelling volume of business demands increased facilities. Warehouses, hotels, and dwellings have risen to an enormous height, while the invention of the modern lift has overcome this disadvantage, and the tendency is to build higher still. But, upon the other hand, we have enormously increased our danger from fire. We have gone beyond the reach of our present fire apparatus, as proved in Boston and Chicago. When I came to this side of the water, I saw even in the nation of Watt, Stephenson, Brunel, and a host of wonderful engineers, in the midst of amazing works of engineering skill, the condition of danger were much the same. Structures are of enormous height and capacity. The late Mr. Braidwood gave important testimony of the insufficiency of our modern apparatus to cope with great fires in English buildings, when he said, "Give a fire in a large building twenty minutes' start, and the only hope is to be able to protect adjoining property." According to the newspapers and the records of the insurance underwriters, it may safely be asserted that scarcely a great cotton or woollen mill, brewery, dock, warehouse, palace, or other great building, thoroughly well on fire, was ever saved in Great Britain, America, or any other country, by the present system of portable fire-engines. I make this statement deliberately, meaning, when I say buildings, the contents as well, for the sole purpose of a building is to protect its contents. In the majority of cases these fires burn themselves out, leaving only tottering walls, and the useless *debris* of a fire.

Amongst many examples which might be cited in proof of this statement, we may call to mind the Alexandra Palace, and the Pantechnicon; the latter a building confided in as fire-proof, but which burned with a quiet energy that defied the best efforts of the fire resources of London, and consumed millions of property, of a character which money cannot replace. If we desire a more convincing proof of the inherent weakness of our modern method, for anything but a moderate fire, we have only to remember the landing-stage of Liverpool, a structure floating upon the water, and not eight feet above the surface, while the engines instead of being compelled to force columns of water to the fifth storey of a building, were actually upon a higher elevation than the fire itself, and yet they were powerless to control that fire. The stage was destroyed, to the embarrassment of the entire commerce of Liverpool, and but for the favourable circumstances of the case, a disaster might have occurred similar to those in Chicago and Boston.

These warnings should teach us to provide against their repetition. What then is the underlying trouble with all our fires in buildings or in ships? Simply a fault of engineering. It is the failure to put a little water in the right place at the right time. It is the failure to strike a fire dead in its incipient stage.

Any system to be successful in extinguishing fire must be capable of prompt application. It must also be able to do the least possible damage, by using the smallest quantity of water necessary to accomplish its purpose. A bucketful of water in the right place at the right time is worth more than twenty tons of water twenty minutes later.

Experience has proved that there is no such thing as an absolutely practical fire-proof building. If walls were constructed eight feet thick, the windows and doors cannot be equally thick, and the building, if filled with combustible goods, will be destroyed, precisely as iron ore and limestone sandwiched with fuel are reduced in a smelting furnace. It makes but little difference how we construct a few exceptional buildings in a city already composed of those that will burn. Nothing can withstand fire when there is enough of it. The practical principle, therefore, of safety is to prevent a great fire by a prompt means of extinguishment. Therefore arrange buildings or ships with appliances to instantly wet them with water, and it will be impossible, humanly speaking, to destroy them by fire. Now, how do we attempt to do this, and how may it be done? Within the past fifty years we have advanced from passing buckets along a line of men from a distant supply of water, to conducting the water near to the buildings through pipes in the streets. We have done so much towards prompt application; but the apparatus to conduct that water from those pipes in the streets to the top of high buildings must be waited for until dragged from distant parts of the city. In the meantime the fire is gaining headway and violence with each minute of delay. Those invaluable first minutes are lost. More time is then lost in erecting ladders and dragging up heavy hose; then windows are broken in, giving the fire air; flames and smoke burst forth, and the blinded, half-suffocated firemen pour tons of water where fire does not exist, and it goes in cataracts upon valuable property below, while a comparatively small quantity extinguishes the fire. It is a necessity of the case. A fireman cannot tell, in a building filled with smoke, the exact location of the fire, but must strike more or less at random. Many times more damage is frequently done by water than by fire when the fire is comparatively small, and according to Mr. Braidwood, and the testimony of all familiar with the subject, no possibility exists of extinguishing the fire when it is great.

It would seem, therefore, that perpetually menaced as they are by danger of fire, permanent buildings should possess permanent appliances for their protection. The plan I proposed to the Boston Board of Trade was to put iron stand-pipes upon buildings, one going to the roof and others to the separate storeys. Then perforated branch-pipes were to be laid at suitable distances apart, over the roof and under the eaves, to distribute water like a rain storm over the entire top and sides of the building, in case heat and flames were attacking it from another edifice on fire. Perforated branch-pipes were also to be fixed upon the ceiling of each storey, in order to strike the top, sides, and floor with small jets of water. Each storey has its own stand-pipe and valve, or cock, the latter being operated from the side-walk. All the cocks are intended to be placed in an iron box let into the wall of the building, always locked to prevent tampering with

by improper persons. By this apparatus it will be seen every square foot of the exterior and interior of a building could be commanded under all circumstances by a man quietly manipulating the proper valves from the sidewalk, without the necessity for going near the danger. If there should be a sufficient head of water, the distributing apparatus described would be connected directly with the mains in the street, and its control placed in the hands of the city authorities. Should there not be a sufficient head of water, there must be steam-boilers and pumps.

It is the custom in America, which is becoming almost universal, to have steam-boilers in the basements of our large buildings, for the purpose of warming them and operating the lifts. My proposition to the Boston people was to remove the boilers from the buildings, and concentrate a sufficient number in a central location underground, and carry steam and water mains through sewers in the streets to a reasonable distance, and supply all the contiguous buildings with steam for heating and for operating the lifts, and with water for the fire apparatus already described. As we should have steam for operating the lifts in the summer, and for warming as well at all other seasons of the year, we should have our men and fire apparatus ready for instant action at all times, night and day. Again, instead of having in one hundred buildings, as at present, one hundred engineers of an inferior order of intelligence, we should have a large district warmed and protected, requiring only three first-class engineers, such as take charge of the engines of ocean steam-ships; one man to be on duty for each eight hours of the twenty-four, assisted by the necessary complement of common firemen.

On the discovery of a fire, a telegraphic signal would summon the chief engineer on duty, a man of judgment and brains, to take charge of the fire. If the fire was beyond the small means of extinguishment usually employed, such as buckets, extinguishers, &c., he could first turn steam into the room on fire, if it was sufficiently confined and small, and smother the flames, with but little damage to the contents of the building; but if too late for that, he would have the last sure resort of water, with which he would give the fire a short quick drench, and then close the valve. There need be no panic nor confusion. Controlling the apparatus with the same ease and certainty with which an engineer down in the bowels of a huge ship controls the movements of her ponderous machinery, it would be the man, and not the fire, that was master of the situation.

It will be apparent that if every square inch of a room was instantly wet, the fire would be sure to be struck and extinguished, and with the smallest possible quantity of water. The prompt closing of the cock when the work was done, would save the flooding of the storeys below, which is now a great fault of our present method. But the main idea in this plan consists in having it upon a large scale, for the advantages of economy, system, and safety. It would not be sufficient to thus fit only a few buildings isolated from each other in a closely packed district. In order to present a bulwark to arrest a large conflagration sweeping towards it, the plan should be general in the district protected by this system.

The concentration of boilers under skilled management, instead of their separation in different buildings, presents important advantages in point of economy as well as safety. The first cost of the plant, including boilers, subways, and mains, was found to be only two-thirds of what it now costs individuals to fit up boilers, fire-rooms, and coal bunkers in their own premises, to include, say, one hundred buildings. The advantages of making steam at wholesale are similar to all other wholesale operations; as, for instance, the manufacture of gas. To make gas in every building would be a very costly operation, but under systematic organisation, and distributed as we propose to distribute steam, its manufacture is a source of handsome profit.

In point of insurance the saving would be enormous, as illustrated by the mutual system amongst mills. In Lowell, the large corporations whose mills are contiguous to each other, adopted a system of apparatus for mutual protection, and subject to the most rigid police regulations. Each mill has a complete set of pumps and sprinklers to protect itself, but if necessary all the mills can direct their force to any given point. The result has been that in these corporations, representing a capital of thirteen million dollars, the entire loss has been less than three hundred thousand dollars in twenty-five years, which was paid out of the insignificant tax levied upon the combined companies. If insurance can be reduced to almost nothing amongst dangerous structures, such as cotton and woollen mills, covering many acres of ground, the same thing can be done with safe buildings covering the same extent of territory in a city.

To show the cheapness of the plan, I can illustrate it by reference to the city in which I live. The fire department formerly cost about thirty thousand pounds per year; at 10 per cent, it is the interest of three hundred thousand pounds which in that small city would have paid for the plant, have taken the entire fire duty off the hands of the fire department, and have furnished the apparatus to supply every important building with heat, while it would save a tax for insurance which of itself would have furnished the district with heat for nothing, and paid the entire yearly maintenance of the apparatus and wages of men. The whole idea is simply the application of the mill system to civic purposes. Amongst mills it is not an experiment; it is in use every day. The only thing that is chimerical about it is to get a large number of men to work together. It would be improper at this time to go into further detail upon this subject; I can only say its practicability has been thoroughly discussed by able engineers in various countries, and brought out strong commendatory letters when it was first made public in America. I believe it is a thing of the future, and must come in its own good time.

Turning now to ships, the explanation of the theory of extinguishing fires in buildings by the means of fixed distributing or sprinkling pipes already given, leaves but little to be said to make its application to a ship easily understood. If a fixed apparatus is needed in a building upon shore, how absolute is the necessity in the limited space upon a ship to have a means of driving water through fire and smoke, without the necessity for

a man to go near the danger. The underwriters of insurance are well aware that nearly one ship per week is destroyed by fire at sea; and the community has not yet recovered from the shock produced by the terrible death of four hundred and fifty helpless people in the ship *Cospatrick*. Old travellers by sea, callous to all other dangers, shudder at the thought of fire. Having once had a personal experience upon a burning ship, and having been forced for many years to make voyages in crowded vessels, you may well believe the protection of a ship has been to me a subject of the deepest interest.

The description already given renders it only necessary to say that the plan proposed embraces the arrangement of main pipes along the length of a vessel, with perforated branch pipes extended across the ceiling of each hold between the deck beams. The apparatus may be divided into as many sections as desired, in order to wet as much or as little of the ship at a time as may be deemed proper. All the main arteries would be connected directly with the steam pumps at the engine-room, with cocks commanding each section of the ship, also in the same place. These same arteries would also receive steam directly from the boiler by suitable connections. The engineer, standing at his regular post, could throw a heavy shower of water upon the interior of any part of the ship by merely opening the cock upon the main pipe connecting with that section. For a small fire he may turn steam through the same apparatus; but, should this fail, he may then render the operation certain by turning on the water instead, without any necessity for a man going near the fire.

Much attention seems to be directed to the use of steam as an extinguisher. Its value depends upon circumstances. In confined spaces, of limited dimensions, it has been useful in holding fire in check, but rarely, I think, extinguishes it; while, in experiments I have made in turning steam into a space where a draught existed, it simply augmented the force of the flames. It must be very damp steam and used in very large volume to be effective; and even then, so far as my own observation extends, as well as testimony derived from accounts of its use, it smothers the fire, but generally leaves it in a smouldering state. It would not be a thoroughly reliable agent to depend upon alone under all circumstances.

With sailing ships enough has been said to demonstrate that the sprinkling system of pipes would give the greatest effect with the limited quantity of water furnished by hand-pumps; and with the further expedient adopted of a quick steam-making boiler, with occasional practice in its use, it is difficult to conceive of the loss of a ship at sea by fire. Finally, as to cost, it is said pounds, shillings, and pence govern this question; however good a plan may be, if it is expensive it will not be adopted. Good things are always cheapest, and bad ones are dear at any price. The cost for this apparatus is, for a given number of feet of common metal pipe, with the valves and appurtenances, roughly stated, about £300 for a ship of 1,200 tons. The interest on that sum of money is insurance; while for a ship carrying passengers, the extra inducements to the public, by the assurance of safety, would bring a largely-increased revenue to shipowners.

In conclusion, but of great importance, comes the matter of the ventilation of ships. The means for this end are already explained, and I will ask your indulgence for only a few moments upon the subject. All who have travelled at sea will understand the disagreeable state of ships from noxious air. All will remember the foul, damp odours, nauseating to the weak, and disgusting to every decent man. Without consuming time in an unnecessary description of the sensations which we too well remember, I will only touch upon the few plans hitherto adopted, especially in the Government iron-clads, for artificial ventilation. The majority of devices have depended upon forcing currents into ships by means of fan-blowers or their equivalents, or by exhausting the vitiated air with pumps, but the results of both these methods have been unsatisfactory on account of their limited effect, and because they produced evils almost as great as those they sought to cure. They cause draughts of air, which all are aware are fruitful causes of disease. Moreover, the air entering an apartment from a pipe or opening will take a direct course for the nearest exit, just as the bulk of the water flows in the channel of a river, leaving still water in the bays out of the influence of the current. So is the dead air left more or less unchanged in those parts of a room out of the direct course of these most objectionable draughts. The difficulty of regulating those huge volumes of air in ships is very great, simply because they are huge. It is the same as with the ordinary distribution of water upon a fire: there is too much of it in one place. The air ought to be subdivided into minute jets, oozing into the room, so that its entrance in any one place shall not be disagreeably perceptible. It has therefore seemed to me to be the correct method to avail ourselves of the plan of perforated pipes, as far as they might be extended in the ship for the purpose of fire protection, with the addition of supplemental perforated pipes, conducted to every part of a ship where air is wanted. This same fire system, and these additional pipes, would be supplied from an air pump and receiver, also under the control of the engineer. In case of fire, the air pump would be shut off, and steam or water turned on the pipes by the simple changing of the cocks. At all other times the air would be forced through the perforated tubes, aerating every part of the ship where it was turned on in an absolutely positive manner. Instead of a great current which "bloweth where it listeth," the compressed air will go where it is sent, even to the remotest corner of the ship. It may be likened to the arterial and venous system of the body, which conducts the vital fluid wherever its ramifications extend. Of the absolutely-positive character of this method of circulation no better illustration is needed than the operations at the Mont Cenis tunnel, where compressed air drove drilling engines and ventilated the tunnel at a distance of three and one-half miles from the pumps; a distance to which no current sent from an ordinary blower would have reached.

While engineer of a silver mine I had ample experience of the futility of all efforts to send currents of air through the ramifications of a mine by blowing engines. Great power was expended, and an abundance of air was furnished, but the air would

not go where it was wanted. The currents were too strong in the main passages, while the men in the remote sections received none at all, and were kept away a long time from their work, after the discharge of every blast of powder. It struck me then that the true principle was to discharge compressed air into the farthest recesses to be ventilated, and it would then push the vitiated air before it to the mouth of the mine. Subsequent experience at the Mont Cenis and St. Gothard tunnels demonstrated that theory to be correct. In many respects there is a resemblance between the interior of a mine and that of a ship. Both are artificial constructions, with irregular spaces and intricate ramifications, in which a natural circulation of air is impossible. Both require artificial ventilation. The use of compressed air has been proved to be good in the mine, and it would seem to be equally good in a ship.

I have thus imperfectly endeavoured to make clear that, by a simple and comparatively inexpensive apparatus, an engineer may deliver water or steam with unfailing precision to the exact points needed to subjugate a fire; while the same apparatus shall furnish the means to thoroughly ventilate the ship.

In its double capacity, the apparatus would confer a boon on mankind by the removal of the terrors of fire at sea, as well as the discomforts of bad ventilation, while its cost shall not be such as to preclude its use.

DISCUSSION.

Mr. G. B. Galloway said the paper that had been read reminded him very much of a plan of his own for which he took out a patent some years ago, only that, instead of small jets, he proposed nozzles at regular distances, through which the water should be ejected. He thought the system of pipes would be especially useful on board ships, because not only would it give protection from fire, but in case of the vessel getting water-logged, the pipes being kept full of air would give additional buoyancy. He hoped to live to see the day when vessels would not only go twenty miles an hour with all the steadiness and comfort to be obtained in a modern hotel, but when accidents—so called—would be things to be talked of but no longer experienced. The reason why at least 90 per cent. of accidents were not prevented was simply that inventors, however valuable their discoveries, unless they could get into a certain position or a certain groove, were entirely snubbed and condemned. He hoped, however, considering the enormous loss by fire annually, that this invention would be taken up in a practical manner.

Mr. A. W. Le Maitre thought a great difficulty in the way of the application of such a system to vessels would be the cost, which he understood would be £300 for a ship of 1,200 tons. He had made investigations into this subject, and had submitted plans to Lloyd's for extinguishing fires at sea; but he found that so many ships were sent out with the express purpose of being lost, and the profits of freightage were said to be so small, that any additional expense would be a great objection. The practical result was, that any system to have a chance of success must be very simple, inexpensive, and effectual. Another difficulty was that if fire were put out by water, in the majority of cases, though the ship might be saved, the cargo would be entirely ruined. He quite agreed with what had been said as to the difficulty of introducing anything new; but he had at present the means of communicating with some of the largest shipowners, before whom he intended to lay some plans of his own, which, if favourably received, he would make public.

Mr. W. Botly said the importance of having a small supply of water immediately available was well shown in the case of the destruction of the church at Croydon, which might have been saved by one bucket of water at the right moment. In building his own house he had adopted the method of having a pipe laid from the cistern at the top of the house to every storey, with a hose connected to it, so that on the first alarm the remedy could be immediately applied.

Mr. J. Sinclair was glad the inefficiency of steam to extinguish fire had been pointed out, and it was also a fact, as had been shown by Professor Gardner, that in some cases steam even added to the strength of a fire instead of putting it out. Besides which, insurance companies paid more for damage done by water than for destruction by fire. He was surprised, therefore, that no mention had been made of the use of carbonic acid, the means of applying which had now become so perfect that 30 gallons of water combined with it were equal to 300 gallons of ordinary water for the purpose of extinguishing fire; while by means of the respirators which had been recently described by Captain Shaw, the fireman could make his way with safety through the densest smoke to the seat of the fire. A case had recently been reported in the Manchester papers where, a mill being on fire, an ineffectual attempt was made to extinguish it by pouring in steam, but a man armed with an extincteur put it out at once. These instruments had now been introduced by many large shipowners, and as the cost to provide for the safety of a large vessel did not exceed £80, it was not open to the objection which had been raised to Mr. Coleman's plan. He might be told that it was difficult to direct the carbonic acid on to the fire, but that would be got over in great measure by the use of respirators, and in the next place this gas had such an affinity for fire that if anywhere in the neighbourhood it would travel to it.

Mr. W. P. Reynolds thought one of the first questions arising with regard to this proposed system, was its great expense, and next, who was to provide it. Such a series of pipes as had been described, if adopted in a large city like London, would occasion an expense which could only be described as stupendous, whilst one of the main difficulties which arose in considering the means of preventing great conflagrations, was the cost even of ensuring a constant supply of water. The Board of Works, with all their powers, were practically unable to put up hydrants in the streets at short intervals on account of the expense, and therefore, he did not see much chance of getting an extensive system of pipes carried over all the houses. But in the next place it appeared to him (though his observations had been rather directed to the causes and results of fires than to the method of extinguishing them), that to put out a fire it required a considerable rush of water concentrated on one spot, rather than a continuous dribble all over the room, which would tend to weaken the pressure. He would like to know therefore, if this system had been tried and found practically successful. With regard to the steam boilers for 100 buildings being concentrated in one spot, it appeared to him that the steam might become condensed in the pipes before reaching its destination.

Mr. W. Swanton thought the great objection to the proposed system was the damage by water to every part of the building. From 25 years' experience in attending fires, his opinion was that in order to do any good, you must strike the fire sharply and immediately with abundance of water. The best appliance in his opinion was a rising main up each staircase, with a branch hose on every landing, so that in the event of a fire, the water could be immediately brought to bear upon it. If such a thing had existed at Croydon, the catastrophe might have been prevented. He did not think any

raining process would be effectual, and with regard to extincteurs, though they might be useful in some places, as an old sailor, he could not picture to himself a man going down the hold with one of these things weighing 70 or 80 lbs. on his back. On the whole he considered the old-fashioned method of applying water by means of a hose or a hand-pump was more readily available than some of these modern inventions. He remembered a case, under the late Mr. Braidwood, in which a fire in a beer cellar was extinguished by means of a hand-pump, and a few bottles of beer emptied into a pail.

Mr. Charles White thought the pipes would get out of order from rust, and that though perhaps useful in steam vessels, they would not be applicable to wooden ships. He advocated the building of houses with party walls reaching six feet above the roof, and official inquiries by coroners into their causes, as likely to reduce the number and extent of fires.

Mr. R. Applegarth asked if Mr. Coleman's system could be used in a modified form with the aid of hand-pumps instead of steam power. His own opinion was, that whatever system was adopted, the direction indicated by Mr. Sinclair must be looked to; for, even with the best possible plans for extinguishing fires, it would often be necessary to penetrate into places which could not be reached without some artificial protection, such as was manufactured by Mr. Sinclair and himself.

Mr. S. K. Holten said one difficulty was to find the exact seat of the fire, but a plan had been devised for effecting this by means of a system of thermometers arranged in different parts of the building, and such a system he thought would prove a very useful adjunct to Mr. Coleman's plan.

Mr. Keale described a plan shown him some 28 years ago by a Mr. Weir for fixing at the top of each building a cistern containing some heavy gas, from which pipes were laid to all parts; when a fire occurred, a tap was turned, and the gas descended by its own weight, immediately extinguishing. It proved perfectly successful in an experimental shed filled with combustible materials and set on fire.

Mr. M. S. S. Dipnall, as a resident in the City of London, had often been struck with the unprotected state of the large warehouses and buildings at night and on Sundays. If a fire occurred in any of them, unless it were met by the prompt application of water, he saw nothing for it but the employment of a large organised force. The governors of Christ's Hospital, of which he was clerk, had naturally considered this subject very seriously, and had introduced, under the advice of Captain Shaw, a complete system of hydrants and mains all over the building; and, as they looked to prevention rather than cure, they thoroughly drilled the boys in their duties in case of accident, so that they might not only use all the means at their command in the first instance, but co-operate with the men of the Fire Brigade if their assistance was necessary. Every precaution was also taken to prevent the accumulation of rubbish which might prove a source of danger, the prevalence of which in almost all London areas, where it was exposed to the casual dropping of a cigar-light, he considered a very serious evil. In private dwellings, he thought, a cistern at the top of the house, filled either with water or carbonic acid gas, would be more useful and less expensive than the system which had been described.

The Chairman, in proposing a vote of thanks to Mr. Coleman, said his own ideas went rather to support the plan he had suggested, and he hoped it would be practically taken up. As he understood it, the main object aimed at was to so saturate the immediate neighbourhood of the flames as to prevent their spreading, and to have the pipes arranged in sections, so that the locality of the fire being ascertained, the rest of the building need not be flooded with water. As to the cost, it was intended not so much for dwellings as for large warehouses, and if it were found to be effectual, the owners might bear the expense, and expect a corresponding reduction in the rate of insurance. In the case of ships, he thought it would be very useful, especially in some cases, such as those carrying coal, which would not be damaged by the water, and in emigrant ships. Such a catastrophe as that of the *Cospatrick* might thus be avoided. He had never seen the extincteurs tried, but he understood that unless kept constantly in use they got out of order.

Mr. Sinclair said that difficulty had been entirely overcome.

The Chairman added that carbonic acid was also fatal to human life, and they might therefore be inapplicable to emigrant or transport ships.

The vote of thanks having been carried unanimously,

Mr. Coleman said the most prominent objection as to the inefficiency of jets of water had been proved practically to be untenable in several large mills in Massachusetts. In one case in particular a fire broke out on the fifth story of a large mill, and obtained such a force that the whole of the operatives left the building in a panic, but by simply turning a cock in the basement it was extinguished in less than ten minutes. In another mill at Lowell, where the entire destruction of the building was considered certain, it was put out in four minutes, though unfortunately by forgetting to turn the water off again, the whole of the mill was flooded. It was quite a mistake to suppose that the effect was simply that of a dribbling rain; it was more like a shower bath, which could be made of any force required according to the steam-power applied. It was simply a question of engineering, and he had seen water ejected the length of that room from orifices only 1-10th inch. With regard to the cost of fitting the pipes, the same thing might be said of gas, and supplying water to houses for ordinary purposes; these things had been accomplished without ruining the City of London, and so could the system he advocated. In the City of Boston he had shown that it would only cost two-thirds as much to have central boilers supplying steam to the surrounding buildings, as it did for each merchant to have his own boiler and engineer, neither of which he understood, so that he was at the mercy of his engineer, who often robbed him, besides having his goods spoilt by ashes and dirt, and running the risk of being blown up at any moment. In fact, his chief argument was an economical one, because it always paid better for each man to undertake and carry out that which he understood. This plan had been tried in Boston to some small extent. He advocated it for some time, with the ordinary results alluded to; at first every one thought it all nonsense, then they thought there might be something in it, but each one wanted his neighbour to try the experiment first; still ultimately a few gentlemen joined together to give it a trial. But it was adopted largely in Lowell and other large manufacturing districts, where sometimes the same corporation owned mills covering many acres of ground. They never dreamed of putting a steam boiler in each separate building, but planted them altogether in one place, under one superintendence, the steam being carried in some cases 1,000 feet. If this could be done in one place it could in another, because geographical consideration did not affect the question. He did not wish to interfere with the use of extincteurs, pails of water, portable pumps, or anything of the kind, all of which were useful, and the more they were used the better; he simply advocated the sprinklers as a desperate remedy to be used in the last resort, and specially adapted to enormous buildings, like mills and warehouses. One large mill was burned down just before he left America, and another had been destroyed since, notwithstanding every appliance in the shape of stand-pipes and hose, the watchmen losing their heads in the suddenness of the catastrophe, and not making use of them in time.

Police regulations with regard to these matters were carried out in America in the fullest manner possible, and the organisation was very near perfection, but you could not control human feeling, nor would one, or even two watchmen, be able to put so large an apparatus in motion, if suddenly called upon to do so. He could mention an instance in which it had failed, and about 40 work-girls lost their lives, though every appliance in the shape of hydrants and hose was provided. As to the damage by water, he would simply repeat what he had suggested to the owners of a large silk warehouse in Boston, viz., that by packing their valuable goods on a few strips of scantling, instead of putting them directly on the floor, and covering them with light waterproof cloths, instead of ordinary coverings to keep off the dust, which would not be very expensive, this difficulty would be met. The water would run off without injuring the goods if they were not on fire, and if they were, the waterproof covering would soon be destroyed, and then the water would extinguish the fire.

A model was exhibited on the table during the meeting of a safety lift, invented by Mr. H. A. Davis. Below a lift of the usual construction, a wedge was fitted to slide along the guides and receive the weight of the lift in case of the lifting-rope breaking.

MISCELLANEOUS.

VIENNA EXHIBITION REPORT.

The reports of the jurors on the Universal Exhibition at Vienna have recently been issued by the Commissioners. They are comprised in four bulky volumes, and an atlas of map and plans. The contents may be summarised as follows. First comes the strictly official part, comprising the Royal Commission, the report of her Majesty's Commissioners, lists of committees, jurors, &c., awards, and similar statements. This is followed by 22 reports:—(1) Colonial Produce, by Mr. W. Robinson; (2) Raw Materials, by Professor Archer; (3) Machine Tools, Textile, and Other Machinery, by Dr. John Anderson; (4) Stationary and Portable Engines, by Mr. G. C. V. Holmes; (5) Agricultural Machinery, by Colonel Michael; (6) Machinery Lent to Commission, by Mr. J. H. Cundall; (7) Small Arms, by Mr. W. H. Russell, LL.D.; (8) The Art of War, by Lieut. Anstey, R.E.; (9) Utilisation of Peat and Peat Lands, by Mr. Paget, C.E.; (10) Influence of International Exhibitions, by Professor Archer; (11) Characteristic Features of Buildings, by Sir Digby Wyatt, M.A.; (12) Pottery and Porcelain, by Professor Archer; (13) Glass, by Professor Archer; (14) Small Wares and Fancy Goods, by Mr. A. H. Mounsey; (15) Educational Appliances, by the Rev. J. G. C. Fussell; (16) Wine and Beer, by Mr. Henry Vizetelly; (17) Food Products, by Mr. S. Phillips Bevan; (18) International Horse and Cattle Shows, by Lieut. T. H. Anstey, R.E.; (19) Cattle, Sheep, and Pigs, by Lieut. T. H. Anstey, R.E.; (20) International Patent Congress, by Mr. T. Webster, Q.C.; (21) Yarn and Flax Congresses, by Dr. F. L. Weinmann; (22) Chinese Manufactures Suited to English Markets, by Mr. E. C. Bowra.

Besides these are a number of "Technical Papers on Special Sections of the Exhibition," contributed by Mr. W. H. Maw and Mr. J. Dredge, the editors of *Engineering*, in which paper they have already appeared. The atlas of plates at the end also consists of illustrations reprinted from that Journal. The advantage of this supplementary matter is that it gives an account of the whole of the Exhibition, whereas the reports only deal with the English Section. The subjects treated are mineral fuel, metallurgical exhibits, locomotives, stationary and portable engines, boilers, cranes and hoisting machinery, hydraulic motors, agricultural machinery, railway rolling stock, marine engines, printing machinery, machine tools, wood-working machinery, sugar-making machinery and brewery plant, artillery, the exhibition-buildings, brick-making machinery, building materials, iron and steel, civil engineering, educational appliances, science exhibits, and miscellaneous.

The Commissioners' Report relates the principal circumstances connected with the arrangements for the Exhibition, and shows how, by the liberality of Sir Richard Wallace, who defrayed all charges connected with the British Fine Art Department, by the unceasing energy of Mr. Philip Cunliffe Owen, and by the co-operation of the manufacturers of the country, all the arrangements for the British Section were successfully carried out. With regard to the labours of Mr. Cunliffe Owen, the Commissioners conclude their report with a tribute of praise which the unanimous voice of all concerned in the Exhibition has amply confirmed. "We cannot," they say, "conclude this report without expressing how much we have been indebted to our secretary, Mr. Philip Cunliffe Owen. The experience gained by Mr. Owen in previous exhibitions made his services on this occasion most valuable; while the tact and indefatigable industry with which he addressed himself to the onerous duties devolving upon him contributed in no slight measure to the successful issue of our labours. We have reason to know that the high opinion which we have formed of Mr. Owen is shared by all those with whom his official position brought him in contact." That less could not justly be said of one to whom is due the main success of this important undertaking is certain, but it must be gratifying to Mr. Owen to find that his unremitting and incessant labours have not been without fitting acknowledgment, alike from his official superiors, and from the numerous body of exhibitors and others, with whom he was in daily contact. A more public recognition of his services has been in the distinction of a Companionship of the Order of the Bath, with which Mr. Owen has lately been invested.

The different reports are far too elaborate and long for anything more than the briefest sketch of their subject to be admitted into these pages. It may, however, be possible to attempt some such account of them as may serve to direct readers to the special points in which they may be interested.

The first is the elaborate report by Mr. W. Robinson on the British Colonies represented at Vienna, with particular reference to their produce. As it was only in July, 1872, that a colonial representation was proposed, it was not expected that a really adequate display of colonial produce could be made at an Exhibition which was to be opened on May 1, 1873. The shortness of notice operated unfavourably in many ways. In some cases there was no opportunity of bringing the matter properly before colonial legislatures, and in all very little time was allowed to manufacturers to prepare and transport their goods. Out of the forty colonies included under the Empire, only eleven were able or inclined to respond to the invitation. These were the Bahamas, the Cape of Good Hope, Ceylon, Jamaica, Mauritius, New Zealand, Queensland, South Australia, Trinidad, Victoria, and the West African settlements. After a few preliminary remarks, likely to be useful to colonial exhibitors at future exhibitions—as to the method in which they should forward information as to their specimens, and the sort of information required—Mr. Robinson passes on to a detailed account of the various colonies above named. In each case a short sketch of the country itself, both as regards its character and its history is given; and this is followed by an account of the principal products of the country, and a statement of exports and imports. In many cases the products thus commented upon were not represented at Vienna by specimens, and Mr. Robinson's aim has evidently been rather to give an idea of the condition of each country and the position occupied by it with regard to the commerce of the world, rather than to confine his remarks

to those particular products which were brought before the notice of visitors to the Exhibition.

With regard to the general effect of the Exhibition in bringing our colonial produce provisionally under the notice of continental purchasers and manufacturers, Mr. Robinson considers them good, and likely to be useful; and he notices that the nucleus of a permanent collection of British colonial productions has been formed in Vienna by contributions from the British exhibitors.

(*To be continued.*)

COTTON GUNPOWDER.

The readers of the *Journal* will recollect that a paper was read before the Society in May, 1873, by Mr. S. J. Mackie, descriptive of improvements in the manufacture of gun cotton, then about to be carried out by a Company, at works situate in Ore Marshes, about four miles from Faversham. A series of experiments organised by the company took place on Wednesday last, in the presence of a number of visitors specially invited to witness them, and it will be interesting to learn how far the manufacture has progressed since the paper was read. The manufacture is in principle the same as that generally adopted; but, as the readers of the *Journal* will recollect, Mr. Mackie claimed for the company's manufacture, by the introduction of certain chemicals, to regulate and control at pleasure the action of the explosive, and at the same time produce an article safe for storage, and such that it is absolutely inexplosive, unless fired by a detonator. The material as now produced is in the form of a fine impalpable powder, and is termed "Cotton Gunpowder."

The experiments were as follows:—Cartridges were held in the hand, lit with fusees, and burned with a steady blaze, while, when ignited by the detonators, they exploded with a loud report. Ten pounds were placed on an anvil, and an iron pile driver weighing half a ton was allowed to fall 15 feet upon it, without causing any explosion. Two barrels, each containing 40lbs. of powder, were placed in a pile of faggots. Upon these being fired the powder burnt with a steady but intense flame, and without any tendency to explosion.

The next experiments were for the purpose of illustrating the applicability of the powder to mining work, iron breaking, &c. A charge of two ounces of powder was placed in a hole drilled in a rough block of Kentish ragstone, 4 feet by 2 feet wide and 20 inches deep. The stone was split into five pieces by the explosion. A solid block of steel of about half a ton in weight was bored to the depth of six inches, and a six ounce cartridge was inserted in the hole. On the explosion taking place it was found that it was split into two pieces. An experiment tried upon a cylinder of cast-iron of the best quality—of a diameter of 2 feet and a depth of 18 inches—was to a certain extent a failure, for the six ounces of powder, used in a hole eight inches deep, only drove a conical piece out of the bottom, without splitting the mass. In all these cases the tamping was by no means of a perfect character. Two half-pound cartridges were laid loosely upon a rail weighing about 70lb. to the yard. Upon their being ignited they not only broke the rail in half, but broke two pieces out across the spot on which they were laid. The greatest exhibition of force, however, was shown in two experiments with steel ingots. In the first experiment four ingots of eight inches square and three feet long were used. In the centre of these four masses of steel as laid together, two pound cartridges of powder were placed, and kept in their place with a few handfuls of clay. In the second experiment the four ingots were each eleven inches square, and the charge used two pounds and a half of powder. The eight ingots were all broken in halves; some of these massive pieces of steel were sent flying high in the air, falling 30, 35, and in one case 45 yards away, while others were sent twisting over the grass, one going over 80 yards. When the great weight of these masses of steel is taken into consideration, it will be seen that the force required not only to break them but to hurl them thus far must be enormous, and yet it was accomplished in the one case by two pounds, and in the other by two and a half pounds of powder.

As examples of its utility for military purposes, a cartridge containing two pounds of powder was placed against the foot of a massive post twelve inches square. This was cut off and shattered in pieces by the force of the explosion. Four boxes, each containing thirty pounds of powder, were now placed in the ground, at a distance of some forty feet from each other. They were simply sunk a little over their own depth, and were covered by a few inches of sod. In each case the explosion formed a deep crater. In one case the crater was about fifteen feet in diameter and some seven feet deep; in the other cases the craters were about twelve feet in diameter.

A box of powder containing 20 per cent. of water was then successfully exploded by detonation, showing that the composition is not rendered useless even if accidentally damped, though, as is well-known, mere application of heat would not even inflame it. As a close to the experiments a torpedo of 50lb. of this powder, sunk 10 feet in the Swale, but not resting upon the bottom, was fired. An immense body of water was projected high in the air, and any vessel which might at the time have been passing over it would have suffered severely.

THE PROPOSED ALTERATIONS IN THE RAILWAY SYSTEM OF THE GERMAN EMPIRE.

(*Continued from page 211.*)

Railway speculators, whose sole object in the establishment of new lines is self-enrichment, cannot complain if other speculators compete with them, even though such competition be unjust and contrary to the interests of the country, as has been found to be the case in England, where the competition of companies has caused innumerable evils, such as high tariffs, both for persons and goods, the fusion of rival lines, &c. But that a Government, whose avowed object is the public advantage, should encourage such competition between public and private lines seems to show an ignorance of the very elements of financial and administrative knowledge. We now, however, come to the question whether State or private railway administration is to be preferred as regards the public interest. In answering this question we must take into consideration the fact that—as in so many other cases—the same system is not applicable to all lands and all circumstances. For example, in a country like Turkey, where all the conditions of order and civilisation are wanting, where the finances of the kingdom are drifting rapidly towards ruin and bankruptcy, the management of the railways by Government is out of the question, it can only be undertaken by foreign companies. The same may be said of Spain. That a country which has been for more than fifty years in a chronic state of bankruptcy should be unable to extend the railway lines throughout the land is self evident. We will confine ourselves, therefore, to the consideration of those States of a certain standing, and whose finances are in tolerable order, for example, England, France, Prussia, Belgium, Holland, &c. With regard to such States no one will contest that they would have been, and are still, in a condition to obtain capital for the construction of their railways at a much cheaper rate than was possible to the promoters of private companies. The very object of the promoters, bankers, and other railway speculators is, generally speaking, to sell the shares and obligations to the public at as high a price as possible—for their own private advantage, not for that of the undertaking—whereas the aim of the buyer is to buy them as much as

possible below par. Because of these diametrically opposite tendencies, it is the interest of the promoters of the scheme to announce the shares and obligations at as much as possible below par, in order that they, and the purchasers of the stock, may make the greatest possible profit out the capital, and buyers may hope to obtain a high rate of interest for their investment. Whether the shares be above or below par, however, they are driven up as high as possible by the promoters, and thus a much greater amount of the national capital is absorbed in the speculation than ever reaches the treasury of the company, or than would be used if the same railway line were constructed by the State. This being so—and who can deny it ?—one great advantage of the State railways lies in the fact that they absorb a much smaller proportion of the national capital than the same railways would do if constructed by a private company. This advantage is much increased by the fact that, with very few exceptions, the abuses and deceptions so much complained of in the railway companies of many countries do not occur with regard to State railways. For instance, an abuse which has notoriously caused so much scandal in many countries, that the promoters of the scheme buy up the land through which the line must pass, and then by some trick or other sell it again to the company at an immence price; or when the promoters and the railway contractors are in league together. It also adds very much to the cost of the undertaking when the contractors, as is frequently the case, are paid in shares on obligations, either at par or below par, in which latter case they must be paid more highly. There are, undoubtedly, some private railway companies where such evils do not exist. But that such jobbing is one of the recognised sources of the wealth of r ailway kings, financial agents, bankers, contractors, &c., is so notorious that it cannot be overlooked when we are considering the comparative advantages of State as against private railways. The Legislature can endeavour to check these abuses, but can never succeed, except by taking the whole concern out of the hands of the speculators.

This, is the great financial advantage of State railways. The social advantage is still greater; for nothing is so demoralising for all classes of society as the scandalously sudden fortunes made by railway promoters through mere speculation, too often the result of swindling and jobbery.

It is also a very great evil that the principal means of communication in any country should be private instead of State property. The consequences of such a false step might have been foreseen, and experience has brought them to light in the most conclusive manner.

Of course the speculators seized first upon the main lines of traffic, such as the routes between the seaports and the centres of industry and commerce in the interior; the roads leading to the chief capitals from the provinces, from the mining and coal districts, &c. On such great lines of traffic, when—as in North Germany—they principally lie across a flat country, where land and labour is cheap, the railways may be constructed, through no merit of the companies, but from natural causes—so as to yield a high rate of interest, from 7 per cent. (as much as 39 per cent. has been made on some of the North German and Rhenish lines).

It is evident what a blunder it was on the part of the Government to allow such a source of wealth to fall into private hands. The profits from the main lines would have enabled the Government to cover Prussia, which possesses comparatively few provincial lines, with a complete network of railways. In the report of the Prussian railway companies of 1871 we find the most recent information on the subject, which is given in the Tables in the next column.

Had the Government from the beginning held the lines A, and obtained the necessary capital of 325 millions thalers at 4·5 per cent.—thus paying about 14 million thalers of interest—there would have been, in 1871, a

A.—Prussian Private Lines Paying more than Five Per Cent.

	Capital.	Surplus.	Dividend.
	Thalers.	Thalers.	Per 100.
1. Magdeburg, Halle, Leipzig.	10,068,671	1,735,970	17·24
2. Berlin, Anhault, Halle	17,000,000	2,788,879	16·405
3. Berlin, Potsdam, Magdeburg	14,896,661	2,104,119	14·12
4. Berlin, Hamburg	14,000,000	1,662,549	11·88
5. Berlin, Stettiner, Slaunnbahn	15,872,762	1,802,264	11·35
6. Kölu-Minden and Kölu-Greisen	67,857,026	7,634,870	11·26
7. Magdeburg, Halberstadt, Wittenberge	20,810,222	1,967,721	9·46
8. Frankfort, Hanau	3,381,993	313,285	9·26
9. Taunus Line	3,569,443	326,593	9·15
10. Breslau, Schwidnitz, Freiburg	12,080,487	1,070,141	8·86
11. Rhine Line	76,374,269	6,738,311	8·82
12. Thüringer Line	26,542,779	2,463,768	8·67
13. Altona, Kiel	10,669,668	820,928	7·65
14. Homburg, Frankfort-on-the-Maine	1,600,000	107,100	6·69
15. Halle, Cassel	10,783,496	715,992	6·64
16. Niederschlesich	3,157,069	190,381	6·03
17. Breslau, Dzieditz	15,466,594	838,523	5·42
18. Glückstadt, Elmshom	1,018,950	51,252	5·03
	325,170,600	33,332,562	10·25

B.—Lines Paying Less than Five Per 100.

	Capital.	Surplus.	Dividend.
	Thalers.	Thalers.	Per 100.
19. Berlin, Collbus, Görltiz	12,128,385	473,655	3·91
20. Vorpommerische (Stralsund)	11,275,619	361,414	3·21
21. Schleswig Line	8,613,197	260,033	3·02
22. Stargard in Prussia, Cöblin, Colberg	9,560,967	377,898	2·91
23. East Prussian South Line ...	14,400,000	312,857	2·17
24. Tilsit, Insterburg..............	2,889,000	38,663	1·34
25. Märkisch Posen Line	15,100,246	182,237	1·21
26. Nordhausen, Erfurt............	3,096,234	31,957	1·03
27. Cöslin, Danzig	8,240,609	56,153	0·68
	85,304,257	1,994,867	2·33
Total (A and B together)...	410,474,857	35,327,419	8·60

profit to the State of 18 million thalers, representing a capital of 414 million thalers at 4·5 per cent., which would have enabled the State, without imposing an additional penny of taxation, to construct throughout Prussia twice as many lines as there already exist under private management.

Had the State constructed all the lines (under the headings A and B together) at a cost of 410 million thalers, and borrowed the money at 4·5 per cent., it would have had a surplus of 35 million thalers, of which 18 million would have been expended in interest, leaving an annual profit of 16 million thalers, which would have also been available for the construction of new lines. Of course the capitalists would have made a smaller profit than in the case of the private companies. Bankers, financial agents, brokers, and contractors make a great profit on the sale and purchase of stocks, but the general public, who are taxed as highly as possible by the promoters and their "clientèle," really receives from the dearly bought shares a much lower rate of interest than the dividends calculated upon the original capital. If the Government held the railways, this additional profit would not have fallen into the jaws of speculators; the holders of Government stock at a modest 4·5 per cent. would certainly not have run up such fabulous fortunes; but as the State would have commanded a double capital, the thrifty and hardworking public would have been

benefited by a generally diffused increase of prosperity. The fortunes gained on the exchange by the swindling of some few capitalists are no blessing to a people, either from a social or moral point of view, neither to the lucky possessor, nor to those who have to earn their bread by the sweat of their brow.

(*To be continued.*)

CORRESPONDENCE.

SCHOOL OF COOKERY.

SIR,—I am sure the lectures on cookery, delivered at Kensington, are conferring a benefit on the whole nation by directing attention to the improvement of this art. In what other employment in life are people left to pick up the necessary knowledge as best they can without training or instruction? Yet, in this country, what are called plain cooks generally begin as maids of all work, and learn all they know by sad experience. And the mistress, whose mainstay is her cookery-book, acquires her knowledge very much in the same fashion, for there is no cookery-book extant which treats of the daily routine of a cook's business, such as the cleaning of pots and pans, the proper method of work, &c. I speak from painful experience myself. I was married at sixteen to a gentleman of good family and little fortune, and at home, never having done anything but learn my lessons, I actually did not know how one boiled a potato. In after years as our income increased, and I could afford to keep a cook, who no longer calls herself "plain," I have found the same want of training, and very often great disregard to economy. And a kitchen-maid, trained under a cook, always expects to rise to have a kitchen-maid herself, although the cooking may be so little that she is required to do, there is no real need for that extra expense.

I am sure if, besides recipes, the School would publish directions and tables of work, also rules of domestic economy, the work would be a most valuable one. I know for a fact that an experienced cook, engaged for a short time to go to the country in summer, used eggs by the dozen, and threw all the whites of the eggs into the fire.

I gave a cook £22 wages and a kitchenmaid, and all the time she was in my service she never had a properly cleaned pot or pan, kitchen-knife, or spoon, yet her cooking was above the average.

I do not think servants are any worse than they used to be long ago, but mistresses now-a-days think it derogatory to look after the details of servant's work, and are, as I myself still am, painfully ignorant of details. Having naturally a very quick taste, I know quite well if a dish is properly cooked when it comes to table, but I could no more dish a dinner for several guests than I could read Sanscrit. And my daughters have carried off prizes in mathematics and Biblical criticism in the Professors' Classes for the Higher Education of Women, but no Professor comes here to teach the knowledge which they will require every day of their lives, whether married or single, viz., to order their own dinner.—I am, &c.,

E. A. W.

In Captain Peacock's remarks in the discussion last week, on Captain Pim's paper on the "Mercantile Marine of Great Britain," reference was made to the firm of Messrs. Maudsley. The name should have been Maudslay.

In Dr. Mann's paper on "The Kafirs of Natal," published in last week's *Journal*, the following correction should be made, for "Foynn" read "Fynn."

GENERAL NOTES.

Public Instruction at Turin.—During the scholastic year 1873-74, the number of boys at the primary schools of Turin was 6,326, of which 5,277 attended the schools in the town, whilst 1,049 belonged to those of the suburbs. Of the former number 3,902 presented themselves for examination, and of these 2,408 were promoted into higher classes. There is also a singing school supported by the municipality, and attended by the pupils from the primary schools. The normal schools are attended by 58 pupils; the higher classes of singing by 68, whilst the pupils of the classes are 994, in all 1,120 pupils. With regard to the girls' schools, the pupils during 1873-74 were 6,387 in number, of which 5,287 attended the schools in the town, and 1,100 in those of the suburbs; 4,024 went up for examination, of which number 2,443 were promoted. The cost of these schools to the municipality last year was 357,000 francs, whilst in 1846 the amount devoted to public instruction was only 46,000 francs.

Whitworth Exhibitions.—Sir Joseph Whitworth, wishing to encourage young men having a mechanical instinct, and who are already possessed of some degree of manual dexterity in the use of tools, proposes to found in connexion with Owens College, Manchester, King's College, London, and University College, London, a certain number of Whitworth Exhibitions, in order to fit them better to become candidates for the Whitworth Scholarships. The competition for these exhibitions is to be as follows:—1. Candidates must not be less than 16 nor more than 18 years of age at the date of the examination. 2. Candidates will be required to produce a satisfactory testimonial of character, and to pass a preliminary qualifying examination in English dictation and composition, arithmetic as far as decimals, and the elements of mechanical drawing, at commencement of the academical year of each college. 3. Having passed the qualifying examination, candidates will be required to undergo a practical examination in the use of tools, to be held at each college or elsewhere. This examination is to include at least two of the following handicrafts—filing and fitting, turning, smith's work, pattern making, and moulding. 4. The selection of candidates will be determined by the marks gained in the examinations. 5. The successful competitors for the exhibitions will be entitled to receive, during the two years next following the examination, instruction in all such subjects (being part of the course of each college) as shall better prepare them for the Whitworth Scholarship Examination —viz., practical plane and solid geometry, machine drawing, mathematics, theoretical mechanics, applied mechanics, and freehand drawing. Provided always that the right to enjoy the exhibition for the second year shall be contingent on the exhibitioner's success in the college examinations held at the end of the first year. Sir Joseph Whitworth will pay each college annually for four years, as a trial of the success of his proposal, the sum of £100 for or towards, at the option of each college, the academical expenses of the exhibitioners.

Thomas Love Peacock, the chief examiner of political correspondence to the East Indian Company, was the means of introducing the first steam-boats into India, which were used on the River Euphrates. He wrote many works remarkable for their wit and philosophical satire, which have just been collected together and published with a preface by Lord Houghton.

The Arundel Society has recently issued a work illustrating the times and specimens of old lace exhibited at the late International Exhibition. The illustrations are the size of the originals, produced in permanent photography, and enable manufacturers and others interested to derive from them the full suggestions which the originals would give.

The description of the fireman's respirator, given in last week's *Journal*, came not from Dr. Tyndall, but from his assistant, Mr. Cottrell, who has been recently engaged in improving these respirators.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

Feb. 10.—"The Sandblast and its Adaptation to Industrial Purposes," by Wm. Newton, Esq.

Feb. 17.—"Description of M. Kastner's New Musical Instrument, the Pyrophone," by M. Dunant. The instrument will be exhibited.

Feb. 24.—"The Art of Illustration as applied to the Printing Press," by Henry Blackburn, Esq.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

February 9.—"Remarks on the general description of the Trade on the West Coast of Africa," by Wm. Babington, Esq., F.R.G.S., late of the Bight of Biafra.

February 23.—"The Social and Domestic Slavery of Western Africa, and its Influence upon Commercial Progress," by Thomas J. Hutchinson, F.R.G.S., F.S.A., late her Majesty's Consul at Callao.

March 9.—"Livingstone's Discoveries in Connection with the Resources of East Africa," by the Rev. Horace Waller.

Indian Section.

Friday Evenings, at 8 o'clock. The following arrangements have been made:—

February 12.—"The Possibility of Adapting the Roman Alphabet for the Languages of India," by Frederick Drew, Esq. Sir Charles Trevelyan, Bart., K.C.B., will preside.

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

February 19.—"Air and Ventilation," by W. N. Hartley, Esq., F.C.S.

March 12.—"River Pollution, with Special Reference to the Work of the late Commission," by T. E. Thorpe, Esq., B.Sc.

April 16.—"Recent Advances in Photographic Science," by J. Spiller, Esq., President of the Photographic Society.

Cantor Lectures.

The Second Course of Cantor Lectures is by the Rev. Arthur Rigg, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

Lecture I.—Monday, 8th February, 1875.

Tools used in very Early Times, evidenced in prehistoric Implements, as well as in Sculpture and Drawings of ancient date; also Tools used in Recent Times amongst (so-called) savage races.

Lecture II.—Monday, 15th February, 1875.

Hammers and Mallets.

Lecture III.—Monday, 22nd February, 1875.

Hammers and Mallets (continued).

Lecture IV.—Monday, 1st March, 1875.

Picks, Axes, Adzes, Chisels.

Lecture V.—Monday, 8th March, 1875.

Planes, Knives, Shears, Saws.

Lecture VI.—Monday, 15th March, 1875.

Saws and Dove-tailing Tools.

Tickets for this course are issued with this we[ek's] *Journal.*

Members are privileged to introduce *two* frie[nds] to each of the Ordinary and Sectional Meeting[s of] the Society, and *one* friend to each Cantor Lect[ure].

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 (Cantor Lectures.) Rev. Arthur Rigg, "The Ma[terial,] Construction, Form, and Principles of Tools and [Con]trivances used in Handicraft." (Lecture I.)

Royal Geographical, University of London, Burli[ngton] gardens, S.W., 8½ p.m. Admiral G. H. R[ichards,] "The Route towards the Pole for the Arctic E[xpedi]tion of 1875." Major-General Sir H. C. Raw[linson,] K.C.B., in the chair.

Medical, 11, Chandos-street, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. [Pro]fessor Ferrier, "Functions of the Brain." (Lectu[re]

Social Science Association, 1, Adam-street, Adelphi, 8 p.m. H. N. Mozley, "The Punishment of the L[...]

Birkbeck Scientific Society, Southampton-buildings, 8 p.m. Mr. Ronald G. Madden, "Coal in its [...] to the Arts and Sciences."

Tues. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., (African Section.) Mr. William Babington, "A G[eneral] Description of the Trade on the West Coast of Af[rica."]

Royal Institution, Albemarle-street, W., 3 p.m. [...] Ray Lankester, on "The Pedigree of the Animal [King]dom."

Medical and Chirurgical, 53, Berners-street, O[xford-]street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westmi[nster,] S.W., 8 p.m. Discussion on Prof. Prestwich's "On the Origin of the Chesil Bank."

Photographic, 9, Conduit-street, W., 8 p.m. A[...] Meeting.

Anthropological Institute, 4, St. Martin's-place, [...] Rev. Wentworth Webster. "The Basque and th[...] An Examination of a Paper by Mr. Boyd Da[wkins,] F.R.S., on 'The Northern Range of the Basques,' *Fortnightly Review*, Sept. 1874."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., Wm. Newton, Esq., "The Sandblast and its Adap[tation] to Industrial Purposes."

Geological, Burlington House, W., 8 p.m. 1. Mr. [...] Davies, "The Phosphorite Deposits of North W[ales."] 2. Mr. Rooke Pennington, "On the Bone Caves [in the] neighbourhood of Castleton, Derbyshire;" com[muni]cated by Professor W. Boyd Dawkins. 3. Pr[of.] W. Boyd Dawkins, "On the Mammalia fou[nd at] Windy Knoll."

Graphic, University College, W.C., 8 p.m.

Royal Literary Fund, 10, John-street, Adelphi, 3 p.m.

Archæological Association, 32, Sackville-street, W.,

Thurs... Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. [...] Zerffi, "Modern French Art."

Royal Institution, Albemarle-street, W., 3 p.m. [...] Tyndall, "On Subjects connected with Electr[...]

Inventors' Institute, 4, St. Martin's-place, W.C., [...]

Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., (Indian Section). Mr. Frederick Drew, "The P[ossibility] of Adapting the Roman Alphabet to the Lang[uages of] India."

Royal United Service Institution, Whitehall-yard, [...] Lieut.-Colonel Arthur Leahy, R.E., "Military Construction."

Royal Institution, Albemarle-street, W., 8 p.m. [...] Meeting, 9 p.m. Mr. W. R. Greg, "Life a[t High] Pressure."

Junior Philosophical Society, 6a, Victoria-street, [...] Mr. F. Butler, "English Cottage Homes."

Astronomical, Burlington House, W., 3 p.m. [...] Meeting.

Quekett Club, University College, W.C., 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m.

Literary and Artistic, 7, Gower-street, W.C., 7 p.m.

Civil and Mechanical Engineers' Society, 7, Westm[inster] Chambers, S.W. Mr. J. G. Morrison, "The W[...] the Clifton Extension Railway."

Sat......Royal Institution, Albemarle-street, W., 3 p.m. [...] T. Wood, on "The Discovery of the Temple of [Diana] and other Results of the Government Excava[tions at] Ephesus."

Royal Botanic, Inner Circle, Regent's-park, N.W.,

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FRIDAY, FEBRUARY 12, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Alkali Examination is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

CANTOR LECTURES.

The sixth lecture of the course of Cantor Lectures on "Alcohol, its Action and its Uses," by BENJAMIN W. RICHARDSON, M.D., F.R.S., F.R.C.P., was delivered on Monday, February 1st, 1875, as follows:—

LECTURE VI.

Physical deterioration from Alcohol, continued. Influence on the vital organs. Mental phenomena induced by its use. Summary.

Towards the close of my last lecture I touched on the effects of alcohol upon the colloidal structures of the body, indicating that it is impossible for these structures to escape deterioration under its continued action. I must dwell for a few moments longer on this subject.

The parts which suffer most, at first, from alcohol, are those expansions in the animal body which the anatomists call the membranes. The membranes are colloidal structures, and every organ is enveloped in them. The skin is a membranous envelope; through the whole of the alimentary surface, from the lips downwards, and through the bronchial passages to their minutest ramifications, extends the mucous membrane; the lungs, the heart, the liver, the kidneys, are folded in delicate membranes which you can strip easily from these parts. If you take a portion of bone you will find it easy to strip off from it a membranous sheath or covering; if you open and examine a joint you will find both the head and the socket lined with membrane.

The whole of the intestines are enveloped in fine membrane, called *peritoneum*. All the muscles are enveloped in membranes, and the fasciculi or bundles and fibres of muscles have their membranous sheathing. The brain and spinal cord are enveloped in these membranes; one nearest to themselves, a pure vascular structure, a network of blood vessels; another, a thin serous structure; a third, a strong fibrous structure. The eyeball is a membrane of colloidal humours and membranes, and of nothing else. To complete the construction, the minute structures of the vital organs are enrolled in membranous matter.

It was held by the old anatomists that this membranous arrangement of the body is mainly mechanical. The parts and organs, according to their view, are supported and held in position by these membranous sheaths and pouches and coverings. Doubtless this is a portion of their usefulness, for in fact they do hold all the structures together in the most perfect order. But this is only a small part of their duties. The membranes are the filters of the body. In their absence there could be no building of structure, no solidification of tissue, no organic mechanism. Passive themselves, they nevertheless separate all structures into their respective positions and adaptations.

The animal receives from the vegetable world and from the earth the food and drink it requires for its sustenance and motion. It receives colloidal food for its muscles; combustible food for its motion; water for the solution of its various parts; salts for constructive and other physical purposes. They have all to be arranged in the body, and they are arranged by means of the membranous envelopes. Through these membranes nothing can pass that is not for the time in a state of aqueous solution like water or soluble salts. Water passes freely through them, salts pass freely through them, but the constructive matter of the active parts that is colloidal does not pass; it is retained in them until it is chemically decomposed into the soluble type of matter. When we take for our food a portion of animal flesh, it is first resolved in digestion into a soluble fluid before it can be absorbed; in the blood it is resolved into the fluid colloidal condition; in the solids it is laid down within the membranes into new structure, and when it has played its part it is digested again, if I may so say, into a crystalloidal soluble substance ready to be carried away and replaced by addition of new matter, then it is dialysed or passed through the membranes into the blood, and is disposed of in the excretions.

See then what an all-important part these membranous structures play in the animal life. Upon their integrity all the silent work of the building up of the body depends. If these membranes are rendered too porous, and let out the colloidal fluids of the blood—the albumen for example—the body so circumstanced dies; dies as if it were slowly bled to death. If, on the contrary, they become condensed or thickened, or loaded with foreign material, then they fail to allow the natural fluids to pass through them. They fail to dialyse, and the result is either an accumulation of the fluid in a closed cavity, or contraction of the substance enclosed within the membrane, or a dryness of membrane in surfaces that ought to be freely lubricated and kept apart. In old age we see the effects of modification of membrane naturally induced; we see the fixed joint, the shrunken and feeble muscle, the dimmed eye, the deaf ear, the enfeebled nervous function.

It may possibly seem to some of you at first sight that I am leading away from the subject of the secondary action of alcohol. Not so. I am leading directly to it. Upon all these membranous structures alcohol exerts a direct perverting power of action. It produces in them a thickening, a shrinking, and an inactivity that reduces their functional power. That they may work rapidly and equally they require to be at all times charged with water to saturation. If into contact with them any agent is brought that deprives them of water, then is their work interfered with; they cease to separate the saline constituents properly, and if the evil that is thus started be allowed to continue, they contract upon their contained matter in whatever organ it may be situated, and condense it.

In brief, under the prolonged influence of alcohol those changes which take place from it in the blood corpuscles, and which have already been described, extend to the other organic parts, involving them in structural deteriorations, which are always dangerous, and are often ultimately fatal.

PRELIMINARY EFFECTS ON VITAL FUNCTIONS.

I remarked in my last lecture that the slow or chronic effects of alcoholic drink upon the body was to induce a series of stages analogous in all respects, except in period

of duration, to the process of acute poisoning by the same agent. In the first prolonged stage there occur phenomena of disease which are as characteristic of the agency when it is known as they are deceptive when the agency is not known.

The ultimate changes that follow the use of alcohol by those who indulge in it, in what is too often considered a temperate degree, are actual local changes within one or other of the vital organs. But before such actual deterioration obtains there are usually other phenomena transitory in character yet unequivocal. I pointed out certain of these in the last lecture, but I did not specify them all.

In addition to that irritation of mind and suffering "of wounds without cause," to which I then drew attention, an extreme emotional derangement is often produced. The afflicted man—and I fear I must say woman also, for women are sometimes afflicted — the afflicted man under this primary prolonged influence of alcohol becomes nervous and excitable, ready at any moment to cry or to laugh, without valid reasons for either act. The emotional centres are alternately raised and depressed in function by the poison, but after a time the depression overcomes the exhilaration, and the impulse is to a maudlin sentimentality extending even to tears. The slightest anxieties are then exaggerated, and there is experienced at the same time an indecision and deficiency of self-confidence which is doubly perplexing. When an act is done, when a letter, for instance, or other piece of business has been finished and despatched, an uneasy feeling of distrust is felt that perhaps some mistake has been made, which distrust passes rapidly into a sentiment that the thing cannot be helped; it is bad luck, but it must take its chance. In various other directions this distrust shows itself, and the worst of all is, that the very doubt prompts the desire for another application for relief to the evil that is the cause of the burthen. A small dram more of the stimulant, not an overpowering draught that will cause quick and sure insensibility, but just a mouthful, that is the remedy, and that is the certain promoter of the sorrow.

We know now, as surely as if we could see within the body, what is the condition of the organs of the person afflicted in the manner thus defined. We are conscious that the vessels of the brain, of the lungs, of the liver, of the kidneys, of the stomach are paralysed, and are injected to full distention with blood. Some of these parts have actually been seen under this state, and the fact of the red injected condition directly demonstrated.

Alcoholic Dyspepsia.

Of all the systems of organs that suffer under this sustained excitement and paralysis, two are injured most determinately, viz., the digestive and the nervous. The stomach, unable to produce in proper quantity the natural digestive fluid, and also unable to absorb the food which it may imperfectly digest, is in constant anxiety and irritation. It is oppressed with the sense of nausea; it is oppressed with the sense of emptiness and prostration; it is oppressed with a sense of distention; it is oppressed with a loathing for food; and it is teased with a craving for more drink. Thus there is engendered a permanent disorder which, for politeness sake, is called dyspepsia, and for which different remedies are often sought but never found. Antibilious pills —whatever they may mean — Seidlitz powders, effervescing waters, and all that pharmacopœia of aids to further indigestion, in which the afflicted who nurse their own diseases so liberally and innocently indulge, are tried in vain. I do not strain a syllable when I state that the worst forms of confirmed indigestion originate in the practice that is here explained. By this practice all the functions are vitiated, the skin at one moment is flushed and perspiring, at the next is pale, cold, and clammy, and every other secreting structure is equally discomposed.

Nervous Derangements.

The nervous structures follow the stomach in the order of derangement, or it may be precede it. We have not yet traced out with sufficient care the conditions of the centres of the organic chain of nerves, but we know that they are reduced in power; and, in regard to those higher and reasoning centres, the brain and its subsidiary parts, the spinal cord and voluntary nerves, we are aware that they are supplied with blood through vessels weakened, and in a condition either of undue tension or undue relaxation. Moreover, the delicate membranes which envelope and immediately surround the nervous cords are acted upon more readily by the alcohol than the coarser membranous textures of other parts, and thus a combined arrangement of evils affects the nervous matter. The perverted condition of the nervous centres gives rise to many striking phenomena, extending from them to the nervous cords and to the organs of sense. The irregular supply of blood to the retina causes temporary disturbances of vision, with appearances before the eyes of those specks and small rounded semi-transparent discs, which are called by the learned *muscæ volitantes*. From the imperfect tension of the arteries, the blood which rushes through causes dilatation of them, and in the bony canals of the skull an impingement is made upon the bony structure. Vibrations which extend to the neighbouring organs of hearing are thus produced, giving rise to sounds of a murmuring, ringing, or humming character, according to the modification of the arterial tension.

The perverted condition of the membranous covering of the nerves gives rise to pressure within the sheath of the nerve, and to pain as a consequence. To the pain thus excited the term neuralgia is commonly applied, or tic; or if the large nerve running down the thigh be the seat of the pain, "sciatica." Sometimes this pain is developed as a tooth-ache. It is pain in nearly every instance, commencing at some point where a nerve is enclosed in a bony cavity, or where pressure is easily excited, as at the lower jaw bone, near the centre of the chin, or at the opening in front of the lower part of the ear, or at the opening over the eye-ball, in the frontal bone.

Alcoholic Insomnia or Sleeplessness.

Lastly on this head, the perverted state of the vessels of the brain itself, the unnatural tension to which they are subjected from the stroke of the heart, which they are so incompetent to resist, sets up in the end one telling, and of all I have yet named most serious phenomenon, I mean *insomnia*, inability to partake of natural sleep. There is a theory held by some physiologists that sleep is induced by the natural contraction of the minute vessels of the brain, and by the extrusion through that contraction, of the blood from the brain. I am myself inclined, for reasons I need not wait to speak now, to consider this theory incorrect; but it is nevertheless true that during natural sleep the brain is receiving a reduced supply of blood; that when the vessels are filled with blood without extreme distension, the brain remains awake, and that when the vessels are engorged and over distended, there is induced an insensibility which is not natural sleep, but which partakes of the nature of apoplexy. This sleep is attended with long and embarrassed breathing, blowing expirations, deep snoring inspirations, and uneasy movements of the body with even convulsive motion, and from it the apparent sleeper wakes unrefreshed and unready for the labours of the day. The effect of alcohol then on the brain is to maintain the relaxation of vessels, to keep the brain charged with blood, and so to hold back the natural repose. Under such form of divergence from the natural life, the sleepless man lies struggling with unruly and unconnected trains of thought. He tries to force sleep by suppressing with a great effort all thought, but in an instant wakes again. At last the more he tries the less he succeeds, until the morning dawns. By that long

time the spirit that kept his cerebral vessels disabled and his heart in wild unrest having become eliminated, he is set free, and the coveted sleep follows. Or perhaps wearied of waiting for the normal results, he rises, and with an additional dose of the great disturber, or with some other tempting narcotic drug of kindred nature, such as chloral, he so intensifies the vascular paralysis as to plunge himself into the oblivion of congestion, with those attendant apoplectic phenomena, which he himself hears not, but which, to those who do hear, are alarming in what they forbode, when their full meaning is appreciated. Connected with this sleep there is engendered in some persons a form of true epilepsy, which all the skill of physic is hopeless to cure, until the cause is revealed and removed.

And now I think I have said everything that I have time to say respecting the general phenomena incident to this primary stage of slow alcoholic intoxication in those who in the world's eye, as well as in their own, are temperate individuals—individuals who enjoy the choice things of this life heartily; who understand a glass of wine, and who can take a good many glasses—or a good many little "goes" of spirit if that be all—but who are never known by friend or foe to be worse for anything they take; who grow mellow as an apple under the mellowing cheer, but never fall, or lose their power of taking less guarded companions safely home.

ORGANIC DETERIORATIONS.

The continuance of the effects of alcohol into a more advanced stage leads to direct disorganisation of vital structures. When once this stage has been reached not one organ of the body escapes the ravage. According to the build or the hereditary construction of the individual, however, or according sometimes to what may be considered as a local accident, some particular organ undergoes a change which gives a specific character to the whole of the phenomena that are afterwards presented. We then say of the person in whom such change occurs that he is afflicted with such a particular disease, letting the general sink into the local manifestation. Many purely local modifications of structures and parts are in this manner induced in the blood; in the minute structures of the moving organs—the muscles; in the fixed vital organs, such as the brain, the lungs, the liver, the heart, the kidneys. In the blood the influence is exerted upon the plastic fibrine and upon the corpuscles, in the brain, on the membranes at first, and afterwards on the nervous matter they enclose; in the lungs, on the elastic, spongy, connective tissue, which is, strictly speaking, also membranous; in the heart, on its muscular elements and membranes; in the liver, primarily on its membranes; in the kidneys, on their connective tissues and membranes.

SPECIAL STRUCTURAL DETERIORATIONS.

The organ of the body that perhaps the most frequently undergoes structural changes from alcohol is the *liver*. The capacity of this organ for holding active substances in its cellular parts is one of its marked physiological functions. In instances of poisoning by arsenic, antimony, strychnine, and other poisonous compounds, we turn to the liver, in conducting our analysis, as if it were the central depot of the foreign matter. It is, practically, the same in alcohol. The liver of the confirmed alcoholic is probably never free from the influence of the poison; it is too often saturated with it.

The effect of the alcohol upon the liver is upon the minute membrances or capsular structure of the organ upon which it acts to prevent the proper dialysis and free secretion. The organ at first becomes large from the distention of its vessels, the surcharge of fluid matter, and the thickening of tissue. After a time there follows contraction of membrane, and slow shrinking of the whole mass of the organ in its cellular parts. Then the shrunken, hardened, roughened mass is said to be "hobnailed," a common but expressive term. By the time this change occurs, the body of him in whom it is developed is usually dropsical in its lower parts, owing to the obstruction offered to the returning blood by the veins, and his fate is sealed.

Now and then, in the progress to this extreme change and deterioration of tissue, there are intermediate changes. From the blood, rendered preternaturally fluid by the alcohol, there may transude, through the investing membrane, plastic matter which may remain, interfering with natural function, if not creating active mischief. Again, under an increase of fatty substance in the body, the structure of the liver may be charged with fatty cells, and undergo what is technically designated fatty degeneration. I touch with the lightest hand upon these deteriorations, and I omit many others. My object is gained if I but impress you with the serious nature of the changes that, in this one organ alone, follow an excessive use of alcohol.

In the course of the early stages of deterioration of function of the liver from organic change of structure, another phenomenon, leading speedily to a fatal termination, is sometimes induced. This new malady is called diabetes, and consists in the formation in enormous quantity within the body of glucose or grape sugar, which substance has to be eliminated by dialysis, through the kidneys—a fatal elimination. The injury causing this disease through the action of alcohol may possibly be traced back to an influence upon the nervous matter; but the appearance of the phenomenon is coincident with the derangement of the liver, and I therefore refer to it in this place.

The *kidney*, in like manner with the liver, suffers deterioration of structure from the continued influence of alcoholic spirit. Its minute structure undergoes fatty modifications; its vessels lose their due elasticity and power of contraction; or its membranes permit to pass through them that colloidal part of the blood which is known as albumen. This condition reached, the body loses in power as if it were being gradually drained even of its blood. For this colloidal albumen is the primitively dissolved fluid out of which all the other tissues are by dialytical processes to be elaborated. In its natural destination it has to pass into and constitute every colloidal part.

The *lungs* do not escape the evil influence that follows the persistent use of alcohol. They, indeed, probably suffer more than we at present know from the acute evils imposed by this agent. The vessels of the lungs are easily relaxed by alcohol; and as they, of all parts, are most exposed to vicissitudes of heat and cold, they are readily congested when, paralysed by the spirit, they are subjected to the effects of a sudden fall of atmospheric temperature. Thus, the suddenly fatal congestions of lungs which so readily befall the confirmed alcoholic during severe winter seasons.

ALCOHOLIC PHTHISIS, OR THE CONSUMPTION OF DRUNKARDS.

There are yet other and more prolonged, and more certainly fatal mischiefs induced in the lungs by the persistent resort to alcohol; and to one of these I would direct special attention. It is that deterioration of lung tissue to which, in the year 1864, I gave originally the name of *alcoholic phthisis*, or the *consumption of drunkards*. The facts came before me at first in this manner. In a public hospital to which I acted as physician, I had brought before me, in the course of many years, two thousand persons who were suffering from consumption. I gathered the history of the lives of these, and of the reasons why they had passed into the all but hopeless malady from which they suffered. In my analysis of these histories I found that the causes of the malady altogether were, in the great majority of instances, predisposition from hereditary taint; exposure to impure air; want; or certain other allied causes. But the analysis being conducted rigidly, I discovered that, when every individual instance had been classified

as due to the causes stated above, there remained thirty-six persons, or nearly two per cent. who were excluded from them, who appeared to suffer purely from the effects of alcohol, and in whom the consumption had been brought into existence by the use of alcohol.

The added observations of eleven years, since the above named fact was recorded in the *Social Science Review*, as a new fact in the history of the disease, have only served to prove, in the minds of other men as well as my own, the truth of the record.

The persons who succumb to this deterioration of structure induced by alcohol, are not the exceedingly young, neither are they the old. They are usually over twenty-eight and under fifty-five. The average age may be taken as forty-eight. They are persons of whom it is never expected that their death will be from consumption; they are generally males. They are probably considered very healthy;—men who can endure anything, sit up late at night, run the extreme of amusements, and yet get through a large amount of business. They sleep well, eat pretty well, and drink very well. They are often men of excellent build of body, and of active minds and habits. They are not a class of drinkers of strong drinks, who sleep long, take little exercise, and grow heavy, waxy, pale—

"Sleek-headed men and such as sleep o'nights."

On the contrary they take moderate rest, and see as much as they can. Neither in the ordinary sense are they drunkards; they may never have been intoxicated in the whole course of their lives; but they partake freely of any and every alcoholic drink that comes in their way, and they bear alcohol with a tolerance that is remarkable to observers. They are hard drinkers as distinguished from sots. Beer is to them as water, wine is weak; the only thing that upsets them is stiff grog in relays, or a mixture of spirituous drinks carried to the extent of what they call, in grim joke—in which death surely joins—"piling up the agony."

As a rule these cannot live in what they consider to be comfort without a daily excess of alcohol, which excess must needs be renewed on emergencies, if there be greater amount of work to be done, less sleep to be secured, or more life to be lived.

As specimens of animal build these persons are often models of organic symmetry and power. In fact they resist the enemy they court for so long a time because of the perfection of their organisation. More than half of those whom I have seen stricken down with alcoholic phthisis have said that they had never had a day's illness in their lives before: but questioned closely it was found that none of them had actually been quite well. Some of them had suffered from gout; others from rheumatism or neuralgia. They had felt severely any depression, such as that which arises from a cold, and if they had been subjected suddenly to causes of excitement or exhaustion, they had detected, without actually realising its full meaning, that their balance of power against weakness was reduced, that the end of the beam called strength was rising, and that an extra quantity of alcohol was required to bring back equilibrium. As a rule men of this class are thoughtless of their own health and their own prospects, for they have an abundant original store of energy. They are designated as "happy-go-lucky" men, or as men who "always fall on their feet," which truly they do, but not without injury.

The countenance of the alcoholic consumptive differs from that which is usually considered the countenance of the consumptive person, and equally from that which all the world adjudges as belonging to the man who indulges freely in strong drink. Who does not remember the wan, pale, sunken cheek of the youth in whom ordinary consumption has set its mark? And who, again, does not recall the *facies alcoholica*—the blotched skin, the purple red nose, the dull, protruding eye, the vacant stare of the confirmed sot? The alcoholic consumptive has none of these characteristics. His face is the best part of him in all his history. When his muscles have lost their power, and his clothes hang loosely on his shrunken limbs, he is still of fair proportion in the face; he has little pallor, and he is expressive in feature, so that his friends are apt to be deceived and to believe that there must be hope for his recovery, even when he is beyond every hope. I remember being actually taken aback on one occasion on finding, in a man who seemed, from his face, to be in perfect health, how completely destroyed his lungs were by the encroachments of disease, and I cannot be surprised, therefore, that others, less informed, should share in such an imperception of danger when it is close at hand. Nobody, in a word, "pities the looks" of these sufferers, and good eyes are necessary to learn that pity is called for.

The phenomena are not always developed at a time when the sufferer from them is indulging most freely in alcohol. On the contrary, it is by no means uncommon that the habit of excessive indulgence has been stopped for some time previously to their development. The reasons assigned by the patients for abstinence vary. One man may have been strongly advised by his friends to desist, or may himself have undergone a certain measure of reform; another has been led by the reading or hearing of arguments on temperance; a third, by want of means to obtain the indulgence; but by far the larger number tell you that a time came when the desire for so much drink did not occur to them. They will state that they tried the round of the various spirits, but found that none agreed with them as before, so that at last they were driven to rely on beer as the only drink they cared for. We read all this off clearly enough from a physiological point of view. We see that, in fact, the body has been resisting the alcohol; that it could not do away with it as it did when all the excreting organs were in their full prime; and that those drinks only can be borne in which the amount of alcohol is least, but the sufferer does not comprehend the fact, and therefore he not unfrequently concludes that his increasing languor and debility are due to the necessary withdrawal of the stimulus on which he seems to have been actually feeding during the greater part of his life.

The signs which first indicate failure of health are usually those of acute pleurisy. There is pain in the side, quick, sharp, startling. The term "stitch" in the side is commonly applied to this pain, and is expressive enough. After a time the pain becomes continuous, and when it subsides, suppressed breathing, or difficulty of filling the chest, is at once felt and recognised. This difficulty is due to the circumstance that a portion of lung has become adherent to the inner surface of the chest. The next sign indicating that the disease (consumption) is present, is, usually, vomiting of blood. In two-thirds of the examples to which my attention has been directed this has been the sign that has first caused serious alarm. It is commonly on this event that the physician is called in, who examines the chest with the stethoscope, and finds too often a condition that is hopeless. From the appearance of that sign all is—down, down, down towards the grave.

There is no form of consumption so fatal as that from alcohol. Medicines affect the disease but little, the most judicious diet fails, and change of air accomplishes but slight real good. The sick man with this consumption may linger longer on the highway to dissolution than does his younger companion, but there is this difference between them, that the younger companion does often leave the highway to find a by-path to health, while the other never leaves it, but struggles on straight to the end. In plain terms, there is no remedy whatever for alcoholic phthisis. It may be delayed in its course, but it is never cured, and not unfrequently instead of being delayed it runs on to a fatal termination more rapidly than is common in any other type of the disorder.

The origin of this series of changes from alcohol is, as you will perceive, again on the membranes. The course of it is through the membranous tissues. The vessels

give way after a severe congestive condition, and blood is exuded, or extravasated into the lung. There are here two diagrams in water tint, in which both these conditions are faithfully depicted, and to these is added a third, which shows in some, but in an imperfect manner, the course of the after destruction of the substances of the pulmonary organs.

ALCOHOLIC DISEASE OF THE HEART.

The heart, not less than the rest of the vital parts, is subjected to deterioration of structure from alcohol. We need not wonder at this when we recall the strain to which it is subjected by the agent, the excess of work it is made to perform. I touched on the mechanical evils that befell the heart from these circumstances in my last lecture, and the structural evils which I have now to specify are not less grave. The membranous structures which envelope and line the organ are changed in quality, are thickened, rendered cartilaginous, and even calcareous or bony. Then the valves, which are made up of folds of membrane, lose their suppleness, and what is called valvular disease is permanently established. The coats of the great blood-vessel leading from the heart, the aorta, share not unfrequently in the same changes of structure, so that the vessel loses its elasticity and its power to feed the heart by the recoil from its distention, after the heart, by its stroke, has filled it with blood.

Again, the muscular structure of the heart fails, owing to degenerative changes in its tissue. The elements of the muscular fibre are replaced by fatty cells; or if not so replaced are themselves transferred into a modified muscular texture in which the power of contraction is greatly reduced.

Those who suffer from these organic deteriorations of the central and governing organ of the circulation of the blood learn the fact so insidiously, it hardly breaks upon them until the mischief is far advanced. They are for years conscious of a central failure of power from slight causes, such as over-exertion, trouble, broken rest, or too long abstinence from food. They feel what they call "a sinking," but they know that wine or some other stimulant will at once relieve the sensation. Thus they seek to relieve it until at last they discover that the remedy fails. The jaded, over-worked, faithful heart will bear no more; it has run its course, and—the governor of the blood stream broken—the current either overflows into the tissues, gradually damming up the courses, or under some slight shock or excess of motion ceases at the centre.

OTHER ORGANIC CHANGES.

In the eyeball certain colloidal changes take place from the influence of alcohol, the extent of which have as yet been hardly thought of, certainly not in any degree studied, as in future they will be. We have learned of late years that the crystalline lens, the great refracting medium of the eyeball, may, like other colloids, be rendered dense and opaque by processes which disturb the relationship of the colloidal substance and its water. By this means even the lens of the living eye can be rendered opaque, and the disease called cataract can be artificially produced. Sugar and many salts in excess, in the blood, will lead to this perversion of structure, and after long time alcohol acting in the manner of salt is capable, in excess, of causing the same modification. In the eyeball, moreover, alcohol injures the delicate nervous expanse upon which the image of all objects we looked at is first impressed. It interferes with the vascular supply of this surface, and it leads to changes of structure which are indirectly destructive to the perfect sense of sight.

In yet another mode alcohol perverts the animal mechanism. By some as yet obscurely definable interference with the natural transmutation of the colloidal substances into saline or crystalloidal, it gives rise to the production of an excess of some salines which appear in the fluid renal secretion. These saline matters accumulated in the blood from inability of the excreting organs to dispose of them, are directly injurious, and exist as possible causes for the promotion of cataractous changes in the crystalline lens, and varied changes in other of the colloidal tissues and membranes. They are also a cause of a disease local in character and produced by the very aggregation of saline products, particle by particle, into a compact mass like a stone. I refer to what is called *calculus*. In writing the history of one of the districts of England in which this disease is very prevalent, I expressed many years ago the view that alcoholic indulgence was one of the most telling agencies in the production of the malady. I have seen nothing since that would lead me to alter that statement.

ORGANIC NERVOUS LESIONS FROM ALCOHOL.

Lastly, the brain and spinal cord, and all the nervous matter become, under the influence of alcohol, subject, like other parts, to organic deterioration. The membranes enveloping the nervous substance undergo thickening; the blood vessels are subjected to change of structure, by which their resistance and resiliency is unimpaired; and the true nervous matter is sometimes modified, by softening or shrinking of its texture, by degeneration of its cellular structure, or by interposition of fatty particles.

These deteriorations of cerebral and spinal matter give rise to a series of derangements, which show themselves in the worst forms of nervous disease—epilepsy; paralysis, local or general; insanity.

But not a single serious nervous lesion from alcohol appears without its warning. As a man who, when drinking at the table, is warned that the wine is beginning to take decisive effect on his power of expression and motion, by certain unmistakable indications, so the slow alcoholic is duly apprised that he is in danger of a more permanent derangement. He is occasionally conscious of a failing power of speech; in writing or speaking he loses common words. He is aware that after fatigue his limbs are unnaturally weary and heavy, and he is specially conscious that a sudden fall of temperature lowers too readily his vital energies. The worst sign of impending nervous change is muscular instability, irrespective of the will; that is to say, an involuntary muscular movement whenever the will is off guard. This is occasionally evidenced by sudden muscular starts which pass almost like electrical shocks through the whole of the body; but it is more frequently and determinately shown in persistent muscular movements and starts at the time of going to sleep. The volition then is resigned to the overpowering slumber, and properly all muscular movement, except the movement of the heart and of the breathing, should rest with the will. But now this beautiful order is disturbed. In the motor centres of the nervous organisation the foreign agent is creating disturbance of function. The fact is communicated to the muscles by the nervous fibres, and the active involuntary start of the lower limbs rouses the sleeper in alarm. Ignorant of the import of these messages of danger, the habituated alcoholic continues too frequently his way, until he finds the agitated limbs unsteady, wanting in power of co-ordinated movement —paralysed.

Deeply interesting as these phenomena from alcohol are, I must leave them here, omitting many others equally significant and equally plain, when they are once pointed out, even to the unprofessional mind. Let it be understood that in each description I have recorded only what alcohol can physically do to the animal economy. It is not always the cause of all or any of these phenomena. They may be induced by other influences and other agents, but it is an agency capable of effecting them, and it is actively employed in the work.

On some of the Mental Phenomena Induced by Alcohol.

The purely physical action of alcohol has been so far treated upon in the preceding pages. To that must now be added a few sentences on the influence this agent exerts over the mental functions. Of course such influence is actually manifested by and through physical means, but as yet these are not sufficiently clear to enable us to trace out the mental aberration through the physical process that has led to it. It is better therefore and simpler to treat the present subject in the mere abstract, passing from the agent to its results, without reference to the intermediate line of connection between cause and effect. These mental phenomena, in the chronic phase, correspond to the phenomena which belong to the second and third stages of acute alcoholic intoxication.

Loss of Memory or Speech.

One of the first effects of alcohol upon the nervous system in the way of alienation from the natural mental state, is shown in loss of memory. This extends even to forgetfulness of the commonest of things; to names of familiar persons, to dates, to duties of daily life. Strangely too, this failure, like that which indicates, in the aged, the era of second childishness and mere oblivion, does not extend to the things of the past, but is confined to events that are passing. On old memories the mind retains its power; on new ones it requires constant prompting and sustainment.

If this failure of mental power progress, it is followed usually with loss of volitional power. The muscles remain ready to act, but the mind is incapable of stirring them into action. The speech fails at first, not because the mechanism of speech is deficient, but because the cerebral power is insufficient to call it forth to action. The man is reduced to the condition of the dumb animal. Aristotle says, grandly, animals have a voice; man speaks. In this case the voice remains, the speech is lost; the man sinks to the lower spheres of the living creation, over which he was born to rule.

The failure of speech indicates the descent still deeper to that condition of general paralysis in which all the higher facilities of mind and will are powerless, and in which nothing remains to show the continuance of life except the parts that remain under the dominion of the chain of organic or vegetable nervous matter. Our asylums for the insane are charged with these helpless specimens of humanity. The membranes of the nervous centres of thought and volition have lost, in these, the dialysing function. In some instances, though less frequently than might be supposed, the nervous matter itself is modified visibly in texture. The result is the complete wreck of nervous action, the utter helplessness of will, the absolute dependence upon other hands for the very food that has to be borne to the mouth. The picture is one of breathing death; of final and perpetual dead drunkenness.

Dipsomania.

A second effect of alcohol on the mental organisation is the production of that craving for its incessant supply to which we give the name of dipsomania. In those who are affected with this form of alcoholic disease, a mixed madness and sanity is established, in which the cunning of the mind alone lives actively, with the vices that ally themselves to it. The arrest of nervous function is partial, and does not extend to the motor centres so determinately as to those of the higher reasoning faculties. But the end, though it may be slow, is certain. And the end is, as a rule, that general paralysis which I have just described. The dipsomaniac is, however, capable of recovery, within certain limits, on one and only one condition, that the cause of his disease be totally withheld.

Mania a Potu.

The effect of alcohol on the mental functions is shown in yet another picture of modern humanity writhing under its use. I mean in the form of what may be called intermittent indulgence, to dangerous excess. This form of disease has been named the *mania a potu*, and it is one of the most desperate of the alcoholic evils. The victims of this class are not habitual drunkards or topers, but at sudden intervals they madden themselves with the spirit. They repent, reform, get a new lease of life, relapse. In intervals of repentance they are worn with remorse and regret; in the intervals of madness they are the terrible members of the community. In their final excitement they spread around their circle the darkness of desolation, fear, and despair. Their very footsteps carry dread to those who, most helpless and innocent, are under their fearful control. They strike their dearest friends; they strike themselves. Retaining sufficient nervous power to wield their limbs, yet not sufficient to guide their reason, they become the dangerous members of our community, whom our legislators, fearing to touch the cause of their malady, would fain try to cure by scourge and chain.

To us physiologists these "maniacs a potu" are men under the experiment of alcohol, with certain of their brain centres (which I could fairly define to you if the occasion were befitting) paralysed, and with a broken balance, therefore, of brain power, which we, with infinite labour and much exactitude, have learned to understand. Our remedy for such aberration of nervous function, if we were legislators, would be simple enough: we should not whip the maniac back again to the potu, we should try to break up the term by taking the potu from the maniac. But then we are only physiologists. We have nothing to do with that £117,000,000 of invested capital, and we are not practical in reference to it.

Transmitted Disease.

The solemnest fact of all bearing upon these mental aberrations produced by alcohol, and upon the physical not less than the mental, is, that the mischief inflicted on man by his own act and deed cannot fail to be transferred to those who descend from him, and who are thus irresponsibly afflicted. Amongst the many inscrutable designs of nature none is more manifest than this, that physical vice, like physical feature and physical virtue, descends in line. It is, I say, a solemn reflection for every man and every woman, that whatever we do to ourselves so as to modify our own physical conformation and mental type, for good or for evil, is passed on to generations that have yet to be.

Not one of the transmitted wrongs, physical or mental, is more certainly passed on to those yet unborn than the wrongs which are inflicted by alcohol. We, therefore, who live to reform the present age in this respect, are stretching forth our powers to the next; to purify it, to beautify it, and to lead it towards that millennial happiness and blessedness, which, in the fulness of time, shall visit even the earth, making it, under an increasing light of knowledge, a garden of human delight, a Paradise regained.

Summary.

In summary of what has past, I may be briefness itself.

This chemical substance, alcohol, an artificial product devised by man for his purposes, and in many things that lie outside his organism a useful substance, is neither a food nor a drink suitable for his natural demands. Its application as an agent that shall enter the living organisation is properly limited by the learning and skill possessed by the physician, a learning that itself admits of being recast and revised in many important details and perhaps in principles.

If this agent do really for the moment cheer the weary and impart a flush of transient pleasure to the unwearied

who crave for mirth, its influence (doubtful even in these modest and moderate degrees) is an infinitesimal advantage, by the side of an infinity of evil for which there is no compensation, and no human cure.

On the motion of the **Chairman** (R. Rawlinson, C.B.), a vote of thanks to Dr. Richardson for his lectures was carried unanimously.

The First Lecture of the Second Course was delivered by the Rev. Arthur Rigg, on Monday, February 8th. The subject of the Course is "Tools and Contrivances used in Handicraft." The Lectures will be published in the *Journal* at the conclusion of the Session.

EXTRA MEETING.

The adjourned discussion on Capt. Bedford Pim's paper on "The Mercantile Marine," was resumed on Tuesday evening, February 5th, Capt. Sir John Heron Maxwell, Bart., R.N., again occupying the chair.

The Chairman, before calling upon Mr. Norwood, M.P., to open the debate, referred to the deputation of shipowners which had lately waited upon the President of the Board of Trade, saying he had the authority of Sir Charles Adderley for suggesting that the present meeting, though it might very well discuss the question, would do well not to express any very strong opinion as to legislation until they had seen the Bill which the Government intended shortly to introduce, and in which they hoped, as far as possible, to meet the wishes of shipowners. The remarks made by Mr. Currie were very apposite, and he had also been glad to see the statement by Sir C. Adderley, that the Government did not look upon Mr. Plimsoll in any way as an opponent; and though they could hardly hope he would be satisfied with the Government measure, he would have an opportunity of endeavouring to modify it according to his own views by proposing amendments in committee. They trusted that Parliament would think the line taken in the Bill was the right and reasonable mode of amending the Merchant Shipping Act, and that no one would look upon a matter of such great national importance as in any sense a party question.

The Secretary said he had received a letter from M. de Lesseps, approving, as he understood it, of the views expressed by Capt. Bedford Pim, but as it was rather lengthy he would not take up the time of the meeting by reading it. (For letter see page 244.)

Mr. Norwood, M.P., in commencing the discussion, said, before offering a few observations on the paper read by Capt. Bedford Pim, a few evenings ago, on the "Mercantile Marine," he desired to express his entire concurrence with his remarks as to the great importance, national as well as commercial, of the subject; and although he should have to question some of his facts, and demur to some of his conclusions, he desired, as a shipowner, to tender his thanks to the honourable gentleman for thus affording an opportunity for discussing and grappling with some of the allegations hitherto made against that class in a form most vague and indefinite. Shipowners had been for so long a period exposed to reckless sensational assertions and unscrupulous vituperation from ignorant philanthropists or professional agitators, that he found it quite refreshing at last to meet with a critic who could advance his opinions in definite and reasonable language, and who, from professional experience, knew not only the difference between the stem and stern of a ship, but also what an A.B. seaman ought to be. The hon. and gallant gentleman naturally divided his subject under the two heads of "Seamen" and "Ships;" and to the former subject he intended chiefly to direct his attention on this occasion. That there had been a deterioration in our merchant seamen as a body, and especially of late years, he feared there could be no doubt. There was still a considerable proportion of good men, competent, trustworthy, and respectable, who were, for the most part, married men, and were found in steamers and the highest class of sailing vessels; and, in addition, it was computed there were about 150,000 men and boys around our coasts, chiefly fishermen, whose conduct and condition might be considered highly satisfactory. But his experience and inquiry unfortunately convinced him that a large portion of our merchant seamen (probably fully one-third of the whole) were lamentably deficient in seamanship, in *physique*, in health, and in moral character—in fact they were unseaworthy. He would not enter into the serious complaints against those men made by owners and masters of ships, of the state of intoxication in which seamen frequently joined their ships, of the infraction of articles of agreement deliberately entered into, by desertion before sailing, or on any opportunity for obtaining higher wages abroad, of the contagious diseases so prevalent amongst the men, and the growing spirit of insubordination. His object was rather to examine the correctness of some of the statements made by Captain Pim and by his *protégés*, the "London Seamen's Mutual Protection Society," as to the disadvantages and grievances under which (as they alleged) our merchant seamen suffered. At the outset, he begged to say that not only did he repudiate the wholesale and unqualified charges against sailors as a class, which it was the fashion nowadays to advance against shipowners, but that he was ready to acknowledge, and to aid in removing, any substantial grievance under which it could be shown that the sailor suffered. His honourable and gallant friend made many distinct and sweeping assertions when he said "1. That the sailor is ill-used. 2. That he is badly paid. 3. That he is badly fed and housed. 4. That his life, a life of continued exposure and hardship, is rendered the less endurable by systematic neglect; and that he is altogether worse off than the members of any other class of his fellow-subjects, not even excepting the denizens of our prisons." He quoted in support of that statement the opinion of the sailors of the north-eastern ports, who said, "We sailors (skilled workmen as we are, and valuable ones) gladly take any employment on shore, where even the farm labourer, although he runs no risk of life or limb, gets better paid." And Captain Pim fortified himself again with the memorial to Parliament of the London Seamen's Mutual Protection Society, which he now proposed shortly to examine, clause by clause, and he would venture to give a specific denial to these assertions. The condition of the labouring classes in this as well as other countries was frequently that of more or less hardship, struggle, and difficulty. The seaman, no doubt, was exposed to the elements and encountered dangers to a greater degree than most of his fellow-labourers, but the remuneration received, the quantity and quality of the food supplied to him, he could fearlessly assert was equal, if not superior to, that received by any similar section of the working classes, and to compare the sailor in regard to his pay, or his food, with the agricultural peasant, was, in his opinion, an abuse of language. What were the facts? He held in his hand an official statement, signed by the Registrar-General of Shipping, as to the current rate of wages out of the port of London at the present moment. It was obtained three days previously, and was as follows:—

	Steamers.		Sailing vessels.
	Weekly.		
North of Europe	£1 10	..	none.

Men Finding themselves.

	Monthly.		
Mediterranean	£3 15	..	£3 10
North America	4 10	..	4 0
South America	3 10	..	3 5
West Coast of Africa	4 0	..	3 5
China, Japan, East Indies, West Indies, Australasian and Cape Colonies	3 10	..	3 5

Food Supplied by Ship.

The above wages were for A.B.'s; ordinary seamen generally received about £1 a month less than A.B.'s, whereas firemen got more, viz., in the Mediterrannean, 10s. a month, and in the Suez Canal £1 a month more. In the North of Europe trade, in cold weather, they were glad to accept the same wages because they had the comfort of the fire. This showed an average for A.B.'s of 20s. per week in steamers, in addition to food, light, coals, and the use of the galley fire, and about 17s. per week in sailing vessels; ordinary seamen and boys got about 5s. per week less. Stokers and firemen received in some trades 2s. 6d. to 5s. per week more than A.B.'s. The cost of feeding a sailor, he believed, averaged in most ships 1s. 6d. to 1s. 9d. per diem. Some months ago he had made a close estimate of the cost of provisioning his own steamers, and found it had risen in five years from 1s. 6d. to 1s. 9d. per diem. An eminent owner in London, who owned both trading and steam vessels, stated in a letter, which he had in his hand, that the average cost throughout his ships was 1s. 8d. per seaman. He found on investigation that the cost of wages and food to his crews in the Mediterranean and Indian trades had advanced, within the last five years, from 20 to 25 per cent. He had lived a long time in agricultural counties, in Yorkshire, for instance, where good wages were paid to agricultural labourers, and knew something of their condition. In that county they got as much as 15s. a week, while in Dorsetshire, they only received 11s. or 12s. But the agricultural labourer, though he might have a bit of bacon twice or three times a week, rarely tasted fresh animal food. With regard to the food supplied on board respectable ships he had the articles of agreement before him. In the collier trade there was practically no restriction on the consumption of meat, as much as 2 lbs. of beef per man being consumed, and the lowest scale in respectable ships (rarely strictly adhered to) was $1\frac{1}{4}$ lbs. of pork or $1\frac{1}{2}$ lbs. of beef per day. If butter was given, only 1 lb. of meat was allowed. He feared the agricultural labourer on his 12s. per week, and a little bacon on Sundays, would consider it a great treat if he had the opportunity of messing with an A.B. on board ship in fine weather, and with a calm sea. In the Baltic and North of Europe trades a system prevailed, which he did not altogether approve of, of paying a man weekly wages, he finding himself. The wages were now 30s. a week, but in may cases the men were half-starved, because they did not provide themselves with sufficient food. Some of them came on board with little more than a bag of biscuits and a few red herrings, so that owners were compelled to provide extra food, or the men would be half-starving if they were a few days over their ordinary time. His conviction was, that whereas it cost him about 1s. 9d. per day to provision his crews, the men themselves did not spend one shilling per day. Then as to berthing. Of course berths differed, and probably no gentleman present would care much for the luxury of a berth on board even a government ship; but he was certain that in this matter there had been a great improvement within the last few years. Since he had had the honour of a seat in Parliament, an Act had been passed to encourage owners in giving good accommodation to their crews, because whenever it was approved by the Board of Trade surveyor, that crew space was deducted from the net tonnage upon which dock dues were paid. In talking about ships and seamen, a great mistake was made by many persons in speaking too generally, and making no exceptions. Owners were all either reprobates or angels, and ships were either all good or all bad. The truth was, they differed like everything else, and he did not mean to say there were not ships with dirty and inconvenient forecastles, but he should have something to say presently which bore materially on that point. Another great grievance of which Captain Pim complained was that Lord Campbell's Act did not apply to loss of life at sea. He felt himself here on somewhat dangerous ground in dealing with his honourable, gallant and, he believed, also learned friend, because he could not but treat with the greatest respect any statement with reference to an Act of Parliament coming from a gentleman who had a right to wear a wig and long robe; but his reply was that the same law and principle was applicable in case of death through culpability of the employer, whether on land or sea. Lord Campbell's Act was simply to this effect. By the barbarous interpretation of the common law, though a workman might sue his employer for his culpable negligence or default occasioning the wounding or maiming of the workman, his representatives could not claim any compensation if the man were killed outright. Lord Campbell's Act went to this, that the near relatives of any man who was killed by the direct negligence of his employer, if they could show a beneficial interest in his life, could sue and obtain damages for the loss they sustained by his death; and that Act applied as much to a seaman on board ship as to a bricklayer's labourer on land. As to the suggestion that no ship should be allowed to put to sea without a registered responsible owner, the reply was that that was now the case, and on payment of 1s. anyone could inspect the true register of owners of any British ship. There was no doubt either that the registered owners were the persons liable at law.

A Member asked if the managing owner was registered.

Mr. Norwood said it was the practice at the present time to ask the name of the managing owner on registering a ship. This had been so for the last two or three years. He did not know that there was actually power to demand this information, but it was always given. Undoubtedly the practice would be continued. The object of attending the meetings of scientific societies was to learn something, and he had often gained much information in that way; but he must confess to being somewhat startled at the following statement of his friend Captain Pim:—"At present, of all proprietors ship-owners have the least real knowledge of their property, and in like manner they have less acquaintance with the persons who are engaged in their service than any other employers of labour in the kingdom. Strange, and perhaps almost incredible, as it may appear, it is by no means an uncommon case to find owners who never have even seen their ships, and who know no more of the men who serve on board those ships than if they lived in Timbuctoo." His answer to that was, that a ship-owner who did not see his ship occasionally would not be a ship-owner long—he fancied the Bankruptcy Court would soon put an end to his career in that line; but if it meant that an owner was not in constant sight of his ship he agreed with him, because if he had a dozen or twenty ships, and they went on different voyages, he did not know how the problem of being in so many places at once was to be solved. But he had a competent man on board to protect his interests, and the Legislature was kind enough to say that he was not capable to judge of the man's abilities, but the man must have a certificate of competency in every respect before he could engage him. He would now examine in detail the humble petition of the London

Seamen's Mutual Protection Society. It ran in this wise; the first clause was this:—"That in the opinion of your petitioners, founded upon their own experience, the men employed in the British Mercantile Marine Service are subject to great disadvantages, which can only be remedied by practical legislation." This was rather vague, and he could not really answer an accusation which was not more detailed. The second was more to the point:—"That the present way in which ships' articles are drawn up is arbitrary, and productive of inconvenience and injustice, and that advantage is taken of the articles to bind seamen to other duties than those which properly belong to them on board ship, and to membership in 'benefit societies,' which have no natural relation to the purpose for which articles of agreement were designed by your Honourable House." Now, articles of agreement were very carefully-drawn documents; he had one before him. There were certain necessary clauses printed, but space were left for the addition of anything which the master and seaman wished carried into effect. It must be signed in the presence of a shipping-master, having been read over in a clear and audible voice to all the crew, and a copy must be sent to the Registrar-General's office in Adelaide-place, to prevent the possibility of the articles being tampered with even at the shipping-office. The Act of Parliament further compelled the shipping-master to hand to the crew an abstract of all the important clauses in the agreement, and they were requested to hang it up in the forecastle or some conspicuous place. It was not true that advantage was taken in them to bind seamen to other duties than those which properly belonged to them on board ship. After careful inquiry, he found that the only clause which could at all bear that interpretation was the usual one inserted in the case of steamers:—"Seamen and firemen to render mutual assistance in the general duties of the vessel when required." He would ask the Chairman, as an old sailor, what impropriety was there in that? If the engineers and firemen were overworked, or if one or more of them were ill, was it not reasonable that the deck hands should be called upon to assist, and *vice versa*. The safety of the ship, cargo, and men's lives depended on the proper management of the vessel, and was it a cruel shame that this should be provided for in the way he had mentioned? With regard to the allegation about benefit societies, he was assured on the best authority that no such clause was ever entered upon a ship's articles, with one small exception. It seemed that by the law of Jersey a deduction of 7½d. a month was legally made from the wages of anyone serving on board a Jersey ship, towards the Jersey Seamen's Sick Fund. Jersey was not a large place, and this provision could not have a very extended effect, but no doubt it was objectionable. If it were desirable to made a deduction from seamen's wages towards a sick fund, it should be a national affair, extending to every ship; but he did not think this was an ingenuous way of putting forward the objection. The third statement was this—"That it would conduce to the welfare of the mariners and the interest of owners of ships, if, at the time of signing articles, it were made compulsory upon owners to give any mariner who required it an allotment note for two-thirds of his pay, payable monthly, for the support of his family or relations, and that it would tend to diminish the evils that arise from the present system of advance notes." In reply to that he would say that it was a general custom to give half-pay, except in certain trades where desertion was notorious, and where it was almost impossible to keep English seamen together. In his own business they invariably gave allotment notes to the extent of one-half the man's pay, and he thought that was ample. If they exceeded it, it would only act as an inducement to desertion, and lessen the feeling of responsibility attaching to the proper performance of the man's duty. There was a strong feeling against advance notes, and no doubt they were the cause of much mischief, but he was not prepared to say he would prohibit them. In the first place he doubted the propriety of interfering between master and man, whether sailor or not, in making arrangements. If in ordering goods from a tradesman, or engaging joiners or bricklayers, he chose to run the risk, when requested, of advancing something on account, he did not know that any great harm was done. He thought advance notes were to some extent almost necessary, but he would not allow them to exceed 20s., and would make them strictly legal documents, which at present they were not, unless accepted and written across by the owners, when they become bills of exchange. A seaman, like every other labourer, ought to have the full protection of the law, and if the owner chose to authorise the captain to give advance notes, he ought to take the responsibility, and pay them without demur if the men were on board at the time. The fourth clause was this—"That in the opinion of your petitioners it is undesirable and unjust that a mariner who fails to comply with the articles of agreement is punished criminally, while he is compelled to take costly and tedious civil remedies against an employer who fails on his part." This was untrue. By the Merchant Shipping Act, a seaman had power to sue the master or owner of a ship summarily before a police magistrate for wages or deficiency of food, to the extent of £50, without appeal. He need not be three days in any port without suing the owner for anything which was due to him. Three years ago an Act was passed giving a certain proportion of the crew of any ship the power to demand a survey as to her seaworthiness and quality of the provisions. The fifth clause stated—"That the laws and regulations with respect to the supply of food to mariners are in many cases evaded or defied by owners or masters; that quantity is deficient, the quality inferior, and that no inspection of food is provided or enforced." He had already touched on this point. The law did not interfere in so many words between the crew and the ship-master, but if there were any deficiency or inferiority the crew had power to demand, either here or abroad, the interference of a magistrate. The 6th clause said, "That under the present system so much time elapses between the discharge of crews and their being paid off that much suffering and immorality arises therefrom. That wages should be paid within forty-eight hours after the termination of the voyage, and any further delay should count two days for one in favour of the mariner." The actual law was, that the master was bound to pay immediately, on arrival, one-fourth of the wages due to the seamen, and the residue within five days. On inquiring at the shipping offices he was told that the almost invariable custom was for the men to be paid off on the second day, and rarely later than the third. He was quite prepared to support a change in the time allowed from five days to three days, which he thought would be sufficient, though it was obvious there were many reasons why the captain could not find the money the first day of arrival. The 7th clause was this—"That in the opinion of your petitioners it would be a great advantage to owners, masters, and seamen, and the nation at large, if seamen were required to pass a practical examination in seamanship before being allowed to sign as an 'A.B.,' and that it should be made penal on the part of the master or other person to engage uncertificated men, and that the apprentice system should be restored, and it should be made compulsory upon owners to carry a number of apprentices in their ships, according to their size and tonnage." In reply to that, he did not think it was possible to examine and give certificates of A.B. to seamen, or that the men would care to be examined; and he was quite sure Jack would often lose his certificate. The consequence would be, men would be driven from the sea altogether if you could not take them without a certificate. Again, it was absurd to propose making it illegal to engage ordinary seamen or boys. This was simply the ordinary Trade Union principle. Why was he not to

engage a man whom he believed to be efficient for his purpose because he did not happen to be exactly an A.B.? It was an attempt to limit labour in the same way in which it had been attempted in Birmingham and Sheffield. He would treat the question of apprentices presently. The 8th clause said, "That great inconvenience and injury result to the mercantile interests of the kingdom from the large and increasing employment of foreigners and Lascars in British ships. That within the last few years the proportion of foreigners to British seamen much exceeds that of one quarter of the whole." His reply was, that a Parliamentary return, made last year or the year before, showed clearly that the proportion of foreigners in the mercantile marine did not exceed one-tenth. With regard to Lascars, it was absolutely necessary they should be employed in the Eastern trade; and it was really a great mercy to English sailors that such men could be found to act as firemen in the Red Sea and other hot climates. The Peninsular and Oriental Company, in fact, found they could not get on without them. For his own part he knew very little about Lascars, but he knew something about Scandinavians, who formed the bulk of the foreign sailors in the English mercantile navy, for they were mostly Germans, Swedes, Norwegians, or Danes. They varied, like other men, but his experience was that as a rule they were well-behaved, obedient, and sober. As Englishmen, of course they all liked to see as many as possible of their fellow-countrymen employed, but it did not lie in the mouth of Englishmen to lay down such a doctrine as that, when there was not a country in the world where they did not abound and flourish. Who made railways in Russia, France, and Spain, and were they not always treated with kindness and consideration? Why, then, should they exclude decent, respectable foreigners from employment in this country? The 9th clause pursued the same subject:—"That a serious evil arises from the shipping of foreigners, generally the outcasts of their country, from the amount of disease they introduce on board ship, in spite of the beneficial working of the Contagious Diseases Acts. Your petitioners therefore pray your Honourable House to so legislate that a compulsory medical examination of seamen shall take place, before the crew will be allowed to sail in any ship under the British flag." He could not debate this subject, but he entirely differed from such a statement. The 10th clause stated—"That great abuses have crept into the present system of shipping seamen at the various shipping offices in the United Kingdom, which require the attention of the Legislature, and especially in regard to large companies." That was so delightfully vague that he could not tell what it meant, and therefore would not attempt to answer it. The 11th was as follows:—"That, in the opinion of your petitioners, great abuses do exist by the practice of shipmasters charging interest upon moneys that may be advanced out of seamen's own wages." If such a thing took place it was a scandalous shame, and the ship-master had no right to charge interest; but probably the real point which the memorialists did not understand was this:—When in foreign ports the crew often demanded an advance, and if the captain had to draw money from his agents, he had to pay a commission upon it, and a proportion of this was, of course, deducted from the amount drawn by each man. He should at once discharge any captain whom he discovered charging interest to his men. The 12th and last clause stated—"That the berthing accommodation at present allowed to sailors is altogether insufficient, and in most cases so disgracefully bad as to call for immediate legislation." As he had already said, berthing was never so good as at the present moment, because the crew space was deducted from the net tonnage, if it was passed by the Board of Trade. He hoped he had not improperly criticised a very important document, which fairly demanded the attentive consideration of the shipowning interest. He had already admitted there was a serious falling off in the quality of our sailors, though he did not admit it to the wholesale extent which had been asserted. He would now venture an opinion as to the cause of this deterioration. No doubt the abandonment of compulsory apprenticeship, coupled with the large increase in steam-vessels, was the primary cause. Sailing vessels required a larger amount of seamanship for their navigation than steamers, which afforded remunerative employment for skilled seamen, but did not create them. Again, the large increase of British tonnage since the late war in the United States caused a demand in excess of the supply of properly qualified men, and the owner or master is too often only glad to complete his crew by accepting almost any man who chooses to represent himself as a seaman, and the result was often disastrous. A man had been known to ship as A.B. who had never made a voyage as a sailor; perhaps he had crossed the Atlantic as a steerage passenger, and not finding employment readily on land shipped himself as A.B. in the port of London. He believed, too, that over-legislation had done much to destroy the individuality and self-reliance of the sailor. He was now coddled and fenced round with so-called safeguards and protection, as if he was a big baby, unable to comprehend or protect his own interests, the result being that he took no trouble to make needful inquiries. Twenty-five years ago, the sailor in want of employment went round the docks, inspected the shipping, made inquiries as to master or owner, and when he saw a ship to his liking, he stepped aft and offered his services. Now, as a rule, a man barely saw his ship till she was about to leave the dock. They attended the shipping offices "like sheep in a pen;" and when his resources were exhausted a man accepted any employment in which good pay and large advance notes were offered, utterly indifferent either to the quality of the ship or character of the master. He had been assured that the inducement of two months' advance would ensure a crew to the most worthless craft in existence, in preference to an A 1 ship without such a bribe. These legislative provisions, forms, and official red-tape, induced suspicion on the part of poor Jack against the owner, and an attitude of antagonism was the result. Again, he believed nothing disgusted a respectable seaman so much as being associated with the disreputable impostors he had alluded to, who, while drawing the pay of A.B., proved incompetent at sea, shirked their work, and thus threw extra labour on the competent men. Another mischief which resulted was this, that these impostors drew the same pay as the good men. It was impossible in a ship's articles to make a distinction of wage between men of the same grade, so that, unless a man were utterly incompetent, and the master took the trouble to carry the provisions of the law into effect and disrate him, he reaped the same remuneration as the man who was worth twice or three times as much. As to the remedy, it was impossible to alter things in a hurry, but the first thing to do was to raise the moral tone and the educational position of the classes from which sailors were drawn. He had no belief in arbitrary attempts to make people good, wise, or clever by Act of Parliament. Next, they should establish a system, not of compulsory but of optional apprenticeship. The idea he put before the Royal Commissioners was simply this, that a sailor could not be produced at a moment's notice, he must be taken young, and gradually trained into a seaman. Those vessels which took a certain proportion of apprentices should be free from any contribution towards the expense of training-ships; but if the owner of a steamer, for instance, said he had not space, or it did not suit him to carry apprentices, then he should contribute his quota in money to the supply of sailors. It was only right to look at what had been done for seamen of late years. Berthing was much improved, and scurvy, which was once so prevalent, was scarcely heard of. He had known men hoisted over the side because they were unable to move for this disease. The power

to demand a survey of the ship or provisions he had already referred to; but, above all, the Board of Trade were armed with powers which he considered utterly unconstitutional, and which he did not think any other large class of Englishmen would submit to. They could of their own motion arrest any alleged unseaworthy or overladen ship, and order the cargo to be discharged, and repairs effected, whilst owners sending ships to sea in a state dangerous to life might be prosecuted for misdemeanour and punished by fine and imprisonment. More than one owner had in fact been sent to prison since the passing of that Act, two years ago. He freely acknowledged that there were some owners who were careless, incompetent, and perhaps criminal, and there were ships badly constructed, badly loaded, ill-found, and improperly manned. But out of 26,000 British ships, and a quarter of a million British shipowners, it would be strange indeed if some were not found who failed to discharge their duties in a proper manner. These important questions ought to be discussed with something like calmness and moderation, but the ignorance which existed amongst the public with regard to ships, and even amongst public men who chose to give an opinion upon them, was something marvellous. In the debate on the Merchant Shipping Act last year in the House of Commons, a distinguished lawyer, whose knowledge of shipping was confined, he believed, to the penny boats between the Temple and Westminster, said, to show the recklessness of shipowners and the absolute necessity for restrictive legislation, the Board of Trade returns showed that a steamer left a Welsh port in the winter months laden with iron, leaving only one inch of freeboard. This rather startled some of them, and they sent for the returns, but in the meantime another gentleman rose, and said that was nothing, for he had seen a ship in the Thames, a China ship, with no freeboard at all amidships, which was a-wash for 16 or 18 feet. Of course these gentlemen were loudly applauded, but on inquiry it turned out that the draft of the Welsh ship was indeed just one inch more than the depth of the hold, but the learned gentleman did not know the difference between the internal and external depth, nor did he make any allowance for the keel, frames, and ceiling, and the truth was that this much abused ship left port and carried her cargo safely with 2ft. 3in. of side. The other case was still more remarkable. He could not imagine what kind of ship it could be that had no freeboard, whether one of Queen Elizabeth's old ships with a high forecastle and poop, or a Dutch galliot. On inquiry it appeared that it was a steamer of 99 tons, built especially for towing craft on the Chinese rivers; she had no cargo, but after calling at many ports to coal on her outward voyage she at last reached her destination in safety. This was only one instance of the reckless contempt of facts which often occurred. If people, from philanthropic or other motives, desired to discuss large questions, the best they could do, before attacking the character for humanity of their fellow-subjects, was to make themselves acquainted with the subject, ascertain the facts, and apply something like common sense to them. A word or two in conclusion as to the ships themselves. Captain Pim found fault with the ships for being eight times the length of beam, sometimes ten times, and occasionally eleven, but he did not say whether he referred to sailing vessels or steamers. With regard to the former it was not correct, for they rarely exceeded four or five times the beam. He went on further to speak of four times being the proper length; but another gentleman who followed him, Captain Peacock, rather relieved his mind, because he said he had the best authority in the world for the due proportion, viz., Noah's Ark, whose length was six times the beam, and he had built a vessel on that model which answered admirably. He could only say that, in his opinion, the old style of ship was thoroughly bad; the old builders' tonnage took no account of the depth, and the result was a style of ship so short and heavy that the Americans, who were under no restrictions, were beginning to run away with the carrying trade altogether, when the legislation was altered, and English ships were also built so as to attain a fair speed. At the same time, he quite agreed that some steamers were built much too long. He should not attempt dogmatically to lay down any precise rule, but he should not care to exceed eight or nine times the beam. Some of Captain Pim's strictures were, no doubt, well founded, but he had gone a little beyond the mark in saying that the loss of life amounted to ten or twelve men a day. They lost by far too many, but the number was about three daily. There was a good deal in what he said about the tonnage, but it was quite a mistake to suppose that the present system was in favour of the shipowner. The present mode did show the actual internal measurement, reckoning by hundreds of cubic feet, and it was quite a mistake to suppose that vessels were built unsafe or improperly in order that the owner might benefit by the mode of calculating the tonnage. This question was a most interesting one, especially with regard to the question of the Suez Canal dues, which he could not then enter upon, except to say that what the French objected to was the numerous deductions admitted in the case of steamers in calculating the net tonnage. The present plan was by no means perfect, but, in considering it, it must be borne in mind that there were two things to be taken into account, one the dead weight carried and the other the measurement.

Mr. Rochussen said he feared he was not the worthiest representative of the class of foreign sailors; but in the presence of so many hard words, which, however, he believed had conveyed rather weak arguments, as had been used on the former occasion, he wished to lift up his small voice in pointing out the economical view which bore upon the employment of foreign sailors. He was prepared to grant that the percentage of them in the British mercantile navy amounted to one-fourth, but if that one-fourth were not employed the result would be that one million and a quarter tonnage of British shipping would want employment, since they had heard that the total amount of British shipping was six million tons. But if British shipping were not employed foreign would be, and there would be a tendency in the cargo to follow the flag, and the trade, consequently, would not only be in foreign bottoms, but would gradually be drawn to foreign ports. The vast increase of the British fleet was not accompanied by corresponding increase in British seamen, simply because after all England had no large population to draw upon for the purpose; and there was a cause at work now which did not exist in former days, namely, the large number of yachts which, at the present day, absorbed almost all the very cream of the sailors who were to be had. Again, at the risk of being offensive, he would contend that the Englishman was not already a sailor, with that innate love of the sea which sounded so well in song and romance, for this was not really found in England to the same extent as it was in Holland, Norway, Denmark, and Sweden, where every child as soon as it could toddle, was accustomed, in the ordinary business of life, to handle a boat, and might therefore be said almost to be a born sailor. They must therefore fall back on the excellent remedy suggested by Capt. Pim, namely, training ships, which not only would give them sailors, but that class of sailors which Mr. Norwood had so happily depicted—sailors who had an affection for their ship, who looked upon it as their home, and whose backbone of loyalty was demonstrated all their lives through. As to the question of food and wages, Mr. Norwood had stated the case, and he believed his arguments were unquestionable. A man who got paid at the rate of 18s. and 12s. for his food, with his firing, light, and lodging, was as well paid as any ordinary mechanic with the same qualifications. No doubt there was something to be said in favour of the complaints made about their

lodging, but a great deal would be done to improve that if they could obtain men more like the typical sailor of the olden day, who would take more interest in the forecastle they occupied. Speaking from old recollection he was reminded of vessels who used to ship their crews, not by a pier head jump as it was called, just getting on board a vessel they had not seen, as she was hauling out of dock, and very ill provided with clothing, but men who had shipped on board the vessel a fortnight before she sailed, and who were well acquainted with every part of her. If the forecastle was not properly cleaned, such men would talk to the mate or to the boatswain about it; would borrow a bucket of paint, and in their off watch would put it to rights. Indeed he had seen some very creditable specimens of decorations done in this way by the sailors themselves. During the last few days he had conversed with some of his friends in the city, and asked if they employed any foreigners, and the reply was, in many quarters, that they employed as many as they could get, and they wished they could get them all foreigners. In the case of the Peninsular and Oriental Company, Lascars did the work which could not be so well done by Europeans, and as that great company had a guaranteed dividend of six per cent., it was obvious they did not employ these men from any unworthy motives. Turning to the question of construction of ships, and dealing with the extreme length which had been represented as so dangerous, he thought that the effects of a heavy sea on a long vessel had been slightly over-stated, because it had been represented that a quantity of water coming on board amidships would eventually swamp the vessel. But taking the extreme case of, say, 50 tons of water thrown on the deck, the consequence would be the ship would be depressed, and consequently would have a different displacement; every fifty tons down on the deck was fifty tons of water below the hull of the vessel, and consequently, it had practically no effect, except that the two ends were not properly supported. That brought him to another point; in old days such a structure would be far more dangerous than now, because modern builders had in iron a material which could be used to strengthen the upper deck as far as the emergency required. Here, however, he showed that the quality of material put into ships was not always so good as the guarantee of Lloyd's rules would lead one to believe. There were rules as to the strength of material in the direction of the grain and across the grain, but they ignored altogether the ductility which the materials should possess; a certain breaking strain was exacted, but nothing was said as to elasticity. Another important point was that these rules laid down by Lloyd's and insurance associations did not touch upon spars, though it was a notorious fact that the amount of dismasting in modern ships was something enormous.

Mr. C. W. Merrifield, F.R.S., said no one could appreciate more highly than himself the value of such a paper as that read by Captain Pim, but as time was limited he must be excused if he came at once to those points on which he differed from him. One thing which struck him most markedly was the excessive attention given to the supposed superiority of old times over the present, that *laus temporis acti* of which Horace had spoken. He however, required evidence to show that seamen had ever been on the whole better than they were now. As regards ships he knew it was not the case. He had followed very closely the history of the construction of merchant shipping, and on the whole he would venture to say, our ships now did their duty better than those of former days. Captain Pim had said, "In those days, if a ship were substantially rigged, fairly fitted out, ably handled, and constructed without reference to builders tonnage"—but how many ifs were there in that sentence? —"our ships were ready to face, and well qualified to surmount whatever weather they might encounter withou straining a rope-yarn." He did not know much about rope yarn, which was in the boatswain's department, not in that of the naval architect, but he did know, as a matter of fact, that they often strained seams, and not unfrequently started a butt; and he had a terrible case present to his mind in which a large East Indian convoy, accompanied and escorted by men of war—eleven first class ships all went down in the Bay of Biscay, simply by being exposed to a succession of severe gales. They could not expect anything worse, even in these days of long, unseaworthy ships and bad iron. No doubt there was bad iron, but it had been caused by the same circumstance which caused the complaint of seamanship, namely, that we had recently been obliged to double and treble the quantity which could reasonably be produced of good quality. As to the tonnage question he was very glad to see that it had been gone into, and that Captain Pim had realised the rudimentary principles both of tare as applied to ships, and of displacement. There was no doubt of the direct application of the two principles, in the general form which he had suggested, that the proper quantity to charge was the difference between the light and the load displacement, but a rudimentary general principle was not of much use except in its application; and on this point, after giving a great deal of attention to it, it seemed to him to be a very difficult question. And so with the Committee of the House of Commons before which he gave evidence last session, which was largely composed of shipowners. They thought it very difficult, and judging by the Bill presented to the Committee by the Board of Trade he should think that Board also found it a very difficult matter. Therefore he did not know whether he ought to set it down to unusual knowledge on the part of Captain Pim, or to the want of studying the literature of the subject, that he found it so easy a matter. If it were possible, without any doubt or hesitation, dealing with a considerable sprinkling of rogues amongst some honest men, to say in all cases what the light line was, and what was the load line, there could then be no difficulty about the matter, but to do that it required that everybody should possess common sense and honesty. With regard to the load line, he should not like to fix that in any particular case, except for a given ship with a given cargo, and when he came to the light line he was entirely at a loss to know what it was. If you had an empty wooden hull you might take her launch line as a certain light line; but when you got beyond that, or when you had the liberty to play tricks with it, by hauling anchors and equipment, and various things of that kind, on board, how was it to be defined? And if you took a vessel with her engines, boilers, and all that kind of thing, filling the boilers with water alone would make several tons difference, to say nothing of the question of coals, although that presented an additional difficulty. If a vessel were built for a light trade she might be built heavy, but if she were built for a heavy trade she might be built light, on the calculation that she would come down to her weights. But, then, supposing a light-built vessel to be employed in the tea trade, or something of that sort, was the kentledge to be considered as part of the light loading or as part of the burthen? It would easily be seen how much opening for fraud was involved in all those questions. They were all agreed pretty much on the broad principle, but the whole question was one of detail, and these details were not easily provided for; in fact, it was on this question of detail that all attempts had hitherto broken down. Mr. Moorsom did not find it so easy a qestion, although he had directed half his life to it; and as the result of his inquiries, the best thing he could suggest was, to take the whole internal capacity of a sailing vessel in which cargo could possibly be carried, and in the case of paddle-wheel steamers excepting the engine-room, which could not be used for the purpose of carrying cargo. Then there came one exemption after the other, following the old system of tare, the rule being to charge for goods only that either were actually carried, or, to pre-

vent fraud, the goods that might possibly be carried, the usual mercantile plan in the case of excessive tare being to charge for the gross weight. That, as he understood, was what M. de Lesseps wished to do. Having had an opportunity of perusing his letter, he understood him not to agree with Capt. Pim exactly as to the mode he proposed for levying tonnage, but in his idea that the present system was unjust, his principal object being to get the dues levied on the gross tonnage, not on the tonnage after deduction had been made for engine space, crew space, and so on. As to the failure of ships in general, he would not attempt to trench on the ground which would have to be occupied by the Bill which was shortly coming before Parliament, or which was covered by the Commission of which he had had the honour to be a member; but he did think that shipowners in this country had been in some respects unjustly charged. Generally speaking, ships were good, but there were bad classes amongst them. Generally speaking, there were good ship-owners, who took care of their ships and of their seamen, because they understood their value, but there was a good deal of ignorant ship-owning, many persons owning shares in ships in the same way as they did in railways, as a mere investment, not knowing anything about the work, and these people made bad ship-owners. But there was another important cause for the loss of ships, and that was the ignorance which prevailed in draftsmen's offices and ship-building yards to a much greater extent than was supposed, of the proper distribution of the strength of material in ships. There was not sufficient education in this matter, even amongst men who made ship-building an occupation, and they ought therefore to be ready to spend any amount of money necessary in the draftsman's office to secure men who thoroughly understood their profession, and who could not only lay off a frame or a longitudinal, but who understood the distribution of the strains of a ship. As a consequence of this ignorance it not unfrequently happened that a ship which had been *bonâ-fide* attempted to be strengthened, had been really made worse than she was before, by the material being put in the wrong place; and he was sorry to say there was no one respect in which knowledge was less diffused in this country than in the consideration of the longitudinal stress of a ship considered as a girder, and of the way in which iron ought to be put into that ship to meet the stress. If, therefore, there was one piece of advice more than another which he would give to ship-owners and builders, it was this, to spare no expense in the draftsman's office in securing men who would really see that every stress was calculated, and every bit of material needed to meet that stress provided accordingly.

Mr. J. Scott Russell, F.R.S., said he highly appreciated the privilege of addressing his old friends of 35 years ago of the Society of Arts, and could not but congratulate the Society on having so important a subject now under discussion, for if there was one art of greater importance to England than another it was the art of creating a navy and of utilising it; and if there were anything more intimately connected with the diffusion of manufactures and commerce than another it was the English mercantile navy. He thought they could not do better than follow the advice of Mr. Norwood, and try to treat this question calmly, putting aside all prejudice, class-feeling, and political party views, and considering it only for the common good. He was glad to see in the Queen's Speech a communication to her Majesty's Ministry and the Legislature to study this question and take it in hand. For his own part he considered it was an additional reason why they should fully discuss the question there, and express their opinions as to what was wise legislation and what was foolish. He had watched and taken some part in legislation on this question during the whole of his life, and his experience had been that legislation had done infinite harm to the shipping interest, and had also corrected that evil and done immense good. It had done harm in this way. Some persons wanted a law saying how many lengths should be legal, and how many illegal, but all such legislation would be prejudicial. One of the most ruinous laws ever enacted was the law saying what breadth a ship should be made of, and what tonnage; because it compelled builders under enormous penalties to build crank, top-heavy, unseaworthy ships. When he was a boy, one of the most eminent ship-builders he knew built a ship so crank that it nearly broke his heart, for she went four times a week past his house, and twice a week did she lie on the starboard side, without moving, and twice a week on the port side. She was built by Act of Parliament, and that was the result. From that time he joined his friends in endeavouring to get that Act of Parliament repealed, and after some twenty years they succeeded, and got Mr. Moorsom's system of measurement introduced. That was the grandest legislative measure ever passed in the shipping interest, because it had emancipated builders from all the trammels which had been thrown around them by legislation, and left them to build the best possible sea-going, money-earning ships they could advise, without the interference of Parliament. His view was that, the shipbuilder should be responsible for the sea-going qualities of the ship, and for every element in her construction, and if she turned out a bad one let him be punished; and if from unseaworthiness she drowned her crew let him be prosecuted. If the builder culpably built a bad ship when he was honestly paid for a good one, and that bad ship had taken good sailors and a good captain to the bottom, that man ought to be accused of a crime, and he should like to see one of the old-fashioned gibbets, such as those on which he used to see the skeletons of pirates hanging in old days, and if any ship was lost through the culpability of the builder, he should like to see him hang on that gibbet. That would be good legislation, and he wished the Board of Trade had courage to make it. If a ship-builder built for any money, or for any customer, an unseaworthy ship, which by its unseaworthiness caused loss of life, let him be summoned as a culprit by a public prosecutor, and let full justice be done upon him. On the other hand, if you wanted a good ship, you should go to a good, honest ship-builder; and he did not believe any Act of Parliament would convert a dishonest, ignorant ship-builder into an honest man. He entirely agreed with Mr. Norwood, that great wrong had been done to ship-owners in much that had been said. There were good honourable ship-owners, masters of their business; the old merchant-ship-owner was as noble a man as you could meet with, but at the same time there were ignorant, reckless, selfish ship-owners, and he wished Mr. Norwood's statement were true that these were very few in number. But when he saw bad ships ordered at cheap prices, and when so made to order deliberately lost after a few years, after being well insured, there was no shutting our eyes to the facts. These two classes existed, and the question for the Legislature to consider and settle was what could they do, having regard to the one class, which he hoped outnumbered the other, and to the other class, which was rather numerous. An honest, intelligent, experienced ship-owner did not require any legislation at all, and he was glad to say that they found out that honesty was the best policy, and he could tell them how honest ship-owners made their fortunes. They did so by first becoming thorough masters of their business, by managing one little ship, and when she had made them money and character adding a second and larger one, and then a third, and so on. They ordered ships of the honestest builder they could find, and gave them such a price as they could build a ship for, of which they might be proud; they trained their own captains, and took the greatest care of their own men; when they found ou[illegible]

good sailor nothing would part them from him. It was not customary then to go into the market and buy sailors from middle-men, as was done now. They grew their own sailors, and took care of their wives and families, and looked after their interests when they were absent, and welcomed them when they came home again. With regard to legislation, it was most desirable that as much as possible of that little petty meddling of the Board of Trade should be done away with. Wherever the Board interfered between any of the persons concerned in a ship and their own business they made a great mistake. It was only necessary for the good shipping of this country to be well managed that the Board of Trade should cease to meddle and muddle. But at the same time, he was not at all speaking against the question of Government legislation on certain matters. It had to legislate on land, therefore it must do so on the water, in order to protect the lives and well-being of the people. Considering the important part which seamen played in our commerce it was the duty of Government, in his opinion, to train and educate sailors, to train them so that they might be a body of men to protect the country and her citizens everywhere, and so to arrange matters that the whole of the sailors of the mercantile fleet should be available in the war-fleet if war broke out, and that when war was over the whole of the sailors in the war fleet should be placed at the disposal of the commerce of the country. In these points Government ought to interfere, and if it only considered the interests of the people it would do do.

Captain Toynbee moved the adjournment of the discussion to Tuesday week, which was seconded by **Mr. Glover**, and carried unanimously.

The following is the communication from M. de Lesseps referred to by the Secretary:—

Paris, le 4 Février, 1875.

Monsieur le Président,—J'ai lu, dans le numéro du 29 Janvier du *Journal de la Société des Arts*, le rapport de l'honorable Capitaine Bedford Pim sur la marine marchande de l'Angleterre. J'ai vu rarement exposer avec plus de clarté l'importance de la question du tonnage des navires, et la nécessité de supprimer partout les lois actuelles de jaugeage officiel, toutes entachées d'arbitraire, toutes favorisant la fraude, toutes "injustes et oppressives" suivant l'expression même de l'honorable Capitaine Pim.

La formule du rapporteur est la seule exacte—comme lui, je n'ai cessé de dire que "le *tonnage réel* d'un navire est *simplement le nombre de tonnes de poids que le navire est capable de porter avec sécurité*." Or, passent fréquemment par le canal de Suez des navires portant réellement effectivement jusqu'à 20 pour cent. de plus que leur gross-tonnage.

Lorsque je décidai que les navires passant le canal de Suez paieraient les taxes d'après leur réelle capacité utilisable, et non d'après le tonnage mensonger de leurs papiers officiels de bord, et lorsque j'ajoutai que cette taxation serait basée sur le gross-tonnage des navires, ce gross-tonnage étant celui qui s'approchait le plus de la réelle faculté de transport des steamers,—non-seulement je rentrais dans l'exécution stricte de mon contrat de concession, mais encore je faisais un acte de justice avantageux à la marine marchande britannique.

En effet, à l'époque où je percevais mes taxes d'après le tonnage officiel des papiers de bord, et depuis que le gouvernement britannique m'a fait imposer par la force une taxation nouvelle basée sur le seul tonnage officiel net des navires, je n'ai cessé et je ne cesse de constater des fraudes scandaleuses dans l'inscription du tonnage. Chaque jour m'apporte une preuve nouvelle de cette vérité; que la perception des taxes maritimes sur le gross-tonnage des navires est la seule, juste, équitable, et surtout égale pour tous. Asseoir les taxes sur le tonnage net des navires, c'est créer une loi qui appelle immédiatement la fraude.

Quand la compagnie du canal de Suez percevait ses taxes sur le gross-tonnage, aucune fraude n'était possible. La perception était loyalement égale pour tous. Tous les navires étaient soumis a un même tonnage—Subissant la violation armée de mon contrat, j'ai subi, en protestant, le nouveau tonnage officiel, lequel devait diminuer mes recettes de 20 pour cent. en moyenne. Il est arrivé dans le pratique, que les navires d'Etat payent, pour passer le canal, 30 pour cent. des moins qu'ils ne payaient que les paquebots-poste des Messageries Maritimes de France et de la compagnie Peninsulaire et Orientale d'Angleterre payent 20 pour cent. de moins qu'ils ne payaient—tandis que les vapeurs de commerce libres non-subventionnés, ne payent que 5 à 6 pour cent. de moins—et encore certains de ces vapeurs de commerce payent-ils plus qu'ils ne payaient avant. C'est l'inévitable resultat d'une perception basée sur le tonnage net des navires.

La marine marchande britannique a, pour ainsi dire, actuellement le monopole du trafic qui s'effectue par le canal maritime de Suez. Mais je sais que les ports autrichiens, italiens, allemands, et surtout américains se préparent à établir des lignes concurrentes. Je pourrai vous citer des vapeurs étrangers faisant concurrence au pavillon anglais et qui, à l'époque où je percevais provisoirement mes taxes sur le net tonnage, avaient des papiers officiels ne donnant pas le *quart* du tonnage vrai. Les américains, qui jadis ont inauguré le système des faux tonnages, mesure déloyale à laquelle nous devons les tonnages mensongers actuels—ne seront-ils pas tentés d'appliquer la même mesure protectrice? Comment pourrais je vérifier et rétablir suffisamment le tonnage net d'un vapeur se présentant pour passer, en pleine charge, le canal? Avec le gross-tonnage, nulle difficulté, nulle perte de temps.

Au canal de Suez comme dans les docks d'Angleterre les navires doivent payer les taxes proportionnellement au service rendu, et les directeurs des docks, comme les propriétaires du canal de Suez, devraient taxer la véritable capacité de transport du navire, sans rechercher comment l'armateur a utilisé cette capacité.

Cela seul est juste, cela seul est équitable, cela seul sera un jour. Une loi a pu donner le caractère officiel à un mensonge, ce mensonge n'en est pas devenu pour cela un vérité. On a pu, par un coup de force en Egypte, violer mon contrat de concession, m'imposer un tonnage nouveau arbitraire, absurde, ridicule; on a pu ainsi refuser aux créatures du canal le minime intérêt dû au capital énorme qu'ils ont chevaleresquement engagé dans l'entreprise; on a pu, enfin, m'empêcher de continuer les travaux d'amélioration du canal que j'avais libéralement entrepris dans l'intérêt exclusif de la marine commerciale; mais on n'a pas pu déchirer mon contrat qui subsiste, ni détruire mon droit qui demeure entier. Il y a deux vérités certaines dont le triomphe n'est par douteux pour moi simplement parcequ'elles sont des vérités. La première c'est que le tonnage d'un navire ne peut pas être autre chose que "l'expression de sa réele capacité de transport." La seconde, c'est que l'act de concession, sur la foi duquel les actionnaires du canal de Suez ont exécuté leur œuvre, veut que les taxes du transit soient perçues sur la *capacité vraie des batiments*, et non sur le tonnage officiel faux—cette "fraude légale" suivant l'expression du *Moniteur français de la flotte*.

Je n'ai pas été surpris de trouver dans le recueil de la Société des Arts le rapport de l'honorable Capitaine Bedford Pim avec qui je me trouve, je le vois, en complet accord d'appreciation des tonnages officiels. La Société des Arts—je ne l'ai pas oublié—eut un jour l'occasion de témoigner de sa sympathie pour l'œuvre du percement de l'isthme, et Son Altesse Royale le Prince de Galles son Président, me fit l'honneur de me remettre une médaille qui m'est un précieux souvenir; j'étais donc certain de voir encore cette Société à côté de moi au

moment où mes associés sont la victime d'un acte de spoliation injustifiable, eux qui ont rempli leur mandat avec tant d'abnégation, de persévérance, et de dévouement, au grand profit de la navigation universelle et surtout de la marine britannique.

Veuillez agréer, Monsieur le Président, l'assurance de ma haute considération.

FERDINAND DE LESSEPS.

Monsieur le Président de la Société des Arts de Londres.

AFRICAN SECTION.

A meeting of this Section was held on Tuesday evening last, the Rev. HORACE WALLER in the chair.

The paper read was—

REMARKS ON THE GENERAL DESCRIPTION OF THE TRADE ON THE WEST COAST OF AFRICA.

By William Babington,

Late of the Bight of Biafra.

In order to give as good a general idea of the West Coast of Africa and its commerce as I am able to do within the limits of this paper, I will ask each of my hearers to imagine himself making the voyage with me to the different ports at which the West African steamers touch. When, in following the line of coast, we arrive at a port at which the steamer does not touch, I will speak of what I know of that from my own experiences, or from sources the authority of which I can vouch for. Let us suppose that we have taken our passage—say in June—in one of the fine vessels that leave Liverpool. In four days from the date of starting we find ourselves at Madeira. I have no time to say much of this beautiful island, so well known and so well described by hundreds of able pens.

The general appearance, as far as outline is concerned, was well hit off by Columbus, who, in reply to the question of Queen Isabella, crumpling a sheet of writing paper in his hand, placed it upon the table, and thus produced a fair model of it, and indeed of any one of the neighbouring islands, the Canary, and the Cape de Verds, all of volcanic origin.

Having finished our coaling, we proceed to Teneriffe, whose peak we see for one moment, the next it is engulfed in a vast mass of clouds. Numerous date palms and dromedaries demonstrate the fact that we have here reached the verge of the north temperate zone, and we find it hot enough for the torrid zone. We are soon off again, and within a few days more we get into a hazier atmosphere. Despite of awning, we find the heat harder to bear. A few days later we skirt the edge of the Arguin bank. On this bank, about eighty years since, occurred the wreck of the French frigate *Medusa*. The pathetic picture in the Louvre of the shipwrecked crew upon a raft is, perhaps, known to some of my hearers.

Our attention is next directed to two or three little hummocks; we are told they are Cape Verde. The sea as we approach the coast has lost its beautiful blue; the air has become heavy and oppressive. At a few miles distance we pass the French settlement of Goree, captured from the Dutch in the early part of the last century. Even to us it appears a hot and forlorn-looking place; nor does the reality belie the aspect it presents to the voyager. It is an outlying picket to the French colony of Senegal.

Soon afterwards we anchor for the night off the bar of the river Gambia. In the morning a pilot takes us up to the English settlement of Bathurst. We are now, for the first time, in an African river—a broad, turgid stream, flowing between low banks fringed with mangroves. The town of Bathurst is situated on a dead flat, and is surrounded by marshes. We at once realise all we have heard of its unhealthiness. A visit to the shore does not remove our impressions. Drainage is bad, and the hospital, though well built and airy, is so situated that no untainted sea breeze can reach it. In the market we find a small assortment of native produce and European goods—kola-nuts (bitter and pungent in taste, but in great request here among the natives), various kinds of edible seeds and grain, leaf tobacco, cotton cloths (of native as well as foreign manufacture), salt, and native saltpetre, used for adulterating snuff, of which they consume enormous quantities. The natives themselves are, however, the greatest attraction. Tall, wiry, and straight, with the free and independent gait of the Arab, they have little of the typical negro about them but the colour. Their dress is of an Arab character. A long white cloth surrounds the body, one end being thrown over the left shoulder; a white turban, leathern sandals, and a scarf, in which is slung a short sword or dagger, complete the costume. All, also, are hung around with innumerable little leather sachets, understood to contain verses of the Koran, and worn as charms to arrest future evil, or to bring present good fortune. They profess Mohammedanism, but it is a strange mixture of Paganism and Islamism. There are three races or tribes—Fulahs, Mandingoes, and Jolofs. These last are the handsomest negroes on the coast; their form is tall and graceful, and their skin is a glossy black; their lips are thick, and their hair is woolly.

Fulahs, or Felattas, and Mandingoes, are African Arabs. They are better informed than the others in their religion, teaching it from the Arabic Koran. We sometimes hear of Mumbo Jumbo in this country. He is generally supposed to be some kind of African god; in reality, he is an institution of the Mandingoes. He is the terror of African women, for whose especial benefit and discipline he has been established. A strong, athletic man, dressed from head to foot in dry plantain leaves, appears when invoked by an injured husband. He goes through all sorts of antics and pantomime among the assembled villagers, all of whom are there under pain of suspicion. Suddenly he pounces, like a tiger, upon the offending wife, and thrashes her severely with a long rod with which he is armed. The crowd, especially the women in it, drown her cries with jeers and laughs. This is Mumbo Jumbo. In other parts of Africa a similar domestic policeman exists. The Mandingoes are a better-disposed and more moral people than any other of the African tribes. They have some respect for truth, and reverence old age.

The Fulahs, or Felattas, are the most numerous and the dominant race. They prevail throughout Senegambia, and as far as Sierra Leone, while they extend to Soudan in the interior. They are of

medium height; they have slight but well-knit figures; their hair is soft and curly; they have good foreheads and noses, and their complexion is a brownish-black. They cultivate the land zealously, but in some places lead a nomadic life. They are shrewd and cunning in trade, but inferior in character to the Mandingoes.

The staple export trade of the Gambia is the ground-nut, called in America the pea-nut; many thousand tons are exported annually. The largest portion is carried to France, where it is converted into the best olive oil.

The Gambia is navigable for 223 miles. At that distance from the mouth we have another settlement on McCarthy's Island. Few Europeans who sojourn there, for even a short time, can do so without a bad attack of fever, yet the necessities of trade compel men to go there. I presume that the trade of the Gambia is profitable to those Englishmen engaged in it, as annexation of the settlement to France, in exchange for another port, was vehemently opposed of late. We are off again. The deck of the steamer is encumbered with men and women returning to Sierra Leone, with the product of their trade in kola-nuts. We observe the well-fed look of our newly-arrived passengers—the Sierra Leone women—and attribute to this cause the good humour with which they endure the somewhat unceremonious treatment they receive from the crew. The line of coast, until we approach Sierra Leone, is flat and uninteresting; but as we near this settlement we are much struck with its picturesque appearance. A mountain range, 3,000 feet high, slopes gradually to the great River Roquelle on the east, and to the Atlantic on the west. Like all volcanic ranges it is irregular, and abounds in craggy peaks and ravines, down some of which rush torrents of water, that gladden the eye of the thirsty man, and suggest invigorating baths. Villages dot the slopes at intervals, breaking the monotony of the dark vegetation and the reddish grey of the rocky heights. Such is the appearance of the settlement at a distance. A nearer approach to the town (Free Town) dispels the enchantment. One is impressed at once with the conviction that laziness and improvidence are all-pervading, and such is the fact, as a rule. We see large and expensive stores, half finished, and rapidly-decaying; others seeming to languish for paint and whitewash; all slovenly and uncared for. We land at a wooden pier or wharf, which is thronged by a crowd of disreputable darkies, clothed in odds and ends of all kinds of dress—a regiment after Falstaff's own heart. In the main streets we find every fifth house a grog-shop, and nearly all the rest, shops of some kind or other, excepting, of course, the large mercantile establishments, in which are to be found every article of import or export required or produced by the colony. In the yards of some of these stores we see coopers and carpenters making a pretence of working, a general air of "I'm as good as you, or rather better" about them. In the merchants' warehouses we find piles of ground-nuts, palm kernels (not well cleaned), ginger, cayenne pepper, gum (of inferior quality), hides (well poisoned to protect them from vermin). These hides are of very fine grain, and are much in request in America, where it is said they split them (as they did the bank-notes some time ago), and make the best Parisian boots of them), a little ivory, and a few samples of dye woods. Palm oil of an inferior quality we find in the yards, leaking out of badly-coopered casks. In the stores we find bales of Manchester cottons, Sheffield cutlery, Wolverhampton ironmongery, Birmingham guns, beads from Bevis-Marks, rum from the Leeward Islands, Geneva from Holland, wines and cordials from Hamburg. In the retail shops attached to the stores we are amused to see last year's fashions in ladies' dresses, and patent leather boots for gents. These things sell well, as anyone can infer if he has spent a Sunday in the colony. On that day, one sees paterfamilias in tight black clothes, chimney-pot hat, and sticking-plaster boots, uncomfortable evidently, but very self-satisfied. And his spouse Dinah, very voluminous, and in very highly-starched muslin, open-work stockings, a red and yellow bandanna round her wool, accompanied by Anna Maria Macaulay, and William Wilberforce Macaulay, their children, small copies of their parents. They are all going to Lady Huntingdon's chapel, or to some other Nonconformist establishment, in which praying and preaching of a very sensational character take place, but from which pomps and vanities are not excluded.

It is to be regretted that trade with the colonists as well as with the aborigines cannot be conducted on a large scale on purely ready-money principles.

Credit-giving is as much a bane to the African as credit-giving is ruinous to the European merchant. I am, of course, speaking generally, but the same remark applies to the whole West Coast trade. Every colonist wants to have something to buy and sell; handicrafts he despises, and regular employment, except as a clerk in a store, he will rarely take. In the latter capacity he will engage himself for little or no wages. But why? In the course of a year or two, his employer finds that the youth who came to him with nothing but what he stood upright in, has married a wife, and furnished a house, perhaps also opened a shop. Stock is taken, and embezzlement proved. The fellow gets two years in the chain-gang, but the person robbed rarely gets back his goods, while at the expiration of the sentence, the ex-convict will meet his former master with an unabashed face, and, if not recognised kindly, will think that he has less Christian charity about him than he the convict has, for he forgives his former master. Among people of such character, the difficulties of commerce are greatly increased.

The trade in African teak, though the timber exists in abundance, has long been a thing of the past. The exports of the colony, including Sherbro', amount to about 500,000 dols. per annum, but the profit accruing to merchants is not at all in proportion to it, owing to excessive duties and bad debts.

The steamer's anchor is weighed, and distance from it, as we proceed eastward, again lends beauty to the settlement. We pass Cape Mount, near the river Gallinas. This place is noted as having been the head-quarters of Canot, the slave-trader, and because the Veys, a people who live in the vicinity, have, within the last thirty-six years, invented a written language, with an alphabet of about thirty letters.

We now anchor off Monrovia, the capital of Liberia. The appearance, as viewed from the sea, is pleasing. The town is built upon a bluff of volcanic rock. A considerable river irrigates the land, and gives access to the farms and plantations which lie upon its banks for many miles. We land in the mail-boat, and are at once struck with the imitation of American institutions. Every one "guesses" and "calculates." We enter the Court-house, a well-built building of brick and stone, and listen to a black barrister declaiming, in a nasal twang, against a decision in a lower court. We are amused, but we cannot stop long. These Republicans are very fond of a handle to their names. Judge this, the Honourable that, General, Colonel, &c. Indeed they extend these titles to the wives of these dignitaries. We see men doing real work; masons, joiners, and boat-builders; they do it well, especially the boat-building.

The import duties are high, especially those on spirits, the object being to discourage drunkenness and small trading, to which, as I said before, every African has a bias. The imposition of these heavy duties does not operate effectually in diminishing the demand for luxuries, either of food and drink, or of dress. Many of the settlers who have squatted inland, have relapsed into barbarian habits, including that of polygamy, But what, indeed, could one expect from ignorant creatures, suddenly become their own masters, and finding themselves in a country where the actual necessaries of life—such as African life is—can be had without trouble or expense; a country where clothing is hardly necessary, and where a few palm-leaves plaited together give sufficient shelter, and form a tolerable domicile.

Liberia, and its loan negotiated in England, were much before the public about 18 or 20 months ago. I hope none of my hearers were deluded into contributing to it. The revenue of the whole of the colony is insufficient to pay the interest—at 6 per cent.—upon £100,000, supposing every officer and employé to work for nothing, an act of self-abnegation which they are incapable of. As to repayment of the principal, that might have been done in "Pennsylvanian bonds."

The following extract from a newspaper is apposite to this subject :—

"Liberia is at present a very, very poor, and insignificant country, with nothing to entitle her rulers and other officials to public breakfasts, dinners, and balls in England. Liberia will never be raised to eminence as a State by demoralising festivities to its public servants, who cannot have any possible claim to such so-called British demonstrations. What Liberia wants is Spartan simplicity—Spartan virtues—hard work—self-denial; and not the corrupting influence or the luxurious excesses of our highly-developed wealth and civilisation."

I do not undervalue the intentions of those who colonised Liberia. Far from it. The scheme was a wise and good one in theory; but that scheme has not succeeded as its promoters anticipated, and I fear that the decadence will increase rather than decrease. One cause, probably, is that since the emancipation of the slaves in the Southern States of America no fresh blood has been imported, and the children of the old settlers are neither energetic nor in any respect ambitious beyond the gratification of their immediate wants.

There are one or two agents of English mercantile houses at Monrovia and Grand Bassa, who buy cam-wood (a good dye-wood, varying a great deal in value), palm oil, palm kernels, gum copal, Malaguetta pepper, and a little coffee, which is of good quality. The currency is ostensibly the dollar, but the trade is virtually conducted on the barter system; that is to say, if produce is valued at so many dollars per ton, the merchant puts a dollar value upon his dry goods, hardware, &c., proportionately, no dollars changing hands in the transaction.

The Liberians possess no good port; their rivers have all of them bars, dangerous at times both to life and property. They claim a great deal of land along the coast, extending from Monrovia to Bereby, and to various distances inland. Their title to all this land is not indisputable; many of the aboriginal tribes ignore it.

The coast from Cape Mesurado to a few miles beyond Cape Palmas has been called the Grain Coast. It is not so named because it produces an abundance of corn, but because Guinea grain, or Malaguetta pepper, sometimes called "grains of paradise," and used for adulterating beer and spirits, is found there.

We proceed on, our voyage. In sight now is the high land of Cape Palmas, crowned with groves of palms. Afloat on the sea are innumerable canoes, most of them little cockle shells containing only three or four men and boys. Cape Palmas is the great fair for hiring labour. The anchor is no sooner dropped than the deck swarms with hundreds of nude and noisy forms in search of former masters, agents, and super-cargoes, on their way to the great oil rivers. Many hundreds of these men, universally known as Krumen, engage themselves during the year to serve as labourers or coolies, for different periods of service, ranging from one year to two or three. They are very valuable. In fact, trade on the coast could not be carried on without them. They are strong, enduring, active, docile, and fairly intelligent. Their power of endurance is something marvellous. I have known them to pull in a boat thirty miles without food, and be tolerably fresh afterwards. They must be watched, however, as they are both thieves and receivers of stolen goods. They differ essentially from all other natives on the coast. In form athletic, they have receding foreheads, and pointed heads, on which the wool is arranged in every variety of African coiffure. One man's head is so shaved in parts that it resembles a piece of allotment ground; another has a great mop of fuzzed-out wool on one side of his head, with nothing to balance it on the other side; while on a third the hair is plaited into almost as many small tails as the beard of the Nineveh bull in the Crystal Palace, and so on. One is struck also by the blue line tattooed down the forehead and the bridge of the nose. This is a distinguishing mark of the race. Their front teeth also are filed to a point, by no means improving their appearance. They live almost entirely upon rice, and tire very soon of any other kind of food. They boil the rice very dry. Their mode of eating it is peculiar. The iron pot containing the rice, hot from the fire, is placed in the centre of a ring of men, who squat upon their hams round it; each takes out a handful of the scalding contents, squeezes it into a ball, tossing it from hand to hand until cooled sufficiently, when it is tossed into the mouth, or

apparently half way down the throat. This operation is repeated until the pot is emptied, when a quart or so of water concludes the banquet.

There is very little domestic slavery among the Krumen, but the subjection of juniors to seniors is remarkable. A chief, or head-man, acquires his ascendancy, not by birth, but by strength of body, force of character, and by success in life. He must have made many voyages, and amassed property in wives, bullocks, and other forms of wealth. And this he is not allowed to do in a hurry. For instance, if a young man who has not made more than two or three voyages is discovered to have boxes of cloth, &c., in his hut, a raid is organised upon him by his fellow villagers, and all his property is seized and confiscated *pro bono publico.* When I have remonstrated with some of them who have suffered, upon the excessive arbitrariness of this communistic proceeding, I have been met by the reply that, "It be we country fash" (It is our country fashion). Also that, "it keep man from getting too sass" (it keeps a man from getting too saucy). And then they would add, laughing, "We shall do the same for another man." It is only when a man, by steady success, is supposed to have acquired a prescriptive right to property that he is allowed to enjoy it undisturbed. A head-man, who has made several voyages and possesses testimonials from former employers, introduces himself to a captain or agent who requires men, and, if approved of, sets to work at once to select his gang. The agent takes out his note-book to put down the names and terms on which each man is engaged, and the muster begins. What is your name?—Tom Bottle of Beer! Very good, Tom is your name. What is yours?—Jack Bottle of Beer. Oh, that's too much beer. Your name is Jack; and so on. The native names are euphonious enough, but the European cannot get his tongue round them; in addition to which there is a terminal O! to every word uttered in their tongue, which does not suit an Englishman's notion of brief and decisive speech. After receiving a month's advance, in goods generally, the newly-engaged men must be watched, confined below if possible, as they are apt to levant, as some of our English sailors do sometimes. In one important point the Kruman can not be trusted. In case of dispute or collision with the natives on another part of the coast his assistance must not be relied on. He is a coward on principle; he has "only one life, and that he wants to take home with him."

Cape Palmas and the neighbouring villages constituted till within 15 years the Republic of Maryland. It was then compelled to annex itself to Liberia to preserve its existence, at that time seriously threatened by the Krumen, whom they had provoked into war. There are several productive plantations of coffee and cacao. The trade of the place is small, in palm oil and cam wood.

A hospital for sick or disabled seamen was built some years ago in an open situation, fully exposed to the invigorating sea breezes, by the Rev. Hoffman, an American Episcopalian missionary, a man whom I consider it a privilege to have known.

Soon after leaving Cape Palmas we pass the large native town of Cavally. Near this place, but a few miles inland, is the Delphic oracle of a large district of Africa. This is the Devil rock, or Devilly rock. I have not seen it, but Mr. Hoffman has described it as a hollow rock, with some acoustic properties, of which the priesthood of the favoured neighbourhood avail themselves very greatly to their own advantage. Pilgrims of all classes flock here from great distances. Deputies from towns come to inquire whether a war will be successful or peace will be more profitable. Rich men come to know if they will have heirs to their estates poor men come to know if they will have any estates at all. The answers given generally bear a doubtful or double meaning, like those of their classical prototype. But the inquirers into futurity leave them satisfied, though considerably lighter in worldly goods. They are, however, enriched with goat's horns full of consecrated earth—charms against all sorts of evils.

We pass the Cavalla river. It is a large stream navigable for some miles, and may prove at some future day another high road into the interior. During the next sixty miles the coast line is broken by many promontories and spurs covered with trees and vegetation.

A little ivory and cam-wood may be purchased for tobacco and cotton goods, but the trade is insufficient for any but small coasting craft. The inhabitants consist of three tribes, who keep up a perpetual feud with one another.

It is as well to be cautious when trading on this coast, as instances of robbing by force have occurred through want of caution, and may occur again from a similar cause. The coast changes its appearance at Fresco. Here it becomes low, and presents one unbroken line of surf, with a ribbon of yellow sand between it and a back ground of low scrub and dwarfed trees. The site of villages and towns, for the next two hundred miles, are now marked by groves and clumps of cocoa-nut palms only. Fresco is a great place for pigs. Outward bound ships may lay in a good stock for a very small sum. The natives are of a different tribe as we advance along the Ivory Coast, as it is called. Both in appearance and language they differ greatly from the Krumen. At Cape Lahou there is a very large town, at which a fair trade may be done in gold, ivory, and palm-oil. On the arrival of a ship here, a few preliminaries, involving gifts to the king and principal chief, and the settlement of the tariff, have to be arranged. And then the natives crowd on board with gold and ivory. The gold is in small grains, and sand, but dirty, and often, purposely, adulterated. They use their own scales and weights, the weights being small castings, in brass, of animals, &c., and seeds.

In trading for ivory, great patience is necessary. The least over-eagerness or display of temper would be fatal to all trafficking. The owner of a tooth, as an elephant's tusk is called, always begins by asking three or four times its value. In return for this, the trader then offers a price that is considerably under its value. The owner indignantly orders it back into the canoe. Another tooth is then talked, as the phrase is, and very likely the same manœuvre is repeated as in the first case. At last, after some hours of chaffering, during the whole of which the intending purchaser affects the most perfect indifference, and

repudiates contemptuously all offers of compromise, one tooth is bought, and the goods handed over. The ice is now broken, and the other teeth are, probably soon, parted with—provided, always, that the purchaser shows no over-eagerness. All trade is done here by direct barter, although the natives have a currency of their own which prevails more or less for about sixty miles along the coast. It is termed the manilla, and somewhat in shape resembles the Roman fibula. Whence it originates, or what is its history, no one has discovered. Forty years ago it was discovered by Englishmen to be the circulating medium between the residents on the coast and their inland neighbours. The original manilla was made of bronze. Tons of this coin have been made in Bristol, and exported from that port since this discovery. Though with Europeans trade is carried on by barter, nothing is bought among themselves except with the manilla. Rich men have quantities of them buried in or near their houses. The value is about 3d. The manilla is not used or known at all, except on this small part of the coast and in the River Bonny. At this river it is also current in the trafficking between the Bonny men and some of the tribes of the Niger. "The existence of a currency" is, or has been, described by a distinguished economist, "a strong proof of an emergence from barbarism."

The French had until recently block-houses or forts at Grand Bassam and Assini, at both of which places there are rivers, which communicate with lagoons running parallel to the coast. French houses have for many years past conducted a trade up the rivers and lagoons. Their success, however, has been but poor. The mortality amongst their employés was awful, and the natives at Jacques-Jacques, or Jack-a-Jack, preferred trading with the English ships that visited their coast, even though very great labour and risk were and are entailed in conveying their produce and in bringing back the proceeds through the tremendous surf. It is an extraordinary and exciting sight to see a large canoe loaded with four or six puncheons of palm oil, each weighing twelve to thirteen hundred-weight, being loaded and navigated through this surf. The casks are rolled down the steep sandy beach into the sea, just after a heavy wave has broken; they are followed by six or eight men to each cask. These men dive under the succeeding wave, never a heavy one, and swimming after the cask they propel it towards the next line of rollers, wait for the next wave to break, and then, being outside the surf, are clear of all danger. When all the casks have been floated outside the surf, at the distance of from 80 to 100 yards from the beach, the canoe, a large dug-out, is launched by 40 or 50 men, who follow her up to their necks in water, as she floats, spring into her, and paddle away furiously. As soon as they arrive at their casks, they jump out, capsize their canoe, and guide the casks into it—then, adroitly righting it again, they shake, roll, and bale the water out. They then get in and paddle away to the ship, keeping admirable time, to a song with a chorus, in which the admirable qualities of their chief is described. A glass of rum all round makes them forget their labours.

My first experiences in African trade were gained on this part of the coast, and I have not liked any other tribes so well as these. They are intelligent, patient, and courteous, and more truthful than most others with whom I have been in contact. They have names for every bright star and group of stars that rise about their horizon. What is more, they know what stars and constellations will rise at certain times. In arithmetic also they are far beyond other tribes. Without any difficulty they reckon up to several hundreds, and are able to keep account and to reckon out, by some rule of thumb of their own, trading calculations of considerable intricacy.

It is common to see a man with a walking-stick covered with innumerable notches. Every one of these notches is a memorandum or record of a distinct trading transaction.

It is difficult to say to what limits the palm-oil trade on this part of the coast might advance if there was good and unimpeded water communication with the markets of the interior. I accompanied a party of one of these tribes to their markets some years ago. A short journey across the lagoon in a diagonal direction, distant from the beach a few miles, landed us at a path such as has recently been described in records of the Ashantee expedition. We met hundreds of women and boys carrying pots and calabashes of oil upon their heads. Our party carried European goods of every description, and salt of native manufacture, in matted baskets of sugar-loaf shape. From time to time our chiefs received news and despatched messages, either back to their towns or by express couriers in advance. After a most fatiguing walk of eight or ten miles we arrived at the temporary station, short of the market, at which our party were expected by their trading agents. I was tired enough, and soon disposed myself to sleep; but, awaking from time to time in the night, I found my friends and their agents discussing trade incessantly. The next day we went to a spot, cleared of bush, with a few huts and a "palaver house," as a place for business or negotiation is called, for our temporary accommodation. The countrymen met us, and the prices of various goods, in manillas, were apparently arranged, samples of goods being produced and notches being made on trade sticks as the negotiations progressed. There was much loud talking and gesticulation; a good deal of palm wine was drunk, and I think that my presence assisted in ratifying some bargains, as I was appealed to occasionally on various points, and knew my cue as to my answers, having been instructed beforehand. I was glad enough to return, as the heat and incessant noise of men, seemingly in high dispute, was fatiguing and harassing in the extreme. On this occasion I passed through forests of oil-palm. The ground was covered with their decaying fruit. The appearance of the coast changes again as we near the gold coast, spurs of rock thrusting themselves into the sea. Forts more or less decayed appear at intervals. Axim, the first of these, which until recently belonged to the Dutch, is the first of the chain that extends to Quittah.

As an admirable paper by a gentleman who knows this part of the coast much better than I do has been read here lately, I do not wish to tre[illegible] upon what [illegible] by any remarks of [illegible]

except that I am certain that a few experienced gold-diggers, provided they could retain their health and energy, would find a second Bendigo or Ballarat in this district. I have seen women at Cape Coast and at Dix Cove, washing the sea sand in a shallow tin dish, and realising from half an akey to one akey of gold, worth about 3s. 4d., by their day's labour. It required a very slight knowledge of geology and mineralogy to see promises of gold in the bands of quartz which cross the red argillaceous earth. Whether the lesson which, at so heavy a cost in men and money, we have been forced to teach the Ashantees, will in any way conduce to the opening up of the interior to Europeans, and especially to us, remains to be proved. Let us adopt the motto of the African Steam Ship Company, "Spero meliora."

Elmina, Cape Coast, and Accra having each been visited, we pass the mouth of the Volta, a river which is destined to assist our commerce, despite of its impeding rocks and rapids. We pass Cape St. Paul, and are now coasting along the celebrated slave coast. We anchor off Jellah Coffee, the great emporium for live stock of all kinds, in this district.

The slave-trade was not effectually stopped until Commodore Wilmot formed a cordon of the cruisers under his command, each one being anchored within sight of another, along the whole of this coast. This system of blockade proved effectual. The traders found the risk too great, and though some successful runs were made by slave-steamers, that went three feet to that of two of any of our cruisers, yet the risk of capture became greater and greater, and the demand also became less. The consequence is, that now the slave-trade may be said to be among the things of the past.

Immense lagoons lie at the back of this coast, separated in some parts by a very narrow belt of sandy ground. These lagoons, once invaluable as affording a means for the transport of slaves to safe places of shipment, are now equally available for legitimate trade. The dollar, Spanish or pillar dollar and the Mexican dollar being preferred, are nominally the currency at the towns of Popo, Whydah, Porto Novo, &c., but cowries are in more direct use. Goods are quoted at so many heads of cowries; and palm oil, almost the only export, is priced in the same way. It is well to observe great caution in dealing with the coloured merchants of Portuguese extraction; they are very hospitable, and equally plausible. Their object is to get goods on credit. If they succeed, months of "hope deferred" must the captain or agent endure before a cask of oil greets his expecting eyes. He is put off from day to day with excuses of unparalleled ingenuity. Now and then a small instalment is paid on account. Insult is perhaps at last added to injury. He is told that his goods won't sell in the market, that so and so's ship will be full before his, because his goods are better; the real fact being that so and so has kept a tighter hand upon them, and not allowed our plausible friend to wheedle them out of him.

Domingo Martinez, once a celebrated slave dealer, was a merchant of great wealth and influence at Porto Novo. Before the export of slaves became very difficult, long before it became practically impossible, he turned his attention to palm-oil trade.

A portion of his oil he sent to England on his own account, but the bulk of it he disposed of to ships trading on the coast. He has been known to name a day when a cargo of 300 to 400 tons would be ready for shipment, and on that day he has been as good as his word. His accumulations of goods of the ordinary trade kind arrived at length at such large proportions that he was induced to order plate, jewels, clocks, and other objects of luxury, all of which were sent to a grand house in the Brazils. He indulged in the hope, a hope that was not realised, of spending the last years of his life *en grand seigneur*, away from the thraldom of the King of Dahomey. Among other extravagant articles ordered by him was a bath of solid silver. From one end of this bath rose a palm tree in frosted silver, among the leaves of which was a shower bath. Domingo Martinez, slave trader and merchant, died about ten years ago. The King of Dahomey, who had mulcted him heavily while living, seized and appropriated his property at his death. As to his property in the Brazils, his silver bath, and gold and silver plate, I know not who possess them.

Our next stage is Lagos. We find many vessels at anchor off it, and rolling heavily in the ground swell. A small steamer is soon seen puffing its way over the bar towards us. Our glasses show her pitching and rolling tremendously; at times she is even hidden from view by a gigantic roller. In an hour she is alongside, bringing, probably, the Government pilot and other officers, as well as some of the mercantile agents. Let us take a passage ashore in one of them. We have ample proof of the fearful character of the bar. At one time we are nearly broadside on to the rollers, one of which lifts us and carries us away like an egg-shell in a mill-race hundreds of yards to leewards, and, apparently, lands us upon a reef, but we are safe, though wet and shivering from stem to stern. Twenty years ago there were no steam-vessels. Canoes and surf-boats did all the carrying; most dangerous was the passage in or out then. Lives and property were continually lost. Those who, by dint of swimming, escaped the waves, were devoured by sharks. At that time it seemed that the impracticable bar would prove an insuperable obstacle to the extension of trade. When, however, her Majesty's steamers found their way in, in suppression, or, more correctly, in annihilation, of the slave trade, English and foreign merchants followed suit. The importance of the trade increased year by year, until now seven steam vessels are to be found in the land-locked harbour. Three of these are very small, but act as droghers, and, under favourable circumstances, tow the vessels over the bar. The others consist of a colonial steamer, and three which are employed in the Niger trade, but make Lagos their outfitting ports. Four English, three French, and two German houses have trading establishments, and a large number of coloured colonists, from Sierra Leone create in the aggregate greater demand for produce than the supply can profitably meet. The approximate yearly export is 5,000 tons of palm oil; 25,000 tons of palm kernels; cotton, of good staple, 10,000 bales; and small quantities of beni seed and miscellaneous products. The palm oil, though fair in quality does not command the best prices in the home

markets. The demand for palm kernels, from which a good oil is pressed, both in France and in this country, increases. Some enterprising gentlemen conducted a manufacture of this oil in Lagos some time ago, but their enterprise was not attended with success. I presume that the utter want of reliable workmen and assistants occasioned the failure. The same result has attended the efforts of others who have attempted to prepare raw material on the spot, with a view, among other inducements, to save freight. The further extension of trade in Lagos depends much upon the judgment exercised in adjusting differences between the tribes located between the colony and Abbeokuta; and also in avoiding cause of offence, on the part of the colony, to these and other neighbouring tribes.

Between Lagos and the River Benin the coast is very low, the scrub behind the strip of surf-fringed land being also low. It is very difficult to find the small towns and villages which dot it at intervals. Cowries continue to be the currency until we reach Benin, and in that river and its neighbourhood also. The River Benin is, except in very clear weather, difficult to hit; indeed, were it not for vessels at anchor off its mouth, much time might be lost in finding it. It pours down a vast volume of water in the rainy season. A considerable trade in palm oil is carried on in Benin. Ivory may also be obtained there. The trade might be increased immensely but for local obstacles. The bar is very shallow and dangerous; ships of even small size cannot pass over it, consequently small craft have to ply in and out to the ships in the offing. The tribes inhabiting this district are powerful and bold. Old travellers, Barbot and Bosman, of the fifteenth and sixteenth centuries, give wonderful accounts of them. Agents for English houses live a life of banishment in this river. There is, however, much to interest them in the habits and character of the natives. I cannot from direct personal knowledge describe them, but I have reason to believe that the chief tribes stand very high in the scale of African humanity.

There is very little doubt that this river communicates with the Niger; indeed, it is next to impossible to say what rivers, on this mangrove-overgrown part of the coast, do not communicate the one with the other. The great rivers, especially the Niger, bring down with them on their way to the sea vast masses of vegetable matter and suspended earth, which, deposited near their mouths, are immediately utilised as a nursery for young mangroves. The mangrove tree, the banian of Africa, propagates its progeny by seed, from its seeds, and by suckers which it drops from its branches into the black ooze at its feet. Leaves, branches, and all imaginable floating objects are bound in the meshes of the ever-increasing pile, the land rises, and a forest is formed in a few years. Innumerable creeks, some of which in point of width and depth arrive at the dignity of rivers, intersect these forests in every direction, carrying with them fresh *débris* for further utilisation. Anything more dreary than a journey by canoe or boat through one of these creeks can hardly be imagined. Towering trees obstruct the rays of the sun. No fresh song or cheerful warble of birds greets the ear. The only sounds that break the monotonous stillness are the creaking of branches, the hoarse croak of wading birds, or the splash of an alligator. Yet towns and villages are built upon the banks of these creeks; some of the towns, indeed, are of great commercial importance. In a negro's eye, the prospect of gain completely overrides considerations of an æsthetical or sanatory kind.

The whole delta of the Niger consists of mangrove forest, traversed by creeks. The estuaries of the rivers, so-called, Nun, Brass, New Calebar, Bonny, Opobo, and of others at present unexplored, appear, from sea, as gaps in the black green of the general landscape. All of them have bars more or less dangerous, as the numerous wrecks sufficiently prove. The Nun mouth of the Niger is the first we touch at. I do not propose to speak of the trade of the Niger, because it requires a paper to itself. We shall soon, I hope, have one from a gentleman who knows it intimately. I will just remark, *en passant*, upon the advances that have been made since 1839 and 1840, when the first Niger expedition met with such terrible loss of life, in the knowledge of the best means of divesting African fever of its terrors. Steam vessels constantly supply factories established on its banks with goods and stores. They seldom lose any of their crew, and are comparatively free from fever.

Off the River Brass we stay for a short time, or we visit it in the smaller steamer that acts as a tender to the large ones. About 3,500 tons of palm oil are taken out of this river annually. The trade is carried on by agents of Liverpool houses, who live in houses ashore, or in hulks afloat. These hulks are thatched over with palm leaves, or similarly protected from the weather by a roofing of corrugated iron. The houses on shore of these agents are tolerably comfortable, and some attempt has been made round them at flower and kitchen gardening.

At its best the life of an agent here is dreary enough; he sees no European faces from year's end to year's end, except of those who are similarly situated to himself, and those of the crew of the steam tender. Of the two I think the life on board the hulk is preferable, as, after trading hours, he has his residence to himself, which those who live ashore have not—it being impossible to exclude the natives. Trade is carried on entirely by barter. Palm oil is seldom brought in less quantities than the puncheon of 13 to 14 hundredweight. A tariff, varying from time to time, is accepted for the staple trade goods. These goods are Manchester prints, Glasgow prints, Madras goods, Birmingham guns, gunpowder of a coarse grain and weak quality, cutlery of a rough kind, ironmongery of an equally coarse description, rum, gin from Rotterdam, and tobacco. Salt is occasionally in great request here, as in other rivers. Coarse crockeryware, comprising wash-hand basons, plates, dishes, covered bowls, and spirit jars, is also in request; silk and what the Americans would call "fixins," have no established tariff with them.

Perhaps it enters the mind of some of my hearers that the problem of successful trade in Africa is solved, by having abundance of the right kind of goods, and a raw merchant's clerk or shop boy to exchange them for produce. As reasonably might you expect eloquent music from a hundred

guinea Cremona fingered by a navvy. There are traders and traders. Good temper, untiring patience, and an off-hand manner, are necessary in dealing commercially with the natives. A good memory and a clear head are as necessary in recording the work of the day. Profit and loss must be worked up in the head while negotiating with the vendors of produce. A reference to invoices should never be made in their presence. Dashes or gifts form no inconsiderable item in trade expenditure; they vary in value and kind from a gallon of rum to a gold watch or a thirty guinea breech-loader.

In the Brass river, it is as well to be on good terms with the chief fetish men. They have power to do you good, and much power to injure you. The people are intensely superstitious; the chains of superstition are drawn tighter by these men, who practice various arts of legerdemain and conjuring, known to the initiated only, acquiring thereby great ascendency. I have heard stories of their performances which quite eclipse Mrs. Guppy's transit through a locked door or a brick wall into the midst of a séance of spiritualists.

On leaving Brass, we steam along a line of coast such as I have described. We pass the wide embouchure of the new Calabar river, and Breaker Island, a large sand-bank formed by the deposits brought down by the River Bonny.

A wide extent of surf fringes this island to seaward. If they have not been washed away, certain buoys mark the channel over the bar, and the proximity of danger. We will suppose, however, that our captain is a good pilot, and is able to take us in past the Valeur Bank, on which conflicting tides create a maelstrom, and near the rough corner on the right hand side. We are now in the wide estuary of the Bonny river. We sight the shipping, distant about six miles, and steaming on are soon at anchor near them. Numerous fine six-oared gigs, manned by picked crews of Krumen, dash alongside, bringing agents and supercargoes anxious for letters and news. We are courteously invited by one of these gentlemen to visit his hulk; it is housed over like the hulks in Brass, but is much larger, and all its appointments indicate a more extensive trade. Numbers of black coopers, natives of Accra, on the Gold Coast, are setting up palm oil casks on one part of the deck, while the remaining part is crowded with puncheons that have seen much service; these are full of palm oil, and have just been hoisted out of an immense canoe that is still lying alongside. A large iron pot, in which oil is boiling, is a conspicuous object; Krumen, under the superintendence of the mate, are starting—that is, emptying—the newly-arrived oil down a canvas hose into casks which are stowed in the 'tween-decks or hold. The poop deck is the residence of our agent, a structure of wood divided into apartments, all tolerably convenient and comfortable. The cabins beneath the poop are used as the shop, or trade-room. In this shop we see ranges of shelves, on which are piled every kind and pattern of Manchester and Glasgow cottons that are in request, and all the miscellaneous goods before mentioned. Our friend shows us strings of coral; they are very valuable and much in request, though more as objects of personal adornment than for trading purposes.

At the death of the late King Pepple, of Bonny, one or two small boys, loaded with hundreds of strings of coral, were produced as part of the funeral pomp. This coral ought, according to custom, to have been buried with his Majesty. Whether his son, who has been educated as a Christian, conformed to this usage, I do not know; probably he did not. Twelve or thirteen Liverpool and Glasgow houses trade in Bonny and the neighbouring rivers of New Calabar and Opobo. The export of palm oil from these rivers has reached 16,000 tons per annum, worth between £500,000 and £600,000 at its present low market price, but much more a few years since. On this large amount the merchants do not realise a net profit adequate to their outlay and to the risk incurred. The expense of ships to convey the bulky goods, and to bring home the oil, is great, but when to these are added freight of soft and fine goods per steamer, insurance upon the same, agents' salary and commission, as well as the expenses of the hulk, it is clear that even under the most favourable circumstances, combined with the exercise of the utmost care and economy on the part of agent and supercargo, a large gross gain must be made before there is any margin for profit. Less than 50 per cent. upon the price of goods will not, in my opinion, allow of this. I have spoken of the merchant's outlay, let us now look at his risks. Apart from the ordinary sea risks, only partially covered by insurance, there are the special dangers of river bars and from fire on board the hulks. The annals of the oil rivers show that losses on the bars of homeward-bound as well as outward-bound ships are frequent, and hulks with their valuable but inflammable contents have often been burnt.

Money recovered from underwriters will not recoup the merchant for time lost and trade disorganised; nor will one, nor, perhaps, even two years of exceptionally good trade compensate him for a stoppage lasting for months; yet to this risk he is continually exposed, owing to war, either internecine or with neighbouring tribes. In addition to his heavy direct loss of interest on money there is an indirect one, not less ruinous. The demoralising effect upon his employés from one of these stoppages cannot be too highly rated. For the first two or three weeks advantage is taken of the enforced leisure to take stock, to repair sheds ashore, or to build new ones; in fact, to do all sorts of things that cannot be done if trade is brisk. After that time there is positively nothing to do. The agents meet and amuse themselves as well as they can, or go away in the steamers for a cruise. They are fortunate if they do not become ill, for nothing conduces to illness so much as having nothing to do; neither the agent nor his subordinates are the better for the long holiday.

Business on board a hulk commences at five a.m. Canoes arrive full of oil or to remove goods; the mate and clerk have enough to do until nine o'clock (breakfast time). The agent has his work also, traders to negotiate with, and samples, &c., to exhibit. Disputes arise about the gauge of casks, the amount of allowances for deficiences, and the quality of the oil. All these are at length adjusted more or less satisfactorily, when, having received books, that is orders for goods due to them, the gentlemen, after the usual gratuities, take their leave. By one o'clock the hulk is free of natives

It is 6 p.m., and nearly dark, before the work of the day is over. The agent has probably, during the afternoon, to visit one of the towns, to look after a canoe-load of oil, of whose arrival from market he has received information. It is necessary, in some cases, to obtain the advantage of first offer, but, as a rule, if his assortment of goods is complete and plentiful, he gets his fair share of oil without looking after it. One day succeeds another, each differing but little from its predecessor. The agent is happy as long as he sees his ship getting in her homeward freight, but when, owing to native quarrels, trade slackens, or is stopped altogether, then do his troubles and anxieties begin. He knows how applicable the Spanish proverb, "The mother of mischief is no bigger than a midge's wing" is to his surroundings. He knows the importance of smothering a smouldering fire before it bursts into a flame. The whole body of European traders meet to concert the best measures to effect this object; the chiefs are invited to attend, and the subject of dispute is discussed. Sometimes, complete adjustment of the difficulty is arrived at, but more often the offended parties can only be induced to forego acts of hostility for a time.

If war, or a long blockade of any of the markets, appears imminent, the consul is asked to interfere, and the admiral or commodore of the station is applied to for the "moral" force of one of her Majesty's cruisers. During three years that I spent in Bonny, some years ago, it was necessary to make several applications of this kind, and peace was maintained; but since that time neither consul nor man-of-war have been able to prevent a war between two powerful families in Bonny. This war resulted in great loss of life, as they fired round shot grape and canister at one another at very close quarters, and the entire destruction of one side of the town. Ja Ja, the chief of one of the families, being beaten, he drew off his followers to the river Opobo, where, in spite of all the attempts of Oko Jumbo, the chief of the other family, to dislodge him, he has maintained himself ever since, and commands the oil markets in that district, thereby securing a valuable independent trade. Though a peace between the belligerents has been ratified in the presence of British representatives, it will be prudent on the part of merchants to watch for the slightest sign of further hostilities, and stop them in time if possible. The losses incurred by the war I have spoken of were very heavy. Pepple is recognised as the dynastic king of Bonny. He is a youth of good disposition and very fair abilities, but, not being wealthy, is deficient in personal power and influence; these rest in the hands of Oko Jumbo, who may be called the mayor of the palace. Pepple's moral influence, as far as it goes, has been productive of good; his position is a very difficult one. Having been educated in England, he abhors some of the customs of his country, and in his own mind despises and laughs at many others, but at present he is obliged, like Naaman, to "bow his head in the house of Rimmon."

Among the abhorrent customs of Bonny, I must, I fear, include cannibalism. I do not believe that it is extinct. In the neighbouring river of New Calabar, it is so openly practised that hardly an attempt is made to hide the fact from Europeans. In Brass, I have myself seen portions of the human body sent as a complimentary present from one man to another. The chief town of Bonny is situated on a low-lying plain of hardened mud; a pestilential creek washes one side of it; a mangrove marsh partly conceals the other. The houses are strange specimens of African architecture; one or two reception rooms, more or less large, with open piazzas, under which assemble followers and visitors, with rooms for goods, constitute the house proper, but immediately adjoining and forming a hollow square are the dwellings of the wives. Sanatory arrangements are as bad as possible, and ventilation altogether wanting. On one side you see women preparing food, on another groups of women are being prepared for a ball. The ball dress and coiffure are very elaborate. Ball undress it should perhaps be called, as the nude body is covered with scrolls and arabesques in purple, of artistic accuracy of design, and the hair is tortured into what the French would call an impossible appearance. The effect of the purple upon the *café au lait* coloured skins is not unpleasing, though peculiar. The different tribes inhabiting the delta of the Niger have each their special fetish; thus in the Brass, the python, or boa-constrictor, is sacred; in New Calabar, the common black-and-white king-fisher; while in Bonny, until recently, the iguana held the distinguished place. As a severe penalty was inflicted on anyone injuring or killing them, these bloated reptiles, four to five feet in length, were to be seen in every corner basking in the sun, or with open jaws and lifted tails threatening intruders. Times have changed for the Saurian deity; he is no longer a permitted and pampered intruder. Disasters to the community having occurred, which his influence should have averted, he was not only deposed, but hunted down and mercilessly destroyed wherever found.

I must not leave Bonny without making some allusion to the contingent afforded to our Ashantee expedition. One of its officers described the men as "ugly yellow fellows, addicted to sundry repulsive habits, but active, vigilant, and brave," and said that they thoroughly understood the use of the Snider. They were picked men, probably slaves of Oko Jumbo's. I have myself seen his men practising the use of the rifle, and loading and discharging guns, with which the large canoes were armed, with a skill and rapidity that would not have been discreditable to our seamen gunners or artillerists.

There is constant communication between Bonny and New Calabar by boats, and occasionally by steam tender. Its trade is, for the most part, subsidiary to that of Bonny. With slight exceptions, arising from fetish restrictions as to patterns, the nature of the goods imported there is the same as those used in Bonny. The same remark applies in a general way to the trade of Opobo. The people are less civilised and more under fetish enthralment than their immediate neighbours, but are equally keen in business. Their oil realises a higher price in the home market than that of Bonny.

The approach to the River Cameroons lies through a grand estuary, the entrance to which from the sea is dangerous; nor, once within the estuary, are dangers and difficulties at an end. A stranger

would find himself in a very large expanse of water, bounded on every side by mangrove forests; he would see, at intervals, gaps in these, indicating rivers or large creeks, and would be at a loss to know which to steer for. A mistake, especially if the weather is not clear, may easily be made. I have more than once seen the mail steamers stick in the mud through errors of this kind. Our captain knows the river well, and we anchor near the shipping, within two hours from the time of passing the bar.

The towns are built on the verge of a sandy cliff, and being surrounded by, and interspersed with, cocoa palms, and plaintain trees, have a pleasing appearance. The ships lie within a short distance of the beach, and not far from one another. Native canoes, propelled with great rapidity, dart about the river in every direction. There is a general appearance of life and energy everywhere, but the amount of yearly exports proves that much of this energy is misdirected. The staple produce is palm oil, of which 1,600 to 2,000 tons are bought annually; a ton or two of ivory may also be obtained in a year. To be successful in trade in Cameroons a man must, in addition to the qualities I have previous mentioned as requisite for an agent or supercargo, acquire an intimate personal knowledge of the people. He should know not only the character of the man, but also his status as regards wealth and influence. Without this knowledge he would soon come to grief. The great end and aim of a Cameroons man is to wheedle goods, on credit or trust, as it is called, out of a white man. Every other object in life is secondary to this. A certain amount must be trusted to leading chiefs and traders to retain their good will and obtain their protection, but extreme caution has to be observed in extending the privilege to others. The form of trade, in contradistinction to that of Bonny, is essentially retail. It takes more time, and an infinitely greater amount of patience, to buy one puncheon of oil here than twenty in Bonny. An agent can never call his time here his own. Applications for gallons and even bottles of rum are put in at all hours. No quantity of oil, however small, can be brought for sale without libations of rum on its arrival and at the conclusion of its purchase.

The various leading families of Cameroons are always at feud with one another. Occasionally these feuds lead to overt acts of hostility, and a large quantity of powder is blazed away. Few lives are lost in these petty wars, but ill-blood increases, and trade is practically at an end for the time. If a chief or man of position is unluckily shot, "the palaver cannot be set" (this is an expressive African phrase) until the relatives of the departed have been squared with half a dozen or so of marriageable women, a greater number of slaves, and rum and trade goods without end. Sometimes, as in other rivers, impending hostilities cannot be prevented without an appeal to the Consul. The appeal is perhaps responded to, the British representative comes over in a man-of-war, summons the chiefs to a solemn conclave, remonstrates with them about broken treaties, and, finally, his right and power to interfere being unrecognised, proceeds to knock down the town of the recusants. After a shot or two has been sent through the bamboos, off comes the missionary, and, under the protection of a flag of truce, which is, by the way, a tablecloth, arrives also one of the non-compliant chiefs. Eventually the British representative's foot is kissed, a fine of certain bullocks is imposed, and personal recognisances to keep the peace are entered into on both sides. If any one of my hearers is curious to know whether such fines are always paid, or bail is ever estreated, I beg to refer him to the Foreign Office. Owing to these perpetual feuds, there is no effectual combination to regulate the inferior markets, consequently prices rise to a figure unremunerative to purchasers. I do not think that the exports from Cameroons will increase beyond their present limit unless access to the country markets is obtained through some other channel.

The Cameroons men are a fine athletic race; their habits are more cleanly and their customs less objectionable than those of many other tribes, but they are false to the back-bone; no moral force controls them. It is by motives of self-interest alone that they can be dealt with.

Old Calabar is the last of the so-called oil rivers at which the steamers call; it is second in importance to Bonny only. On our route from Cameroons we have a splendid view of the mountain. The sea is deep to within a short distance of the bold rocky shore, but as we advance onwards towards Tom Shot's point the coast becomes low and mangrove-clothed. The river is as difficult to make as Cameroons. The steamer pursues a devious course among the mangroves, sometimes passing very near to clumps of them, until a broader reach is opened, when the ships and hulks appear in full view. The native towns are on rising ground to the right; the Presbyterian mission establishment crowns the highest point. Old Calabar exports annually about 7,000 tons of oil, also some ebony and ivory. There is a recognised currency here, termed coppers; this is an appropriate name, as it consists of wire hammered out of copper rods. The articles used in trade are much the same as those used in the other rivers, with the addition of copper and brass rods. The system of trade is, as a rule, wholesale. Trust is given to the chief men, but in far less amounts than they were accustomed to receive in former times. Merchants in those evil days experienced fearful losses from the extent to which this subversive system was carried. I have known cargoes of £8,000 to £10,000 in value given out on trust; and have seen fine ships rotting at their anchors, for over two years, waiting for their homeward cargoes. This kind of thing is, I believe, now at an end. The chief people are intelligent and courteous, but though not quite as bad as their neighbours of Cameroons, they are, to say the least, slippery in their dealings.

My "general description of the trade of the West Coast" is finished. May I further trespass upon your patience with a few remarks. Throughout Africa, from 12° N. to 20° or 25° S., from the southern verge of the great Sahara to the northern limits of the Cape Colony, from the Atlantic to the Straits of Madagascar, a family likeness exists among the inhabitants. Dialects differ, but the language is in formation the same. Religion professes the same features. The existence of an all-powerful and beneficent God is acknowledged but he is too great to be approached; prayers do

not arise, nor are sacrifices offered to him. Not so in the case of maleficent spirits. To them an adoration of fear is perpetually paid. This is in fact fetish worship.

What the natives believe respecting the spirit world, no one, be he traveller or missionary, can venture to say that he knows. One portion of this belief is that the *manes* of departed relatives possess power to injure the living if funeral rites are not carried out in due form. That the efficiency of charms to avert evil or to produce good is recognised among a race whose only knowledge is drawn from oral tradition, cannot surprise us, when we know that it is believed in in this country —aye, and even greater follies than these are accepted as truth, by educated ladies and gentlemen.

Domestic manners and customs are also alike. The man buys his wife and sells his daughter. His wealth consists in wives and slaves. The wife prepares the food and chops the firewood, and if her husband is poor works in the farm also. In all cases she must be ready to simulate woe in dust and ashes on the death of a relation, and to dance and sing night and day for the succeeding week. She must endure corporal punishment patiently, and share her husband's love with any number of rivals that his purse enables him to buy.

The implements of war differ a good deal, but the assegai and shield of the Kaffir are to be found in Equatorial Africa, while the bow and cross-bow extend throughout the whole of the same district. Agricultural implements are the same. The matchet and hoe clear the bush and scratch the ground everywhere. The axe and adze are the same. The blacksmith on the Zambesi uses the same kind of bellows that his fellow uses on the Gold Coast. Stringed instruments and harmonicons, tom-toms and drums, are alike in form; and monotonous songs in a minor key are the universal vocal music. I could add many other instances proving a family likeness. The day is perhaps not far distant when European commerce, and with it civilization, will find its way into the interior more directly than it does at the present time. Let us hope so.

DISCUSSION.

Mr. Thomas Hutchinson said he had listened with great pleasure to a paper describing so well a portion of Africa of which he had had ten years' experience, five of which had been in her Majesty's service. The disastrous Niger expedition mentioned by Mr. Babington was one of the most fatal ever fitted out, for of three steamers which went up but two returned, worked almost entirely by their officers, and more than two-thirds of the men were left behind dead and buried on the banks of that miasmatic stream. Several subsequent expeditions had, however, been more successful, one of which was under the direction of Mr. Macregor Layard and Mr. Oldfield, and another in 1854, of which he had charge as senior medical officer. That expedition went 250 miles up the river, and brought back the whole of its crew, 58 Africans and 10 Europeans, without the loss of a single life. He said this, not to boast, but to corroborate what had been said by Lieut. Forbes in his work on Dahomey, that African enterprise would be far more general if there was less cant about disease and fever. He believed the men were kept alive on board the *Pleiad* by attention to hygiene, administering quinine as a preventive rather than a cure, by keeping the decks clean, and the men in good spirits by music and dancing. Mr. Babington had made an allusion to the doings of the Foreign Office at the Cameroons, and the fines levied on the native chiefs; but the fact was these fines were never imposed in any way for the benefit of the Foreign Office, but were paid to the supercargoes in the river, and were really spent in the development of British trade. As the representative of the Foreign Office, he was obliged to go when sent for, and was told that King Obi, or King Tom had killed so and so, and that civil war had broken out; but these supercargoes never asked themselves or their employers who gave powder and fire-arms to these natives. They were brought out to buy palm oil with, and he considered that one of the worst features of African trade was introducing these articles, as well as gin and things of that kind to the Africans. Until this was stopped there would never be a healthy commerce on the Gold Coast. The amount of the trade at Bonny had been stated at 14,000 tons, but in 1856, the second year he was there, it amounted with that of New Calabar to fully 16,000 tons. The expedition up the Niger which he had mentioned found the palm-tree growing at a distance of 600 miles from its mouth, so that if proper instruction were given to the natives in the manufacture of palm oil, it was evident the supply from that source would be almost illimitable. He begged leave to move a vote of thanks to Mr. Babington.

Mr. Swanzy seconded the motion. In reference to the suggestion in the paper that a new Ballarat or Bendigo might be found on the Gold Coast if it were systematically worked, provided the miners could retain their health and vigour, he said that this proviso was a most necessary and important one, for about the year 1846 an attempt was made by the Dutch Government to carry out large mining operations, thirteen engineers being sent to the spot selected, but unfortunately only four returned to the coast in three months, and one of those died shortly afterwards. It was quite out of the question to attempt anything of the sort in such a climate, where there was nothing more dangerous than dealing with newly-turned soil. With regard to the introduction of fire-arms and ammunition he did not believe this was the cause of the natives going to war, for even in the interior, where there were no guns, they were constantly fighting amongst themselves. It rather surprised him that gentlemen should speak with disapprobation of the introduction of arms and powder into Africa, while at the same time England prided herself on the possession of an ironclad fleet, each vessel of which was constructed for the purpose of killing or sinking thousands of fellow creatures. It was, in fact, impossible to prevent the commerce in these articles, and he believed on the Gold Coast the Government were reconsidering the question of their prohibition. The only consequence was that they would be introduced at Grand Bassam and Assini, where the French did a large trade, he being the only English merchant. He was informed that the French were just about importing 2,000 chests of guns into this territory, and he could do the same if he liked, but he did not choose. It was contrary to political economy, or any other principle, to prohibit any particular article of commerce, and could not be carried out, and it would be much better therefore for the Government to derive, as it might, a considerable revenue from it. Some people fancied that guns and powder formed the principle articles of trade, but this was a great mistake, for in his own transactions cotton goods represented fully 60 per cent.; arms and ammunition did not form one-sixth of the whole. He knew this was a question on which different opinions were entertained, and he should be quite prepared to hear the Chairman advocate the opposite view; but the matter should be calmly discussed, and he hoped it would not be treated as if those who h[eld] his own views were solely actuated by personal or s[elfish]

feelings. He could assure the meeting that the guns supplied to the natives were not nearly so dangerous as an ordinary knife, and if they could not fight with them they would with something else. No doubt large quantities of spirits were sent out, but he should be equally pleased if the natives would take tea or coffee; but they would not. He considered a little spirit was one of the necessaries of their existence, particularly as they had nothing but putrid water to depend upon, and a main portion of their animal food consisted of stinking fish. They only took a very small quantity of rum at a time, and very seldom got drunk, so that he believed the evils were much exaggerated.

Mr. T. Hutchinson said his remarks were not intended in any way as an attack on the trading community, but his experience in Bonny and such places taught him that immense injury in every way was being done by the introduction of gunpowder. With reference to spirits, when he was going up the Niger a woman offered to sell him her two children for a bottle of gin each, and if this was the sort of commerce which was to be developed, it was all nonsense to talk of putting down domestic slavery. He did not speak from the philanthropic point of view, because he believed it might often be said of philanthropy, as was said by Dr. Johnson of philosophy, it was a very good horse in the stable, but a wretched poor jade on a journey. He believed these things were an immense obstacle to the spread of legitimate commerce.

Mr. Edward Hutchinson, while agreeing with Mr. Swanzy's remarks in a measure, and conceding that as an abstract principle it was unwise to interfere with the freedom of trade, said it must also be borne in mind that these poor Africans were very much like children, and, therefore, merchants and others could not divest themselves of a certain amount of responsibility in dealing with them. Of course he looked at the matter from his own point of view as secretary to the Church Missionary Society, and from that standpoint he could not but think it would be well if those supercargoes and merchants who subscribed for the erection of a church in which they might worship according to the faith of their fathers, would carry their philanthropy a little further, and consider whether, in importing fire-arms and ardent spirits into Africa, they were not introducing that which had proved a curse in all parts of the world. The Church Missionary Society had to deal with the white trader in all parts of the world, and everywhere he carried these things with him; therefore, he did not advocate any such Quixotic notion as the absolute prohibition of such articles; but he did ask them to consider with whom they were dealing, and not let it be said that when the King of Dahomey wanted to take Abbeokuta, there was an English firm willing to supply him with war rockets for the purpose. He had attended the meetings of this Section from time to time, and, as he understood, the object was not simply the private advantage of African merchants, but the development of commerce which should benefit the country itself, and he was therefore sorry that he had not heard any suggestion leading in that direction on the present occasion. For instance, in treating of Sierra Leone, there had been nothing said as to how they were to deal with that important settlement in connection with the striking facts that the death rate exceeded the birth rate, that French money was becoming the general currency to the exclusion of English, and that, as had been described, everything seemed to be at a standstill. It must be remembered in dealing with that region, that only a generation ago it was the seat of the largest and foulest slave trade the world ever saw, and that many of these men who had been rather sarcastically described, had either been slaves themselves or were the sons of slaves. It would have been well, also, if some notice had been taken of the attempts made to educate them and the results. The traders and their clerks were as a rule fairly educated, and education was necessary as an assistance to commerce; but something had been done already. 14,000 persons in Sierra Leone attended English places of worship, there was a coloured bishop there, and Mr. Pope Hennessy had described meeting there a black gentleman, whom he considered the best educated man he had met with anywhere. Mr. Babington did not say much about Lagos, but he referred to the complications which had arisen in the interior, and which had for some time put a stop to trade. There was no doubt that for 18 months between 1871 to 1873, there were very heavy losses there, though as far as the Government revenue was concerned it did not immediately show itself, most of the traders having imported largely in advance; but, in his opinion most of these complications had arisen from the bad system of credit which had been referred to, and this view was borne out by the Government Blue Book. But who initiated this credit system? The Manchester merchants and the African traders; and Governor Barclay stated that in his opinion it lay at the root of most of the complications which had arisen. The question of slavery, again, had much to do with it, as the delivering up of slaves was a matter being constantly urged by the chiefs in the interior. With regard to the development of Lagos, which was undoubtedly the best situated port to serve as a trading centre, he would mention that two missionaries had recently explored a new branch of the Niger, which found its way into the lagoons behind that town, and it seemed that from these lagoons there was a perfect stream of clear water, with an occasional fringe of rushes which could be cut through, or passed over like the floating bridges described by Dr. Livingstone in his last journals, communicating directly with the Niger. If this were so, as Sir John Glover believed, it would form a direct means of communication with the river above the hostile and cannibal tribes which lined the lower banks, and would help to develop the trade which they all expected would yet come from that region. When Bishop Crowther returned from his last visit to the Niger, he described the readiness with which the tribes he met with were prepared to enter into friendly relations with the British Government; and he could not help feeling that if a line of water communication could be opened up from Lagos to Lopaja, a very large commerce would be the result.

Mr. Swanzy said he hoped before long to contribute a paper on the history of European settlements on the West Coast, in which he should attempt to show what had been done in the way of educating and improving the natives.

Mr. Rochussen remarked that the universality of French coinage on the coast of Africa was not surprising considering that a great part of the trade from Cape Spartel to Sierra Leone was carried on by Frenchmen or on French account, and but two-thirds of the produce went through French ports. In addition to this, the French coin was better adapted for trading purposes than the British, which, with the exception of the sovereign, was not marketable. A five-franc piece was really of the value it represented, but the English silver coinage was not. He should have said something as to the importation of arms and ammunition, but had been forestalled by Mr. Swanzy, with whose views he concurred. He would add, however, that the African gun was not so much an engine of warfare as a domestic implement used for the expression of joy or grief, as was shown by the great variety of fashions which prevailed in different districts, in the colour and pattern of the barrel, stock, and fittings. These guns, however, though looked upon more as fancy articles than as instruments of war, were all proved as carefully as the most expensive rifles.

The Chairman said he had had such an unfortunate and lamentable experience of guns and powder in Africa

that he could hardly accept as satisfactory the glowing pictures which had been drawn of the uses and advantages of the trade musket; nor did the various statements which had been made exactly harmonise together. Mr. Swanzy said the Africans would fight whether they had guns or not; but the last speaker seemed to think the muskets were not used for fighting at all. Again, Mr. Swanzy said that, after all, the guns were so inferior, that not much harm could be done with them, which was not much to be proud of on the part of the vendors; but, on the other hand, Mr. Rochussen said they were all proved as carefully as any other weapon. There might be a great difference between the East and West Coast in many respects, but in the former he had seen very bad results following from the introduction of firearms. The tribe nearest to the coast which first got hold of these weapons immediately made war on their next neighbours, and these, finding there was nothing which could withstand these new arms, sold their children and people in order to obtain them, then, in turn, making war on the tribe behind them; and so it went on. He could mention four tribes where he knew this kind of thing to have occurred. It was his bad fortune to be with Bishop Mackenzie and Dr. Livingstone at the back of the fourth tribe when this took place, and he knew the miserable effects which followed. A gun was looked upon as the most destructive instrument, and when it once got into the slavers' hands they spread terror all around, so that the very greatest curse in the country, next to the slave dealer himself, was the gun he carried with him. Mr. Swanzy had told him that evening of a rare bead of which he had found some traces on the West Coast, but Dr. Livingstone's servants, when taken into a shop in the City where all these articles were kept, at once picked it out, and said they had found it in the farthest part of the interior country. The merchant informed him that that particular bead had never been sent to the East Coast, but to the west only, whence it had evidently passed into the interior, and this proved to him that Livingstone had, in fact, reached the border line between the reach of the traders' arm on the two sides of Africa. And so it was with these muskets. People on the coast might not shoot each other with them, but they gradually got into the interior, and reached places where they formed a terror to all within their range. If, therefore, there were any intention of rescinding the rules which had been laid down as to the importation of arms following on the Ashantee war, he should regard it with a feeling of dismay. There were, of course, wheels within wheels, and he could not say what would be the ultimate conclusion, but he could not but hope that some good would result from such discussions as the present. On the 23rd inst. a paper would be read by Mr. Consul Hutchinson, on "Social and Domestic Slavery in Western Africa," in its bearing on commercial progress, and he would not therefore go into that subject at present, but there was no doubt that it was a most important one, and probably all kinds of intrigues would be set on foot to try and obtain some alteration in that which the Government had determined on. He hoped, however, that any such efforts would be in vain. The day for low caste traders on the coast was happily past, and commerce was now conducted by gentlemen, who not only tried to make their trade an honour to the English name, but would also, he was sure, join with all their hearts in any well-considered efforts for the welfare of the people amongst whom they went. In conclusion he must repeat that he was not at all shaken in his opinion of the evil results attending the introduction of firearms. Whether the guns burst, as they did on the East Coast, so that the Kaffirs would not buy them on account of their bad quality, or whether they were as good as was represented on the West, they were equally unfitted to be placed in the hands of such children as the native Africans.

The vote of thanks having been put and carried unanimously,

Mr. Babington briefly acknowledged the compliment, and said that he had not gone at length into some of the points which had been touched upon, because they were not properly within the scope of the subject, which was strictly the trade on the West Coast of Africa.

NINTH ORDINARY MEETING.

Wednesday, February 10th, 1875; ROBERT JAMES MANN, M.D., in the chair.

The following candidates were proposed for election as members:—

Ashworth, Taylor, J.P., Sunny Bank House, Shelton Stoke-on-Trent.
Benskin, John P., The Cannon Brewery, Watford.
Drummond, Dugald, North British Railway Company, Cowlairs, Glasgow.
Glydon, William, Spring-hill Metal Mills, Birmingham.
Greener, Thomas, Benton-lodge, Darlington.
Harris, Underwood P., Surrey-villa, Tufnell-park, N.
Hough, Captain George, 2½, Ingram-court, Fenchurch-street, E.C.
Innes, George McKay, London, Brighton, and South Coast Railway, Brighton.
Lamb, James, John Dalton-street, Manchester.
McNiel, Henry, 39, Market-street, Manchester.
Mason, David King (Consul for Siam), 5, Great Winchester-street-buildings, E.C.
Nicholson, John, 59, Wells-street, and Vicar-lane, Bradford.
Player, J. Hort, Phosphorus and Chemical Works, Oldbury, near Birmingham.
Robinson, Thomas William Usherwood, Houghton-le-Spring, Durham.
Stockinger, Franz, Austrian Consulate, 29, St. Swithin's-lane, E.C.
Swanton, William, London Salvage Corps, 65, Watling-street, E.C.
Walmsley, Thomas, Brooklyn, Bolton-le-Moors.
Warwick, John Francis, 5, Castle-gate, Newark-on-Trent.
Williams, Francis, Messrs. D. F. Taylor and Co., Newhall Works, George-street, Birmingham.
Wright, Howard, Phoenix-lodge, Chapel Allerton, near Leeds.
Yarde, Giles, 60, Lamb's Conduit-street, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Arteaga, Rodolfo de, 79, Gower-street, W.C.
Browne, Roland Jay, 3, Hare-court, Temple, E.C.
Cleaver, the Hon. William, 122, Cannon-street, E.C.
Emmott, W. T., Binfield-lodge, Clapham, S.W.
Fox, Colonel A. Lane, 9, Sussex-place, Onslow-gardens, S.W.
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Waugh, John George, 11, South-square, Gray's-inn, W.C.; and Highfields, Crouch-end, N.

The paper read was—

THE SAND-BLAST AND ITS ADAPTATION TO INDUSTRIAL PURPOSES.

By William E. Newton.

In this process, which is the invention of Mr. B. C. Tilghman, of Philadelphia, a jet of sand (propelled at a high velocity by a steam or air-blast) is employed as a tool for cutting stone, and for producing ornamental carving on stone and other materials. At a lower velocity of jet it is also employed for grinding and ornamenting the

surface of glass. The cutting, grinding, engraving, and ornamenting of glass, stone, wood, and other hard substances are operations requiring a considerable expenditure of time and labour, and some of them a vast amount of skill. The object of the sand-blast process is to economise time and reduce the amount of skilled labour required to produce ornamental patterns and architectural devices in stone, slate, marble, and other hard substances.

This new process in the arts is based upon the fact that when grains of sharp sand are driven with a high velocity against a hard surface, such as glass, stone, slate, marble, wood, or iron, the surface is cut away more or less rapidly.

The greater the pressure of the steam or air which produces the jet, the higher is the velocity imparted to the grains of sand, and the more rapid and powerful their cutting effect upon the surface exposed to their action. When driven at a high velocity the impact of the grains of sand will cut substances much harder than themselves. Corundum can thus be cut with quartz sand, and quartz rock can be cut by small lead shot. The hardest steel, chilled cast iron, or other metal can also be cut by a stream of quartz sand. The action of sand driven at a high velocity on the hard surface of glass, wood, stone or slate, is very rapid, and if a sheet of plain polished glass be subjected to the sand-blast it will be quickly depolished or ground, but if a portion of its surface be protected by covering it with some soft or elastic substance, such as india-rubber, paper, or other suitable material (cut to any particular pattern or device), all those parts so covered will remain intact, while the exposed surface will be ground or cut away by the impact of the sand. By means of stencil plates, letters or designs can be engraved upon stone, slate, and other hard substances; also by varying the shape, number, and direction of the jets of sand, and traversing them over the work, cuts or holes can be made of any shape or size.

For ornamenting stone, marble, slate, granite, or wood, iron templates made of the required pattern are used to protect the stone or other material from the action of the sand at all such parts as are not to be cut away. These templates, which are of cast iron, are very easily made. The process adopted is to draw or transfer the pattern (either in pencil or ink) on to the surface of a piece of wood of proper thickness, and then to cut out the design with a fret saw. The wooden pattern thus made is used to produce a mould for an iron casting in the ordinary manner. An iron template formed in this manner, and about 3-16ths of an inch thick, may be used 100 times to produce the same pattern on stone of moderate hardness. If made of malleable iron, the template will last about four times as long. It will be evident from the above explanation that almost any design an architect may make (however elaborate it may be) can be cut in flat-relief in stone, marble, slate, or wood.

The peculiar feature of the sand-blast process which distinguishes it from the other methods of cutting and grinding is, that each grain of sand acts by its own velocity and momentum, like a bullet or projectile, and pulverises or indents the object it strikes. In consequence of this peculiarity of its action, some substances (which, though comparatively soft, are also tough or elastic, and cannot, therefore, be pulverised by a blow, such as copper, lead, paper, wood, or india-rubber), are less rapidly cut and ground by the sand-blast (particularly at moderate velocities) than much harder substances of a brittle nature, such as stone, glass, or porcelain. A peculiar advantage of the sand-blast is that its action takes place with equal effect upon irregular surfaces, and therefore recesses hardly accessible to ordinary methods of working can be cut. Steam is generally found most convenient for the impelling blast, particularly for high velocities, as when operating on stone or marble, but in some cases air is preferable. Steam of all pressures has been used up to 400lbs. per square inch, and its efficiency has been found to increase with the pressure.

The sand is fed into a funnel, which is connected by a flexible pipe with an iron or steel tube of any convenient length, and of about 1-6th inch bore. This sand tube is secured exactly in the centre of a brass casing, which forms the steam chamber. The annular space between the two tubes is closed steam-tight at the back end; and at the front end or orifice the casing is shaped with a tubular neck, and brought to the same length as the sand-tube. The neck of the casing is bored out to a diameter of ¼-½ inch for a length of about ¼ inch from its end. For about ½ inch in length from the end, the sand tube is reduced to 0·23 inch external diameter, so as to leave a uniform annular opening of 0·015 inch in width, extending backwards for a length of about ¼ inch, and then enlarging gradually to the full diameter of the casing. This annular passage forms the opening through which the steam-blast issues. The casing or steam chamber is connected with the boiler by a flexible pipe, so as to allow of the jet apparatus being turned and moved in any direction. A tube, called the nozzle-tube or gun, about 1-3rd inch bore and 6 inches long made of wrought iron, steel, or chilled cast iron is fastened on the neck of the casing by means of a set-screw. The end of the sand tube is accurately adjusted and fixed in the centre of the steam aperture, so that the annular opening is everywhere of the same width all round.

The sand used is sifted of even size, and should be clean, hard, sharp, and dry, so as to run regularly through a small hole without clogging. The steam should be perfectly dry, and when used at a distance from the boiler a steam separator should be added to free the steam from condensed water.

In the working of the instrument, the steam when turned on, issues with great velocity from the annular opening, and creates by suction a current of air through the sand tube. A valve in the bottom of the sand-box is now opened sufficiently to let a stream of sand of from one to two pints per minute fall into the funnel beneath, whence it passes down the sand-pipe and is carried by the current of air through the sand tube and is sucked into the jet of steam, by which it is driven through the nozzle-tube at a high velocity, and finally strikes against the stone to be cut, the end of the nozzle being held at a distance of about six inches from the stone. The shattered fragments of the sand and stone, partly in the state of very fine powder, escape sideways and backwards together with the steam.

In cutting granite with a steam jet of about 300 lbs. pressure per square inch, an inclination of about one in nine from the perpendicular will make the sides of the cut parallel; but with the same jet acting perpendicularly on rather soft burnt brick or on sandstone, the sides of the cut are almost parallel. Sufficient space must always be allowed for the escape of the waste steam and sand. By directing the blast-pipe successively to all parts over the surface, the stone will be cut down either with parallel sides or with the sides undercut, so as to make a hole of larger diameter at the bottom than at the top. It will now be understood that if a metal or other perforated template, with any desired pattern formed thereon, be placed on the upper face of the stone, the latter will be cut away by the sand-blast at all parts which are not protected by the template.

The quantity of stone cut away by the sand-blast is much greater when ample space is afforded for the free escape of the expended sand and steam after they have struck the stone than when the space is narrow and confined. When a rapid lateral traverse is given to the blast-pipe or to the stone, so that the sand is constantly striking upon a fresh surface, a much greater cutting effect is produced than when the blast is kept directed upon one spot. The reason of this is that when the sand rebounds from the stone, it interferes considerably with the fresh sand which is being projected against the stone. This interference is particularly evident when a hole is cut but little larger than the diameter of the sand jet. It has been noticed that when the sand-blast is held at 4 or 5 inches distant from a stone, a greater quantity is cut than when held at only 1 inch distance; also that when the sand-blast is directed at an angle of from 30 to 45 degrees from the perpendicular, a greater quantity is cut than when the same sand-blast at the same distance is directed perpendicularly upon the stone. The explanation of these cases appears to be that the divergence of the sand-blast spreads it over a wider surface of the stone, and also gives more room for the waste to escape, thus avoiding interference with the sand in the jet. The quantity of sand used with a given steam jet may be considerably varied according to the effect desired to be produced. When a soft stone is to be cut over a wide surface (and there is consequently a free lateral escape), two or three times the quantity of sand used in the preceding cases can be employed; but where a hard stone is to be cut in a narrow groove, a small feed of sand produces a better result.

The principal points to be attended to in order to obtain the best results in economy of power and time in working with the sand-blast are—first, to get an impelling jet of great velocity; second, to feed the sand regularly and in such a manner that it shall acquire as nearly as possible the velocity of the impelling jet; third, to direct the jet of sand upon the desired spot, without wasting its force in wearing away the nozzle-tube; and fourth, to provide free escape for the expended steam and sand, so as to avoid interference of the outgoing sand with that which is being driven forward.

Where only a small quantity of material is to be cut or ground away by the sand-blast from the surface of a hard substance, and where only a moderate velocity of jet is required, a blast of air (produced by a rotary fan) is found to be convenient. This method is used for grinding or depolishing glass, china, or pottery, either over their entire surfaces or for the production of ornamental designs. In engraving designs, air is more convenient than steam for the impelling jet, because with air the sand keeps dry and rebounds, leaving the pattern clear; but with steam the sand becomes damp, and is apt to adhere to the fine lines and corners and clog them. The sand being fed into the air jet by falling from a column of sufficient height, it is carried along by the air in a tube or close trunk, and directed upon the glass, which is held or moved opposite the mouth of the trunk; the sand-jet thus cuts or stars the surface of the glass wherever it strikes it.

The air current from the fan (having a pressure of about four inches of water) is brought in by a trunk, of about two square feet sectional area, and descends through the narrow vertical slot, of about one inch in width, from the bottom of which it issues with a velocity proportioned to the pressure of the air. Into the upper end of the air slot, the sand is evenly fed from the sand-box above by means of the sand slot, of about half an inch in width, the lower end of which is closed by an iron plate perforated with holes about a quarter of an inch in diameter and half an inch apart, so as to supply from 15 to 20 cubic inches of sand per minute for each square inch of cross section of the air slot. In passing down the air slot the sand acquires a velocity proportioned to that of the air jet, and strikes upon the plates of glass, which are made to traverse across underneath the mouth of the slot. The plates of glass are carried upon a set of india-rubber belts, which travel at the rate of about eight inches per minute, so that each part of the glass is exposed to the action of the sand-blast for about six or eight seconds. After striking the glass, the air and sand pass away at the sides into the large settling chamber below, where they lose their velocity, and the sand settles to the bottom, while the air escapes at the aperture, or returns to the fan. To diminish the escape of dust and sand into the external atmosphere, india-rubber flaps are provided, which close with a slight elastic pressure upon the glass passing through. The pressure of the blast holds the sheets of glass down upon the belts which carry them. The sand from the bottom of the settling chamber is raised by an elevator into the sand box at top, and is used over again repeatedly, until it becomes too fine.

For cutting a design upon glass, the covering stencil plate must be of a strength and durability proportioned to the thickness to be cut away. Toughness and elasticity and the absence of brittleness appear to be the qualities needed for resisting the cutting action of the sand. India-rubber (particularly when vulcanised) possesses the desired properties in an eminent degree; parchment and parchment paper also possess considerable durability. Stencil plates made of paper or thread are rendered more durable by covering them with a tough or elastic varnish. A design can either be drawn on the glass with a composition applied by a brush, or the glass can be covered all over with a preparation of gelatine or glue, and the design cut through the protecting coat when dry, so as

to expose certain parts of the glass to the action of the sand-blast. A layer of wax resists a sand-blast having a pressure of up to five or six inches of water. A film of bichromatised gelatine produced by photographic processes is capable of resisting the action of a blast of the same fine sand, during a sufficient time to allow of the exposed portions of the glass being cut or engraved by the sand-blast; and photographic pictures have been engraved by this means. The finer the sand used and the lower the pressure of the blast, the finer is the grain of the depolished surface, and the weaker and more delicate may be the texture of the covering substances used to produce the design. Any of the processes by which a design can be produced or transferred in a sufficiently tough medium may be used to prepare a surface for being engraved by the sand-blast. Many natural objects, such as plants, leaves, &c., which can be fastened flat upon a surface, offer sufficient resistance to a blast of fine sand to admit of their outline being thus engraved.

When wood is subjected to a sand-blast of moderate velocity, the softer and more brittle portions are more rapidly and deeply cut away than the others, and the grain of the wood and the hard lines and knots are thus brought out in relief.

When the sand-blast at a moderate velocity is directed upon a metallic surface it removes but little of the metal, but the grains of sand make innumerable small indentations in the surface, and produce a frosted or deadened appearance; and by means of stencil plates any design can thus be engraved on metallic surfaces. It will be evident from the above explanation that a special peculiarity of the process is, that not only can many kinds of work which are ordinarily done by hand be produced by it automatically, and at a very trifling cost, but other things can also be done which cannot otherwise be produced at all at anything like a reasonable cost. As an example of this kind, inscriptions can be cut in granite with raised polished letters; the cost of this by hand work would be very great, but it is done by the sand-blast process with great facility and expedition. The mode of executing this work is by first polishing the surface of the stone, and then cementing upon it metal letters forming the intended inscription, and subjecting the whole to the sand-blast; the surface of the stone is by that means cut away uniformly wherever it is not protected by the metal letters; and on removing the metal templates the inscription will be left in relief, with letters polished on the face and finished with fine sharp edges. The operation is effected with a single steam jet moved backwards and forwards over the work at a rate of about 20 feet per minute, and the stone is traversed slowly at the same time in a transverse direction, until the jet has passed once over the surface; the cutting of the specimen shown, 10 inches square and 3-17ths inch depth of cut, required only eight minutes with a pressure of 60 lbs. steam, and it was done with the steam jet exhibited with $\frac{5}{8}$th inch bore of tube.

The pierced ornamental marble panel exhibited was cut at two operations by placing a thin iron template on one face of the marble, and sinking the pattern half through its thickness by means of the sand-blast; the marble was then turned over and the template fitted upon the other face exactly corresponding in position with the first side, and then subjected to the sand-blast until cut completely through. A perforated design is thu formed, having the edges all regularly chamfere from each face, on account of the tapering form o the holes cut by the sand-blast. The specimen o marble shown, of about half a square foot area an $\frac{3}{4}$ inch thick, was completed in thirty minutes wit a steam jet of 50 lbs. pressure, and a similar speci men cut in sandstone was completed in only te minutes. Another specimen shows a similar desig cut in glass to a depth of $\frac{1}{2}$ inch.

When the material operated upon is not of uni form hardness, as in the case of granite (which an agglomeration of substances of different degre of hardness), the bottom of the hollows are not e level, and the harder portions, such as the quar crystals, are left slightly projecting above th ground. These may be dressed down by hand finish the work; but in uniform materials, such marble and slates, the whole is left neatly finish by the sand-blast process. Sunk panels in wo carving are readily produced by this process, b the time required is about twice as long in oak in marble, on account of the wood having a certa amount of elasticity, which softens the effect of t impact of the grains of sand. In operating up oak, the greater hardness of the grain of the wo causes the bottom of the hollows to be left uneve but with boxwood the work is left with a level su face, and the specimens exhibited show a beauti finish.

By using a higher pressure of steam jet t hardest substances can be cut, as shown by t hole cut in the specimen exhibited of corundum, mineral twice as hard as granite; and even harden steel can be cut, as shown by the specimen of a f 5-6ths inch thick, having a slot through it 5 inch long and 2-8ths inch wide, which was cut in abo thirty minutes.

DISCUSSION.

The Chairman said it was a very remarkable fact th so delicate a pattern as that of lace could be transfer to the surface of glass by this process, and this seem to point to the discovery of some new truths w regard to the molecular condition of different bodi It seemed at first sight very astonishing that steel, of the hardest substances known, could be eaten aw with tolerable rapidity, whilst a thing so fragile a fragment of lace would resist the same action for a c siderable time. One of the most remarkable thi about this invention was the wide range of its ap cability; to mention one instance, he had been infor that at the present time an order had been given America for 200,000 gravestones, to be erected to memory of those who fell in the civil war; whilst the other extreme as it were, stood the engraved la globes, which had been exhibited, about a gross hour of which could be produced by a boy with on these machines.

Mr. Pitman inquired if the part of that glass wh had been eaten away could be polished, because, if s would add greatly to the beauty of the appearance some cases, especially if it were silvered. Most of specimens seemed to present simply a bright pattern a rough surface; but there were many cases, as in s kinds of Venetian glass, in which it was desirable polish the engraved parts, and thus add greatly to lustre of the general effect.

Mr. Newton said there would be no difficulty in adapting any of the present processes of cutting or polishing by the wheel to glass treated by this method, but he did not quite see the utility of repolishing a surface which had just been depolished.

Mr. Pitman said his remarks had reference more particularly to engraved glass, which, when polished, reflected the light very beautifully, and was much increased in value.

Mr. Newton saw no reason why any of the ordinary processes of polishing should not be adopted if desired. This method was being largely employed as a substitute for the acid process, which was unhealthy, slow, and much more expensive. For instance, it had been largely used for producing coloured designs, lettered or otherwise, on flashed ruby glass, the design or inscription being left coloured, while the ground was eaten away by the acid. The sand-blast produced a better appearance, in less time and at much less cost; and when once the template had been prepared, a great number of plates could be produced, whereas, by the old plan, each separate sheet had to be etched.

The Chairman said he had noticed in last year's International Exhibition, at South Kensington, a very useful application of this process in the production of ornamentally perforated glass for ventilators.

Mr. Newton remarked that he had purposely avoided going into the thousand and one applications of which this process was susceptible, as it would have taken a great deal of time, and would have been travelling out of the course he had laid down for himself. In 1873, however, he read a paper before the British Association, in which he went into the question, describing the process as a new power in the arts, and mentioning a variety of purposes to which it might be applied. He had also read a paper before the Institution of Mechanical Engineers, in which he went into the engineering part of the question, and showed how it might be used for cutting tunnels and rock-boring. He was bound to say, however, that the experiments which had been made in that direction led to the conclusion that for such purposes it possessed no advantages over the methods at present in use. In reply to a question as to the comparative cost of this and the etching process for putting inscriptions on lamps and such like articles, he said the cost was about one-twentieth. Letters could be bought for a few pence per thousand, which could be placed on the glass, the blast applied, and in a few seconds the operation was completed. The lettering of publicans' bottles, lamps, &c., was done to a large extent.

Another question having been asked as to the practicability of boring holes through glass,

The Chairman drew attention to a large piece of corundum, one of the hardest minerals known, through which a hole half an inch in diameter had been bored, also to a file, through which a longitudinal slot, corresponding to the slot for the jet, had been cut in the same manner.

Mr. Newton said it took about half an hour to cut through the file in the manner shown. This was produced merely as an experiment, to show what could be done, not as being a useful application of the process, though he had no doubt such a mode of using the process would often be of considerable practical utility in mechanical engineering. Another application might be mentioned which had been found of some value, and that was the cleaning of iron castings from the sand which adhered to them, and which often injured the tools in filing, turning, and finishing them. For this purpose a special form of apparatus had been devised. It had also been used to prepare zinc plates for photographic purposes, and for electro-plating, producing a slightly roughened surface on which the deposited metal would adhere.

Mr. Tilghman said the process had been in use in America for the last two years, but its various applications had been pretty well all mentioned. It was largely employed for producing ornamental glass of various kinds, also for ornamenting sandstone, and marble, and for tombstones, and for cleaning castings, particularly in the case of elaborate patterns which were very difficult to clean from sand by the ordinary method. It had also this additional advantage, that it detected any rotten or defective place in the casting, and made it worse, so that it could neither be overlooked or covered over and filled up.

In reply to a question whether this process would be available for cleaning dirty wine and beer bottles,

Mr. Newton said there was no doubt the blast could easily be introduced into a bottle, but it would dedestroy the interior surface of glass, and possibly leave the dirt upon it. However, the works of the company in Sage's-buildings, Gray's-inn-road, were open to the inspection of any one interested in the subject, and the company would be happy to afford facilities for experiments in any manner which might appear likely to be useful.

Mr. Alexander Payne, as an architect, said the process appeared to be eminently useful in architectural decoration, but most of the specimens shown were somewhat fine in character. He should like to know whether it could be applied to such purposes as producing the tracery on church windows, and so on, where the apertures were of considerable size, and what would be its cost as compared with ordinary methods.

Mr. Newton said there was no difficulty in executing work of this kind, it was simply a question of the size of the grains of sand. They could use sand as fine as dust, or as large as small gravel, and by raising the steam pressure the work was done with increased rapidity. There was no difficulty in cutting to any required depth, provided there was room for the waste steam and sand to escape. The fact was, however, that this coarser kind of work was done quickly and roughly by hand, and they had not tried to compete with it, but had rather confined themselves to finer work, which either could not be done at all by hand or only at a great expense. For instance, the specimens of engraved granite and perforated marble on the table could be produced for as many shillings as it would cost pounds to do by hand; and they could produce a similar description of work in sandstone, which with the greatest care and the finest tools could not be done at all by the old method. The sand process, however, acted in such a delicate way, cutting away atom by atom, that there was no risk of failure.

Mr. Pearsall suggested this process might be useful in cleaning and renewing the surface of monuments, obelisks, and public buildings, which might then be coated with some kind of silicate or paint, so as as to resist the further action of the weather. Such an experiment could hardly be undertaken by an individual, but possibly a public company might try it, and if it proved successful, there would be in London alone a great demand for its application.

Mr. Newton said it had been tried in this way, and when the surface of the building was covered with what might be called clean dirt, or dust, there was no difficulty about it, but, unfortunately, there was often a coating of soot, which had become converted by time into a sort of gummy substance, which was very difficult to remove.

Mr. Tilghman added that the success of the operation in such cases depended in great measure on the kind of stone employed. Many buildings in London were constructed of Portland stone, which consisted of materials of different degrees of hardness, shells and other hard substances being imbedded in a matrix of carbonate of lime. In this case the sand-blast disintegrated the softer

material, and left the shells projecting, as might be seen as the result of the action of time in some of the columns of St. Paul's. The accretion of smoke and soot also acted almost like an india-rubber stencil plate in protecting the stone beneath, but if this could be scraped off first, the sand-blast would be very useful for cleaning purposes, because it would penetrate into all the recesses of the decoration, and thus leave the design as perfect as ever, instead of wearing away only the projecting portions.

Mr. Skelton asked what template was used in cutting through the file, and whether there would be any practical difficulty in cutting steel dies in this way.

Mr. Tilghman said in the case mentioned no template was used, the file was simply held about two inches over the blast. He had, however, engraved letters on steel by cementing on the surface soft iron letters which resisted the action much more than the hard steel.

In reply to a further question,

Mr. Newton said there was no difficulty in perforating glass by this method, though it was so difficult an operation by the ordinary process that about one plate in four was generally spoiled. He had had a piece of glass a foot square with as many as 150 holes through it.

On the motion of the Chairman, a vote of thanks was unanimously accorded to Mr. Newton, and the proceedings then terminated.

MISCELLANEOUS.

VIENNA EXHIBITION REPORTS.

(*Continued from page* 227).

The other report included in the first volume is that of Professor Archer, on the collection of imports of raw material exhibited by the British Commission. This consists for the most part of a list of the articles exhibited or illustrated, with statistics concerning them. Its object, as stated by the writer, is more to assist future collectors of such products in the formation of a proper classification, than to provide much information of a novel sort. The classification adopted was:—1. Food. 2. Dyeing materials. 3. Tanning materials. 4. Textile fibres. 5. Vegetable and animal oils. 6. Gums and gum resins, caoutchouc, &c. 7. *Materia medica*. 8. Timber, &c. 9. Miscellaneous vegetable substances. 10. Horns, hoofs, bones, feathers, quills, bristles, shells, &c. 11. Manures. 12. Mineral substances. 13. Mineral waters. The rest of the first volume is made up of other matter, to which reference will be made hereafter. For the present it may be as well to pass on to the next report, on machine tools, textile and other machinery, by Dr. J. Anderson.

This is divided into two parts, the first dealing with the machinery generally of the exhibition, and the second taking in detail the exhibits of the different countries. The writer found that, great as had been the advance in the production of machine tools and machinery, the comparative advance of other countries had been so much greater than that of Great Britain, that she no longer held the great pre-eminence manifested in previous exhibitions, that of Paris, for instance, in 1867, and still more, the Great 1851 Exhibition. Nor was the British Section as well represented in this department as were other countries. On this point Dr. Anderson speaks most strongly, and impresses on our manufacturers the great necessity that exists for keeping up our credit at such international contests as that of Vienna, if they would not see their trade passing away to Germany and elsewhere. Great as were the exertions made by many manufacturers who did come forward, there were yet many more who did not come forward at all in Exhibition, and to their supineness is attributed w ever shortcomings were to be found in this part o British Section. This was the great lesson to be l at Vienna, that this country must put forth all her en and skill if she is to retain the position she still tinues to hold, even among the eager competitio surrounding nations.

Comparing our exhibits with those from Austri reporter noticed a lack of new ideas in ours espec though he appears to find the same defect evident i whole show of machinery through the exhibition. was a want of originality. "Notwithstanding exuberance of contrivances that was shown at Vien was more by shuffling the old inventions than by ing new ones." America showed the greatest n of new devices, but, with an occasional exception, not considered to come quite up to European st standard. Austria had a magnificent display of every description of machinery, many of her m tools, especially those for working wood, being equal to the best of any country." France and Ger were considered to have almost arrived at the sam fection as our own best houses. Belgium did not much improvement on her exhibits at Paris in Sweden, with a small collection, showed much th good. Switzerland made the finest display she ha done. In the Russian Section, great improvemen visible, though in many respects that countr behind Germany and Austria.

Such is a meagre outline of the view taken Anderson about the productions of the different cou Into the many descriptions of the different machin hibited there is no space here to follow him. I cluding his report, he observes that it has become that we have no longer a monopoly of the class of described, hence he urges our future success will on the "united co-operation of capital with both th and workers, with each in his place doing his utm refine and improve our productions, and in the de of better auxiliary means in order to produce them and more rapidly and economically."

The next report is by Mr. G. C. V. Holm stationary and portable engines and boilers, pumps and fire-engines, hydraulic motors and h machinery. Mr. Holmes begins his remarks by pression of regret that there were not more opport for applying practical tests to the various engines The juries were consequently obliged to make awards without accurate knowledge of the perfor of each, and hence dissatisfaction arose in some For the guidance of the managers of future exhib Mr. Holmes sketches out a scheme for testing e and boilers which might be applied, he thinks, wit results.

Turning to an examination of the contents exhibition, the reporter did not find very much th peared promising in the way of prime motors othe steam. Nor as regards steam generators was with a few exceptions—much token of progres regards the comparative value of the display m different countries, neither America nor Great was conspicuous. As regards the latter, Mr. looks to the increased cost of coal as likely to good results in this direction, a country where plentiful and cheap not being the one which we m pect to find appliances for its economical consum France, too, was very deficient in this department, of things attributed to the recent war. Belgium is of in terms of high commendation for some exhibits. Switzerland, for the number of her exhi made the best show of all. The exhibition m the German empire was of great amount and of class merit, but Austria, though equally with Ge occupying a very large space, had not so much t that was original. The Ehrhardt steam engine Dingler, Germany), a Swiss "Corliss" engine (

...and Co.) Brotherhood and Hardingham's "...gon" engine, two heat motors by F. Siemens of ...n, and a straw-burning locomotive boiler, for use ...the great corn districts of Hungary and Southern ...a, were among the objects singled out for special ...mendation.

...llowing the above, comes Lieutenant-Colonel ...hael's report on agricultural machinery. In this ...nce the reporter is able to speak in much more ...factory terms than the writers of reports before ...ed on the character of the British display. Our ...facturers, seeing the advantage of getting access to ...new market for their implements afforded by the ...corn-growing countries of South-eastern Europe, ...d in a conjoined effort, which made their show of ...ultural machinery inferior to no part of the exhibi... The implements even now used in the district ...re mentioned are of the most primitive kind, and ...is an almost boundless field for improvement. ...he English agricultural machinery was so superior ...at shown by any other country that Colonel Michael ...confined his remarks almost entirely to it, noting ...a few foreign implements which received special ...from the jury. The circumstances not appearing ...able for the employment of practical tests, the ...ish machine makers determined to decline them ...ly, and to submit their machines to inspection ...ly, a course the justice of which the results of testing ...ed to foreign implements subsequently confirmed. ...various classes of agricultural machinery were all ...illustrated, and beyond the improvements in con...tion which our frequent agricultural shows have ...familiar to all interested in this subject, there is not ...that need be mentioned here. There were one or ...special appliances, such as a combined threshing and ...-bruising machine for use in the south of Europe, ...hay is unattainable and the straw is of so hard ...brittle a character that it cannot be treated in the ...chaff-cutters, but requires a special bruising before ...will eat it. The portable engine, using straw as ...has been alluded to above.

...r. J. H. Cundall's report on the machinery lent to ...British Commission is very short, comprising only a ...pages. It gives merely a list of the ten firms who ...engines, boilers, cranes, &c., and a brief account of ...arrangements made for generating and supplying ...to the machinery in the British Section.

...r. Russell's report on small arms also is not very ...thy. He expresses an opinion that in Vienna and ...they are running the London makers very close in ...llence of finish and apparent quality. As to general ...ovement, he considered that none of the exhibitors ...nted any useful, novel, or ingenious invention to ...nguish this exhibition from the last at Paris. Dr. ...ell also thought the exhibition deficient in quantity ...quality. Some countries, such as Russia, were barely ...ented; Belgium was only represented by one firm. ...of the best known French firms were *hors concours*. ...English exhibitors were few. The Americans sent ...fowling-pieces, and their makers exhibited merely ...and military rifles. With the exception of Berlin, ...gue, and Vienna, there were few manufacturers of ...whose workmanship was even of second-class ex...llence in the foreign department.

(To be continued.)

The *Moniteur Industriel Belge* states that ... manufacturers are purchasing the fish bones ...red along the Norwegian shores which result from the ...tive fish-curing stations there located. These bones ...a fine fertiliser, and, when pulverised by suitable ...chinery at the point of collection, are readily transported. ...same journal suggests the more extended utilisation of ...bones from the establishments in Newfoundland, and ...states the product from American fisheries at twenty ...illion pounds a-year.

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the month of January, 1875. When they are counted by sight the words "by sight" are used, when by turnstile the word "machine":—

	Voted in 1874.	Number of Visitors. Jan. How counted.
1. British Museum	£102,442	return refused.
2. National Gallery	6,346*	58,822 (by sight).
3. Kew Gardens and Museum	17,862	7,344 (by sight).
4. South Kensington Museum	38,024†	61,807 (by machine).
5. Bethnal-green†	5,810	44,125 (by machine).
6. National Portrait Gallery	1,748	No return.
7. Geological Museum, Jermyn-street	8,998	5,564 (by machine).
8. Patent Office Museum §	1,490	No return. (by machine).
9. Edinburgh National Gallery ‖	2,100	18,680 (by machine).
10. Edinburgh Museum of Antiquities ‖	...	16,358 (by machine).
11. Edinburgh Museum of Science and Art **	9,824	76,679 (by machine).
12. Edinburgh Botanic Gardens	1,750	No return
13. Royal Dublin Society	1,823	"
14. Dublin Museum of Natural History	1,672	5,482 (by machine).
15. Glasneven Botanic Gardens and Museum	2,148	4,232 (by machine).
16. Dublin National Gallery	2,380	No return.
17. Geological Society, Dublin	500	"
18. Museum of Royal Irish Academy, Dublin	2,084	"
19. Zoological Gardens, Dublin		3,330
20. Tower of London††	2,236	9,181 (by sight).
21. Royal Naval College, including Greenwich Painted Hall	1,416	15,178 (by sight).
22. Royal Naval Museum	...	3,585 (by sight).

* Exclusive of special purchases. Total number of visitors for the year, 807,304. The Gallery was closed from Monday, Sept. 28, to Monday, Nov. 2.

† These expenses may be treated as local to the Museum; others for purchases, circulation, travelling, carriage, &c., for 120 Schools of Art, amount to £51,859, and a portion, say £15,000, should be added to the above. The returns of the number of visitors to South Kensington Museum for the year 1874 were as follows:—Morning (six days of seven hours), 531,903; evening (three days of three hours), 270,495; students (daily), 111,729; total, 914,127—being an increase of 55,090 over the numbers in 1873. The total numbers since the opening in 1856 has been 13,940,228.

A correspondent of *Iron* writes:—"In the present scarcity of gold it may be satisfactory to hear of the discovery of fresh gold-fields in India. From time immemorial gold has been found in certain streams running from the Neilgherry hills in India, and quite recently gold-reefs have been discovered in the coffee plantations in the Wynaad, the watershed of these streams. The country there is partly the property of the native rajahs, partly of English coffee planters. The latter have already begun to work the gold-fields with machinery from Australia. The yield is about 2 oz. of gold to the ton. The discovery is of such importance that the governor of Madras has gone to the hills to inspect the gold-fields."

The total coal produce of the United Kingdom in 1873 was 127,016,747 tons, representing a value of £47,631,280. The iron ore amounted to 15,577,499 tons, valued at £7,573,676. The coal raised in 1873 was employed as follows:—Exported to foreign countries, 12,712,222 tons; railways, 3,790,000 tons; iron manufacture, 35,119,709 tons; smelting other metals, 763,607 tons; mines and collieries, 9,500,000 tons; steam navigation, 3,650,000 tons; factories, 27,550,000 tons; gas, 6,560,000 tons; water-works, 650,000 tons; potteries, glass-works, brick, lime, and cement kilns, 3,450,000 tons; chemical works and all other sundry manufactures, 2,217,229 tons; domestic consumption, 20,050,000 tons.

Arrangements have just been concluded with the Council of the Royal Albert Hall for an Annual International Exhibition of Fine Arts, to be opened about the commencement of April. The Exhibition will be organized by Mr. J. H. Gammon, formerly connected with the Belgian Department of the Annual International Exhibitions.

The Philadelphia and Reading Railroad Company have commenced the use of petroleum gas in their cars.

THE PROPOSED ALTERATIONS IN THE RAILWAY SYSTEM OF THE GERMAN EMPIRE.

(*Concluded from page 229.*)

The State only has an interest in covering all parts of the land, however remote, with a well-regulated network of railways. It is the duty of the State to deal out to all parts of the kingdom even-handed justice, giving to all alike the means of communication, without which one district must necessarily fall behind those which are better provided. The State also reaps the fruits of the general well-being which results from the opening out of agriculture and commerce, mines, forests, &c., in the shape of taxes and duties, and increased profits of Government lands. Even if with one hand the State makes great pecuniary sacrifices, it will be indirectly repaid on the other hand in a thousand different ways.

In Würtemberg, for example, before the construction of railways in 1838-39, the revenues derived from the Crown forests amounted on an average to about 1,669,946 florins, whilst during the ten years between 1862-72 the average revenue amounted to 3,102,127 florins per annum, or more than double the former figure. The smelting works yielded in 1831-39 on an average 211,936 florins to the Treasury, as against 400,656 florins per annum from 1862-72. The liquor duties yielded in 1840-44, 1,206,654 florins per annum, in 1872-73, 4,296,424 (which at the same rate of taxation would have amounted to 3,603,504 florins). The proceeds of the property-tax also increased immensely in consequence of the impetus given to trade and industry by the extension of the railway system. These figures, taken from the official reports, will prove sufficiently that the State of Würtemberg has suffered no financial loss from the Government railways. It must not, however, be understood that the State could afford to have all its lines ruined by competition of private lines.

Let us look at the words spoken by Baron von Friesen in the debates in the Saxon Upper House, which deserve to stand in letters of gold on the table of every statesman who has any influence on the question of State as against private railways.

The Commission appointed to examine into the proceeds of the State railways had explained the reasons for the reduced profits of the Saxon lines (chiefly due to high prices of material and labour). On this the Minister of State, Baron von Friesen, remarked, "That what the Commission had stated was perfectly correct. But they had omitted one cause, and that in his view the principal one, of the reduced profits of the State railways. He was the more anxious to draw attention to it, because it was most important that a fall in the profits of the whole railway system should not be confused with the profits of any individual line. A fall in the latter would have been to be deplored, whilst the reason of the fall in the former could only be a cause for rejoicing, for it lay in the fact that for some years the extension of the railway system in Saxony had been carried out rather with industrial than financial ends in view. The Government had constructed a number of lines with the certainty that they would not only bring in no profit, but not even cover their expenses. But he rejoiced in the action taken on the question, for these lines were of the greatest importance for the development of industry, agriculture, and the general well-being of the country. He could not refrain from pointing out that the principle firmly adhered to by the Government, of keeping the construction of certain undoubtedly profitable lines in its own hands, had been crowned with success, for only by the State constructing the profitable lines would it be possible to bestow upon those poorer districts, whose resources could only thus be developed, the necessary means of communication and transport. He therefore begged the Chamber not only to consider the financial results of the State railways, but their importance for t
general welfare of the country."

The importance of the railway system being entir
under the control of Government has been exemplifi
in France, where the main routes have been left in t
hands of private companies. Although these compan
received large subventions from the State, yet no n
work of lines was formed, rather a star, of which
centre was Paris, whence lines radiated to
sea-coast and great commercial towns of Fran
Of course the further these radiating lines were fr
Paris, the wider were the tracks of land betwe
which were destitute of railways. To remedy
evil the Government projected some new lines in
public interest, and by offering immense subventi
induced some companies to undertake their construct
The result was that France paid altogether 1,713 mil
francs in subventions, payable at about $\frac{2}{3}$ in capital,
$\frac{1}{3}$ in annuities, whilst the capital supplied by the c
panies amounts to about 8,573 million francs; also
State has guaranteed annuities at 5·65 under cer
chances of repayment, and as the small branch l
only pay a very small dividend, it has to pay a l
sum under this head. But as even these branch l
of which all are not yet built, by no means satisfy
demand for intercommunication, the French Gov
ment has been driven to give subventions to an
series of lines, of which about 1,475 kilometres
been finished in the year 1869. These latter railw
however, for which the capital has been bro
together chiefly by the issue of obligations, do not
to be self-supporting, and the public has at various t
been warned in the French papers against the purc
of such shares. This unthrifty management, by w
the companies holding the main lines have secured
own dividends, such as they were before the creati
the branch lines, but by which the State will prob
have incurred a loss of two milliards, in the sha
subventions and advances, shows the results which
ensue when the State leaves the main lines with
high profits in the hands of private individuals, and
is left to supply the other unprofitable lines by di
immense sacrifices of the States, *i.e.*, by the taxpa
money.

In Belgium, again, the Government has bitterl
pented having damaged the value of the State line
granting concessions to railway companies. Let us
what the Belgian Minister of Public Works sai
answer to a question put to him by the Oppositi
the Chamber of Deputies, concerning the increase o
cost of working the Government line (May 1, 187
"This increase," said M. Beernaert, "is partly d
the general rise in prices, partly to the multiplicati
railway lines. In this respect the condition of thi
nowhere worse than in Belgium, and it is due to
I will not call a series of mistakes made by the pre
Governments, but at least to a great want of for
and wisdom. It is the agreement of April 25,
which weighs so heavily on the finances of the
and contributes principally towards making the wo
of our railways unremunerative. By this agre
630 or 640 kilometres of less profitable railways
added to the 900 kilometres of profitable State
But this was a necessary step, and had I been
in Parliament I should certainly have voted
and why? Because the Government, having tho
lessly granted all concessions which were solicite
allowed the State lines to be gradually surrounde
network of private lines. until they woke one fine
ing to find themselves bound hand and foot b
net, which it was necessary to break at any
The railway company whose line led through th
regions had managed the matter very cleverly; th
so arranged their lines as to draw away the traffic
the State railways at every point. Their object ha
less to open out new resources and to work new mi
wealth, than to divert from the old channels, for

advantage, those already existing; and the consequence is that the Government is now compelled to work lines side by side with one another, of which many were only destined to compete with the others, and which ... exactly the same interests." In Belgium, in ... the Government, which possessed the main lines ..., without sufficient reflection, granted here and there concessions to private companies, which had been clever enough to combine and unite together, and so to reduce the State to the alternative between the purchase of the private lines and the ruin of the State lines; and now the Government has come into possession of all the ... lines, it finds out that the railway system is ... ruinous. In many parts they find that there are two or three lines where one would be quite sufficient. It is self-evident that no advantage can be gained by railway competition. Such competition necessarily ends in coalitions or fusions of companies, and the increase of fares and tariffs. The expense of establishment and railway construction is so enormous, that all the capital invested in this manner would be lost, if the line were ...ed. The traffic, though promoted and stimulated by the railway, is after all limited by the direction in which the line runs—not like the activity of a manufactory capable of an indefinite extension. Many railways ... succeed on one route, because there is only a ... amount of traffic to be divided amongst them, and each company is compelled to spend almost the same ... on stations, offices, &c., for the transport of half ... that of the whole traffic, the competition of several companies on the same line necessarily ends in higher ... and rates than would have been the case had ... company held the whole traffic undisturbed. ... advantage of the State railways lies in this, ... the railway debt is paid off, the State is enabled to transport persons and goods at the lowest possible ..., as the railways are a possession which, even with ... tariffs, brings in considerable profit to the Treasury. ... last, not least, that corruption and jobbing is prevented, which as is well known is carried by the promoters and directors of railway companies even into ... Parliament or Chambers of Deputies. Under the ... of men whose sole object is the promotion of the public interest, we find too often, contractors, directors, ... speculators legislating exclusively for their own interest. And instead of one central Board administering the national railways, we see in the case of railway companies a multitude of administrators, all ... disproportionately high pay as directors of ... respective lines.

If any one State, as Prussia, for example, chooses to ... a portion of its railway system to fall into the ... of private individuals, that is a matter to be decided by its own legislature; but other German States ... have more or less accepted the principle of the ... control over the railways, have a right to demand ... they shall be allowed to decide the point themselves, and not be compelled by orders ... Berlin to ruin their State lines and finances ... granting concessions to railway companies. For these reasons we do not wish for a Railway Bill, ... much less a Bill like the one before us. If ever ... was a measure which ought to be vigorously opposed by every State Government throughout the Empire, beginning with that of Prussia, whose Minister of ... does not appear yet to have reached that ... of opinion indicated in the "motives," it is the ... now brought before our notice by the Railway Department for regulating the Imperial German Railways. We hope that the legislators and statesmen of Germany will give this momentous question their most ... and impartial consideration.

One thousand five hundred and twenty-four ... of rail were completed in the United States in 1874, ... 4,... miles reported for the same period in 1873, and ...

GENERAL NOTES.

Female Education.—A meeting was held on Wednesday last, at Mr. Holloway's, in Oxford-street, to consider a proposal by that gentleman to found a college for women. Mr. James Beal presided, and there were also present Sir James Kay-Suttleworth, Mr. Samuel Morley, M.P., Mr. D. Chadwick, M.P., Mrs. Fawcett, Mrs. Arnold, Mrs. Grey, Mr. E. Ray Lankester, Mrs. Pennington, Mr. W. J. G. Fitch, Mr. Arthur Arnold, Dr. Hague, and Dr. Richardson F.R.S. It was stated that a site at Egham had been purchased at a cost of £25,000, and plans had been prepared for a building to accommodate 400 boarders. With whatever readiness the munificence of such an offer may be recognised, it must be remembered that the creation of a building is of far less importance than the establishment and endowment of a suitable educational scheme. Were such an institution once started, with adequate funds for the acquirements of actual teaching, it might be safely left to private enterprise to supply houses and all necessities for boarders, nor would any building be required beyond such as would supply accommodation for lecture-rooms, class-rooms, and the like.

Consumption of Wood in France.—The *Independence Belge* gives some curious statistics relative to the consumption of wood in France, of which the following is only a small item. Every person in France consumed on the average daily five lucifer matches, so that 4,600,000,000 matches are consumed monthly by the entire population. A large quantity of soft wood is used for making toys, and to give an idea of the magnitude of this trade it will be sufficient to take one article alone, children's drums, of which in Paris alone 200,000 are sold every month. The total number made annually in France is estimated at 30 millions, whilst a considerable quantity of wood must be consumed to supply 60 millions of drum-sticks.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Statistics of the Colony of Victoria for 1873. Part 9, Vital Statistics, &c. Presented by the Agent-General.

Gemeinnützige Wochenschrift for 1874.

On the Policy of Liberalism, by Daniel Grant.

Nova Zembla; a poem, translated from the Dutch of H. Tollens, by William Young. Presented by the Translator.

Capital and Labour; the Steains Prize Essay, by Houghton Baldwin.

Reports of the Vienna Universal Exhibition for 1873; four parts, with maps and plans. Presented by Her Majesty's Commissioners.

The following works relating to the Paris Exhibition of 1867 have been presented by the Science and Art Department:—

Catalogue of the British Section. Two copies.

Calalogue of the Fine Arts Division (British Section).

Catalogue of the Illustrations of Printing, executed in the United Kingdom.

Catalogue Général, Histoire du Travail. Part 2.

Catalogue Officiel des Exposants Recompensés par le Jury International. Two copies.

Katalog der österreichischen Abtheilung. Two copies.

Berichte uber die Allgemeine Austellung. Two copies.

Rapport Précis des Opérations.

Documents Officiel du 1er Fevrier, 1865, au 1er Avril, 1867.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

February 17.—"Description of M. Kastner's New Musical Instrument, the Pyrophone," by M. Dunant. The instrument will be exhibited.

February 24.—Adjourned Meeting for Captain Bedford Pim's Reply to Discussion on his Paper on "The Mercantile Marine of Great Britain."

March 3.—"The Art of Illustration as applied to the Printing Press," by Henry Blackburn, Esq.

March 10.—"Food Adulteration and Legislative Enactments Relating Thereto." By Wentworth Lascelles Scott, Esq.

Extra Meeting.

February 16.—Adjourned Discussion on Captain Bedford Pim's Paper on "The Mercantile Marine of Great Britain."

The specimens shown at the meeting of last Wednesday, in illustration of Mr. Newton's paper on the Sand-blast, will remain on view at the Society's House for a few days. Members are also invited to visit the works of the Sand-blast Company, at Sage's-buildings, Gray's-inn-lane, when the whole process can be seen in operation.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

February 23.—"The Social and Domestic Slavery of Western Africa, and its Influence upon Commercial Progress," by Thomas J. Hutchinson, F.R.G.S., F.S.A., late her Majesty's Consul at Callao.

March 9.—"Livingstone's Discoveries in Connection with the Resources of East Africa," by the Rev. Horace Waller.

Indian Section.

Friday Evenings, at 8 o'clock. The following arrangements have been made:—

February 12.—"The Possibility of Adapting the Roman Alphabet for the Languages of India," by Frederick Drew, Esq. Sir Charles Trevelyan, Bart., K.C.B., will preside.

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

February 19.—"Air and Ventilation," by W. N. Hartley, Esq., F.C.S.

March 12.—"River Pollution, with Special Reference to the Work of the late Commission," by W. Thorp, Esq., B.Sc. Lond., F.C.S.

April 16.—"Recent Advances in Photographic Science," by J. Spiller, Esq., President of the Photographic Society.

Cantor Lectures.

The Second Course of Cantor Lectures is by the Rev. Arthur Rigg, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

The remaining Lectures of the Course will be delivered as follows:—

Lecture II.—Monday, 15th February, 1875.

Hammers and Mallets.

Lecture III.—Monday, 22nd February, 1875.

Hammers and Mallets (continued).

Lecture IV.—Monday, 1st March, 1875.

Picks, Axes, Adzes, Chisels.

Lecture V.—Monday, 8th March, 1875.

Planes, Knives, Shears, Saws.

Lecture VI.—Monday, 15th March, 1875.

Saws and Dove-tailing Tools.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Rev. Arthur Rigg, "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft." (Lecture II.)
Royal United Service Institution, Whitehall-yard, 8½ p.m. Mr. J. K. Laughton, "Scientific Instruction in the Royal Navy, including an outline of the Studies at the College."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on the Paper by Mr. J. R. Knollys, "On the Landlord and Tenant Question."
Entomological, 12, Bedford-row, W.C., 7 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 8½ p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Rev. Prebendary W. J. Irons, "On Mr. Mill's Work on Theism."
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. Carpenter's "Physical Geography of the Deep Sea."

Tues. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on Captain Bedford Pim's Paper on "The Mercantile Marine of Great Britain."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. E. Ray Lankester, on "The Pedigree of the Animal Kingdom."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Charles William Lancaster, "On the Erasion of the Bore in Heavy Guns, and the means for its Prevention, with further Suggestions for the Improvement of Muzzle-loading Projectiles."
Statistical, Somerset House-terrace, W.C, 7¾ p.m. Mr. Charles Gatliff, "Improved Dwellings, their Beneficial Effect on Health and Morals, with Suggestions for their Extension."
Zoological, 11, Hanover-square, W., 8½ p.m.
Royal Colonial (at the Pall-mall Restaurant, Waterloo-place). Mr. W. F. Chesson, "Fiji."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mons. Dunant, on "The Pyrophone."
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thurs.... Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. Dr. T. S. Cobbold, "On the Structure, Affinities, and Probable Source of the large Human Fluke." (*Distoma crassum*, Busk).
London Institution, Finsbury-circus, E.C., 7 p.m. Professor Ella, "Music Lecture II."
Chemical, Burlington House, W., 8 p.m. Professor Clerk Maxwell, "Lecture on the Dynamical Evidence of the Molecular Constitution of Matter."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Dr. H. C. Zerffi, "English Sculpture."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "On Electricity."
Numismatic, 13, Gate-street, W.C., 7 p.m.
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. W. N. Hartley, "Air and Ventilation."
Royal United Service Institution, Whitehall-yard, 3 p.m. Major C. B. Brackenbury, "The Intelligence Departments of the Staff Abroad and at Home."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Professor Frankland, "River Pollution."
Geological, Burlington House, W., 1 p.m. Annual Meeting.
Philological, University College, W.C., 8 p.m. Dr. Murray, "Early and Modern English Dialects."

Sat......Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. T. Wood, on "His Discovery of the Temple of Diana, and other Results of the Government Excavations at Ephesus."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,161. Vol. XXIII.

FRIDAY, FEBRUARY 19, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Alkali Examination is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

GENERAL EXAMINATIONS, 1875.

The attention of the Secretaries of Local Boards is requested to the following paragraphs from the Programme of Examinations:—

"19. A list of each Local Board (giving the exact address of the Secretary) should be submitted to the Council of the Society of Arts before the 1st of February, 1875, and where a Local Board comprises so large a district that, for the convenience of the candidates, Branch Local Boards have to be formed, lists of these must also be given. All changes in the composition of the Board should be notified to the Society of Arts.

"The Secretary of any District Union or Local Board in connection with the Society of Arts, desiring to adopt the scheme of Elementary Examinations, must apply to the Secretary of the Society of Arts before the 1*st of February*, stating the number of *male* and *female* candidates respectively desiring to be examined in *each grade.*"

EXTRA MEETING.

The adjourned discussion on Capt. Bedford Pim's paper on "The Mercantile Marine," was resumed on Tuesday evening, Febuary 16th, Capt. Sir John Heron Maxwell, Bart., R.N., again occupying the chair.

The Chairman remarked that very much interest was felt in the question under discussion, but he desired to suggest that in the remarks which might be made, gentlemen should more particularly confine themselves to offering practical suggestions rather than in attempting to rebut, or perhaps more correctly meet, the charges made by Captain Bedford Pim. It must not be forgotten that painters in the first instance laid the paint rather thickly upon the canvass which was afterwards toned down, and so Captain Pim had perhaps employed a good deal more colour in the first instance than was necessary, and which might afterwards be toned down. He could assure the meeting that any suggestions which were made which could be of practical use, would receive every attention at the hands of the gentleman who had introduced the Merchant Shipping Bill into Parliament. One thing he desired to mention, was the omission of a clause in the Bill looking after the health of the men of the mercantile marine. In the navy every seaman was subjected to a medical examination. In the merchant service nothing of the kind took place, where it was of much more vital importance from the smallness of the crews, as the loss of half a dozen men from sickness in a merchant ship was of much more serious consequence than it would be in the navy, where the crews were so much larger. He was happy to say that Sir Charles Adderley would not require very much pressure to introduce a clause to this effect.

Mr. Scott Russell gave notice that at a later period of the meeting he should move the following resolution, which he had reason to believe would be generally concurred in:—"That the council of the Society of Arts be requested to appoint a special committee to watch the progress of the Merchant Shipping Bill through Parliament."

Captain Toynbee said:—There is a general feeling that our seamen and ships are not all they ought to be, and, Adam-like, we naturally look round for some one on whom to throw the blame. Philanthropists have come down with sweeping charges against ship-owners and the Government, frequently without sufficient discrimination between the good and the bad, while I think ship-owners have often taken to themselves, as a class, what was only intended for the bad. Permit me very briefly to state what my experience teaches me may be done by Government, by ship-owners, and by captains and officers. Government could so arrange our shipping offices that the sailor might go from his ship to his home at once, without the delay of an hour, for the influence of crimps and other bad characters. Money can be available, cabs might be in all docks, as they are in those at Liverpool, and the seamen advised to go off at once to their own homes, whither the rest of their pay should follow them. This would save a very large percentage of the young and married who are not in slavery to bad habits. A little poem, "Davie Blake the Sailor," by that admirable writer, Mrs. Sewell, illustrates this difficulty well. Government can start a Pension Fund and Life Insurance for Seamen, to be managed at shipping offices; it is undeniable that when once a man has saved a little money he is inclined to save more; and if sailors could buy a pension and insure their lives with lump sums, paid when they liked, they would not only provide for old age, but would not be likely to change their names, or leave their ships or country. Government might also start training-ships for respectable poor boys, so that they might be as well off as young criminals, and preference should be given to the sons of seamen. Here Mr. Norwood's suggestion comes in, that such training-ships should be supported by a tax on those ships which do not carry a full complement of that class of boys, and that steamers which require trained seamen, but cannot train them, should be required to help in their training. There is, no doubt, a dearth of trained seamen, and I think Mr. Norwood has well accounted for it by the doing away with compulsory apprenticeship, and the immense increase in the number of ships. I heard the other day of the captain of a steamer, who was hard up for A.B.'s, saying to a man who offered himself as such, "Can you do this?" "No." "Can you do that?" "No." "Well, can you wheel a barrow?" "Yes." "Then I'll take you as A.B." But I could fill volumes with complaints of the incompetency and sensuality of seamen. My answer is that I expect them. You might as well hope to put your hand into the fire and not be burnt, as to keep any class of human beings good without education. How can you expect men to do right who spend eleven months cut off from all sources of enjoyment, and the twelfth surrounded by the strongest temptations to sin. The ship-owner and captain who do nothing for the mental welfare of their seamen have forgotten the most important part of their ship's outfit. This is the more important now, as it is more difficult to give proper time to the subject in

these days of steam racing over the world. I would remark, in passing, that Lascars are British subjects, and have as much right as English seamen to be employed on board our ships. Government inspection has, I am aware, great difficulties. We learn from Mr. Norwood that it has, however, put an end to scurvy, and that ships' forecastles are more comfortable; but we are still in want of a clever invention to prevent sea-water from coming into a top-gallant forecastle whilst the cables are being bent, and during the time that they remain so. I must own to having ventured nearer the land than was prudent without bending cables and having the anchors ready, just because I feared washing my men's chests and bedding out of the forecastle. Still, top-gallant forecastles are so much fresher for tropical climates than lower ones, that I prefer them on the whole. I hear from a captain, just about to sail in a fine ship, that now most ships have an almost water-proof slide, to slip over the cable just abaft the hawse-hole, when it is bent. If this is fitted to some, why not to all ships? Another captain tells me that most steamers work their cables through pipes, which prevent any water coming into the top-gallant forecastle. This seems to be the best plan, and will, I hope, be required, until something equally good or better is invented. The public mind is still not satisfied on the overloading question, as is shown by the great desire for a load line; and though legislation for it has been styled "meddling and muddling," such "meddling and muddling" may be only as the irritation surrounding a wound that is being healed, and I would rather see it than that we should give in to the difficulty, and allow overloaded ships to go to the bottom with their crews, even though Mr. Scott Russell's remedy were applied, and their widows and orphans were permitted to see the owner dangling on a gibbet. Mr. W. W. Rundell, secretary of the Underwriters' Registry for Iron Ships, Liverpool, whose name is well-known in connection with the adjustment of compasses, has proposed that ships should be marked with a line showing the percentages of registered tonnage under the deck, and that the "Fair load-line" and "Too deep load-line" should be made quite clear upon it. He supposes the following case:—"It is getting to the end of the season, and the last steamers are about to sail for the Baltic. Shippers are anxious to get their goods forwarded, and the steamship owners find that they must either disoblige their friends or load their ships more deeply than usual. The owners know that the risk will be greater, and that the ships will take two or three days longer on the voyage, but they will get more freight; they are also their own underwriters to a large extent, and they determine to run the risk. But what of the other underwriters on the ship and cargo, and what of the crew? Are they consenting parties? Are not the former entitled to more premium? Are not the latter entitled to more pay, or to be allowed to leave the vessel without the unpleasant alternative of a month in prison? The remedy that I offer will still allow the ship-owner to load as deeply as the exigencies of his business may require, only it makes him subject to a special engagement with his crew when his vessel is loaded beyond certain well-defined limits." I strongly recommend the whole letter to Government; and before closing my remarks on what might be done by Government, I must say that I think it would be a very good thing to have an office of the State specially devoted to our mercantile marine, and wish to call attention to an article in the *Nautical Magazine* for this month, entitled, "Wanted, a Ministry of Commerce," from which I take the following quotation:—

"Is is singular that the people of Great Britain, the chief of maritime states, will rack the country, and waste months of talk on questions relating either to the exact moment of closing public houses, or to the length and colour of a parson's vestment, or the details of his gestures, but will not afford one whole night in a session for the consideration of merchant shipping matters. A people dependent for their food and clothing, nay, even for their very existence, on our merchant ships and merchant seamen, not only pay no consistent attention to the subject, but even do not
to provide funds to establish an office of State in which it can
adequately dealt with. At the same time, Members of Parliame
who can get no votes from seamen, do not take that warm inte
in them that they do in publicans and parsons. We do not say
this is the case with all Members of Parliament, but a cynic once
that, out of the mystic 658, the eight would very nearly cover
exceptions."

We also learn from Mr. Norwood that, through Gover
ment interference, ship-owners have been fined
imprisoned for doing wrong, thus proving the value
legislation. Here let me say that I have great sympat
with ship-owners; many of them are excellent m
anxious to do their duty towards God and towards m
and the very best have great difficulties to contend wi
One more thing Government should do. Our colon
and all our dependencies have their very existe
through seamen, and yet only the filthiest part of
port is devoted to them, instead of a piece of land
a building for their recreation. The sailors' ho
provide for the few who live on shore, but an instit
might provide recreation and intellectual and religi
teaching for the hundreds, and sometimes thous
(as in Calcutta), who belong to ships in
port, and only go on shore for recreation.
much for what Government may do. Ship-ow
can supply good and comfortable ships, and have t
properly loaded. They can select able men as c
manders, and give them sufficient pay. How can i
supposed that well-trained men can be found as c
manders for £10 or £12 a-month, with no other h
means for making money? One captain writes to s
"I know that some men in command of vessels
800 tons in the East India trade have only £10 a m
A few days ago I was offered £350 to go in a new sa
ship, and that is the highest pay I ever heard of. S
owners very rarely allow any commissions on fr
or passage money, and forbid private ventures.
ship-owners are averse to masters taking their wives
families with them, and if they do they often charg
them." Of course there are a few fine exceptio
these low rates, but it seems that whilst we
specially training young gentlemen for the merc
service, and all articles for supporting a family
getting more expensive, the pay of the mass of merc
captains is decreasing. I have heard bitter compl
from conscientious men as to their difficulties in sup
ing a wife and family. They have told me how
get perquisites on coaling, others on provisioning ab
&c., which as honest men they could not accept.
told me that he was required to provision his crew
officers at 1s. 3d. per head per day. This led m
write to a leading firm of provisioners in London,
tell me that 1s. 2d. for men, and 2s. to 2s. 3d. for ca
and officers per day, are fair rates. But they go o
say:—"We do know of scales where captain and of
are victualled for 1s. 5d. per day (sailing ship),
crew at 10½d. per day; provisions inferior an
variety." They add:—"We consider this poor econ
and never run after the order, as complaints often fo
and no wonder." Of course, nothing could be bett
the good ship-owner than to put a stop to such wo
this, and the question is, can legislation do it? A
owner told me a few days ago that there is a man
in London who said to his captain just before star
"If this voyage ends as I expect it will, you shall
a new ship when you come home;" it being well u
stood that the ship was to be lost. At another ti
water-logged ship was brought home for him by a
scientious captain. Of course the latter was pai
and when another owner called on the above w
to learn the character of his late employé
reply was, "Oh! he's a very clever fellow
too clever for me; he actually brought hom
water-logged ship." I do not suppose *he*
much for provisions. Mr. Norwood tells us
his men cost 1s. 9d. a day for provisions, just twi
much as the low rate (10½d.) mentioned by the

steamers for some sailing ships. Their letter throughout implies that sailing ships are not so well provisioned as steamers; the only way in which I can account for this is that steamers being so often in port, the men would soon cause trouble if the provisions were inferior; whilst the sailing-ship, once at sea, is kept there until the voyage ends, when if a man runs away the wages due to him pay for a substitute. I hope there is a more creditable reason. No one can find fault with Mr. Norwood's 1s. 9d., but he remarks that in some steamers the men have 30s. a week and feed themselves, adding that they feed themselves very badly. Now he had before told us that his married men were his best men; and a married man with a family would naturally stint himself in food to provide for those at home, for if he spent 1s. 9d. a day on his own food, he would only have 17s. 9d. a week for all other expenses, and I quite agree with Mr. Norwood that it is a very bad system. The sailor who leaves his wife and family without his head to guide and his hand to protect them, loses more than the value of his own food by his absence, besides the loss of home comfort; and our seamen might fairly expect as much pay as a skilled workman on shore, and their food into the bargain. Of course if all seamen were so paid, the weight would not come on individual ship-owners, but on the public. With regard to the relation between ship-owners and their ships; I suppose a few cases might be found in which a man was part owner of a ship which he had never seen, but no doubt it is extremely common for them not to know men who have served them a great number of years. Employers of labourers on shore see their men at work, and generally have them and their families living near them, so that they have a strong inducement to take an interest in them. But the ship-owner rarely, if ever, sees the crews of his ships; they jump on board as the ship goes out of dock, and they jump on shore as she comes into dock, whereas the owner's visits are generally paid when she is being re-fitted, so that he looks to his captains and officers to manage their crews; he does not know where their wives and families are living, does not even know that they have any, except when they call at his office to get a monthly note cashed, and thus he may easily forget that he has any of those responsibilities which belong to the employers of labour. Then, again, it often happens that seamen only serve an owner for one voyage, so that the tie of master and servant is scarcely formed before it is broken, but this seems to make it more than ever compulsory that ship-owners should combine for the improvement of seamen. I fear it is a sad truth that no people in the world are more unprotected than the wives and families of seamen, for though there may be individual ship-owners who take some interest in them, the general rule seems to be to ignore them, and to do nothing to throw some slight protection round them in the absence of their husbands and fathers. I have always felt this very strongly, and about twelve years ago called a meeting at the London Tavern, and addressed a few of our London ship-owners with the object of getting them to build a block of married sailors' homes, where their men could have their families respectably housed and kindly advised for less money than they are now paying in dens of vice and temptation. The result was that a company was formed, a prospectus drawn up, names were down for £[illegible], and I was in hopes that something would be done; but my duties called me to sea, and when I returned my Married Sailors' Home Company had vanished. But the ship-owners' responsibility has not vanished, it has immensely increased. I do hope that one result of this discussion may be the building of a block of married sailors' homes in each of our large ports; and if one is built in London, my wife and I will engage to devote all our spare time to managing it; and if I were an independent man I would give my whole time to it. But I feel sure that many old captains might be found who would enter on such work as a labour of love, and not of money. The buildings might certainly pay at least 5 per cent., for the owners would have the rents in their own hands, and, indeed, I would not advocate them if they were not self-supporting. Ship-owners can also put libraries on board their ships, and encourage all those measures for the comfort and improvement of seamen which I am about to mention as depending more on their captains and officers than on anyone else. I have great sympathy with captains whose difficulties are very great, especially those who are badly paid, and command ships which are badly found; but they have accepted the berth, and whilst they hold it should make it their one object to make the best of it. Captains can give their men as much of Sunday as possible, and can very generally make it a holiday. In the week they can give the men time to clean the forecastle, wash their clothes, and after muster on Sundays ask if they have any complaints. They can see the sick themselves, and take care they have the best that the ship affords. They can lend books, open a class for reading, writing, navigation, &c., and have an evening class in harbour. They can put them in the way of writing to their friends, and, when the voyage is ended, get the ship-owners to have some money ready at the docks, advise them to go home at once, advance some money to enable them to do so, and part only with the wish of sailing together again. I know from experience not only that these things can be done, but that they are great aids to first-rate discipline. In conclusion, permit me to say that no legislation can supersede that heart-work, which is the true motive power for raising all classes out of their difficulties. We must get rid of the selfishness and sensuality which are the sources of the evils against which we are trying to legislate; and seeing what has already been done, can we doubt that we will soon complete the work we have begun. I strongly recommend those owners and captains who are annoyed and disgusted at the sensuality of many seamen, but do nothing to help them out of it, to remember that it is the result of extremely trying social circumstances.

Mr. Glover agreed with the observation of the chairman, that Captain Pim had drawn a picture of the state of the mercantile navy, and that on the very eve of legislation. It was therefore very necessary to determine whether the picture was tolerably true. The first element in the picture was that the background was rather black. It was a picture of the extent to which the United Kingdom was dependent for its daily food on foreign countries, and consequently showed that it was dependent on tonnage to carry that food from the foreign country where it was grown to where it was to be eaten; that it was the duty of every person in the kingdom to increase the means of carrying food from foreign countries where it was in excess to this country. Then Captain Pim asked what was the condition of our mercantile marine, and at that point he must say, after reading the paper, they were in a very sorry case. Captain Pim found no softer term in which to describe it than that it was melting away. What did that mean? He could understand ice melting away and becoming gradually less in the presence of some stronger power, or agent. Did it mean this? If so the question arose, what was this superior force or power which was melting it away? It was not the bad wages of the seamen; it was not that they were badly housed, badly clothed, or badly fed; but it was an Act of the British Legislature which was melting British maritime power away—an Act passed no longer ago than the year 1849. But what was the sober fact? An Act of Parliament was passed in 1849. In the following year there were entered and cleared in the ports of the United Kingdom 8,000,000 tons of tonnage. By 1860, ten years after the melting away process had begun, it had gone on so far that there were not 8,000,000, but 12,000,000. Coming to 1870, how much further had this melting away process gone on? It was not 8,000,000 nor 12,000,000, but it was 22,000,000. He would there-

fore ask the honourable Council of the Society of Arts if it was right that the pages of their *Journal* should be defaced by such a misrepresention as that? But another objection of the honourable member for Gravesend was to its being carried by foreign sailors. But he would ask what was the increase of foreign tonnage in our trade, and a single sentence would reply to the objection. Twenty years after the repeal of the Navigation Laws, the proportion of foreign tonnage in the trade of the United Kingdom was actually a larger proportion than it was in 1849. Gentlemen might be astonished, but he was representing facts which were written, not in his imagination, for he did not draw upon his imagination for his facts, but in the Board of Trade returns, which were accessible to every member of the House of Commons, and he did say that before the honourable member had presumed to make such statements it was his duty to have made himself acquainted with the simple initial facts of the question. Now as to that dangerous state of things so graphically pictured by Captain Pim, what were the remedies he proposed? If this Act of 1849 had done all the mischief, he should have expected that the honourable member would have given notice to move that the Navigation Laws be re-enacted. Still, he does not do that, but says the first thing for Parliament to do would be to appoint a director-general of our mercantile marine, consisting of 25,000 ships and representing £100,000,000 sterling, and owned by the most respectable of her Majesty's subjects. He would ask, had they not already got one in Mr. Farrer and another in Mr. Gray? The honourable member for Gravesend told them in his paper that he thought the incubus of Board of Trade interference had reached its limit. If he thought that, then what good were they to get out of a Director-General of Marine? Well, that was his remedy No. 1. Now, what was remedy No. 2? He expected to hear something that was practical, and that would really deal with the question, but remedy No. 2 was the enactment of a Lord Campbell's Act to meet all kinds of British casualties at sea. But did they think that would stop the melting away? Was there any connection whatever between the disease and the remedy? Was it at all likely to affect it? But let them ask themselves, soberly, what was the real state of the case. He was responsible at present, if certain contingencies happened, for £15 a ton on the registered tonnage of his vessel. That was by way of penalty. Then if a further event happened he was liable to be indicted criminally, and sent to prison. He would appeal to the meeting if two such heavy responsibilities were not sufficient to act as deterrents, or whether they thought that the appointment of a director-general, or the enactment of any further penalties they could imagine, would act as a further deterrent? He submitted that if deterrents would accomplish a remedy, they had got enough of them already, and needed no more. In conclusion, he sincerely hoped that this learned Society, before the debate was closed, would see that an actual statement of the simple facts (which would be of great use to its readers) was inserted in its *Journal*, and circulated throughout the world, to correct what had been said about the proceedings of the British Legislature, which were so exceedingly contrary to the facts.

Mr. Thos. Brassey, M.P., said the resources of the Society could never be more fitly employed than they were on the present occasion, in discussing this great and important subject. To a great maritime country like this, the condition of our mercantile marine, and the condition of our sailors, was of the most vital importance. His attention had been given to the best mode of supplying the mercantile service with sailors. It had been very frequently urged that there has been a sensible deterioration in the professional qualifications and in the moral conduct of our seamen. That was one of those statements which it was not so easy to establish upon any conclusive data. Each man gave his own impression; each witness spoke of what he had seen; but it was exceedingly difficult to bring all to one focus, and to arrive at a conclusive result. It was, however, quite clear that the recommendations of the Royal Commission, which had inquired into the subject, so far as they went, must be productive of good. That, following the recommendation of a previous Commission, had said that it was desirable that encouragement should be given by the State to ships established for the training of boys for the merchant service. He thought the contributions of the State should be given upon certain conditions with regard to service in the naval reserve, and if it were the disposition of ship-owners to make a contribution for such a purpose, and they were willing to employ the State to administer those contributions to the best advantage, he was convinced that the expenditure would be productive of much good. They were constantly reminded by ship-owners of the difficulty of procuring competent crews for their ships, but he hoped and believed that the adoption of the suggestions of the Commission would absolutely meet the difficulty. They did not hear so much on another very vital point, namely, the professional status, qualification, and position generally of the officers of the merchant service. He was glad that Captain Toynbee, one of the brightest ornaments of the profession, had thought it right to make some allusion to the subject. The best guarantee possible for the safety of life at sea would be the exercise freely and without restraint, on the part of officers in the merchant service, of their own judgment in these matters. The captain, of all others, was surely the person best qualified to form an opinion as to the condition in which his ship was, with reference to the state of the hull, and so forth, and also as to the limit to which the vessel should be loaded; and if the officers of the merchant service were able and disposed to give the same independent advice to the owners of merchant ships on these subjects, which a barrister gave to his client when consulted on some case of law, then a very large amount of that loss of life and property, which they all so much deplored, would be saved. But the problem was an exceedingly difficult one no doubt. The supply of officers exceeded the demand, and the tendency of such a state of things was to depreciate the value of the article supplied. He did not wish to see any artificial means adopted for limiting that supply, but he did wish to see the independence of the officers of the merchant service secured. Nothing gave a man such a sense of independence as a high education, and it might be prudent, in the interest of life at sea, to raise the standard of examinations for the appointment of masters, at least to the higher commands, such as those of passenger ships on the great ocean-going lines. Another point which ought not to be forgotten was, how was the master to be protected who made unpalatable representations to owners who would not be prepared to receive them from the consequences which were likely to follow. Some kind of mutual protection society suggested itself. But such an idea demanded careful consideration, and needed to be elaborated prudently and wisely, on the one hand, to promote independence, and so as not to promote disloyalty on the other.

Mr. Donald Currie said:—It is of the utmost importance, in debating the questions raised by the honourable member for Gravesend, that we understand the facts involved in the discussion. The honourable member has no doubt a good object in view. He appears to be solicitous for the welfare of the sailor, but I venture to think that he is not judicious in his proposed measures for their relief, or in his mode of dealing with ship-owners. There is throughout the paper a vagueness of statement and exaggeration of facts which might have been dispensed with. First, as regards sailors. Is it just in the honourable member to say that our sailors are worse off than the denizens of our prisons, that they are badly fed and housed, ill-used, and inadequately paid? It is true that in small vessels, such

to those employed in the coasting trade, there is limited sleeping space and a good deal of hard work. It is not possible to have large vessels for the coasting trade. But would the honourable member like the carrying trade from port to port along the coast transferred to railways, and if so, where then would be this excellent nursery for the navy and the mercantile marine? One of the most serious elements in the present discussion is the lightness with which some speakers play into the hands of the land carrying interest of this country. Though the accommodation be limited, is it worse than the days to which the honourable member looks back with such regret—say, thirty years ago? Are the sailing coasting vessels of to-day worse than the sailing coasting vessels of that day? Or is the sailor worse off in the steam collier which makes the trip in two days than he was in the old times, when on board the small schooner, battling along the coast for a week, or a fortnight, or more? The honourable member is concerned not merely for the sailor, but for the masters of our ships. He considers that there is no other class of her Majesty's subjects liable to be deprived of earning a livelihood for errors of judgment. I can assure him that the great majority of our countrymen are liable to lose their livelihood if they part with their judgment. The honourable member told us, in a very stirring part of his paper, that at present, of all proprietors, shipowners have the least real knowledge of their property, and less acquaintance with the persons who are engaged in their service, than any other employers of labour in the kingdom. He told us "it was almost incredible, and yet by no means an uncommon case, to find owners who know no more of the men who serve on board of their ships than if they lived in Timbuctoo." Now, is it extraordinary that a shareholder, say in a steam-ship company, should never have seen one of the company's vessels, or that a person holding a few 64ths in a sailing ship or a steamer, should consider it unnecessary to go and examine the vessel? Let us put it another way. We are all aware that the English people are fond of investments in things which they do not see. The honourable member is acquainted with Central America, and the fortunes that may be made there. Supposing we put the honourable member's remark respecting ship-owners thus:—"Strange, and almost incredible as it may appear, it is by no means an uncommon case to find people who have never seen the places where they invest their money, and who know no more of the men they trust than if they lived in Timbuctoo!" Here we arrive at this point—the trades union and the seamen. The delegates of the trades union, at their meeting in Liverpool the other day, proposed to support the sailors from a trades union point of view. As there were about 600,000 trades unionists represented by their delegates in Liverpool, it is clear they desire to have another 200,000 enlisted from the seamen, and then secure four-fifths of the whole to vote the general funds, with the certainty that the great majority of the seafaring men cannot vote. I call your attention to the serious evil which would result in the power thrown into the hands of trades unions to stop at any moment the dispatch of vessels to sea. But, further, if this power were secured by the trades unions, there would be a further development of the levelling process which marks the trades unions whereby one man is entitled to as high wages as another, quite irrespective of ability; one of the greatest errors of the principles of trades unions. And, further still, the union desires to secure, as it proposed, the exclusion of foreigners, and also the extension to sailors of the certificate system now applicable to officers. Indeed the honourable member proposes it should be made penal for an owner or master to take an uncertificated man. All this means the limitation of the supply of seamen, while ship-owners, the country, and the navy are crying out that we are short of men. A great deal has been said about apprentices. Let me give you some statistics about them. In 1845, 15,704 apprentices were enrolled, and there were 7,412 cancellations, deaths, and expirations. In the year of the abolition of the Navigation Laws, viz., 1849, there were 9,659 apprentices enrolled, and there were 10,540 cancellations, deaths, and expirations. In 1873 there were only 4,045 apprentices enrolled, while there were 4,769 cancellations, deaths, and expirations. It is not difficult to see that the falling off in the enrolment of apprentices from 10,540 in 1849, to 4,045 in 1863, explains the diminished supply of British seamen. But let it be remembered also that in the last few years California and Australia have attracted to the gold mines a very large number of our seamen. They often forsook their ships in a body on arrival. The wages of seamen have increased notably in the last few years. In the year 1848 the wages of seamen to India and Australia were 40s. a month; in 1857, 50s. a month; in 1872, 60s. a month; and in 1873, the wages were 65s. a month for sailing ships, and 70s. a month for steamers. The honourable member stated that foreign seamen are to be had comparatively cheap, but the truth is foreigners are paid in our steamers and sailing ships the same wages as their British companions. In comparing the number of British and foreign seamen serving in vessels registered in the United Kingdom, I find the following:—In the year 1852 there were 153,863 British seamen employed, and 5,700 foreigners. In 1862 the number of English sailors employed had only increased by 4,000, that is there were then employed 157,767 (and of course looking to the increase of the tonnage more sailors were necessary), and that year there were 16,096 foreigners. Nothwithstanding the enormous increase in our tonnage in 1872 compared with 1852 there were only 30,000 more British seamen engaged, for in 1872 we had 183,129 British seamen, and 20,591 foreigners. Second, as regards ships. The honourable member spoke in exciting terms of the risk run by sailors and the public in the new style of vessels, so excessively long, or at least so much longer than they used to be. The honourable member was not able to lay down any rules for our guidance, or even to make any suggestions respecting the construction of ships. The honourable member has laid down a general rule, and I desire to examine it. It is this. We should build something safe, he says, in the way they did 30 years ago. The honourable member told us that 30 years ago ships were about four times their beam. This he evidently thinks is a better style of ship than eight or ten times her beam, for he had a model in his hands, and showed you that model first in its entirety, and then cut in two. It was very amusing to see the honourable member followed by a supporter who drew our attention to the time of the flood, and praised Noah's judgment in building a vessel six times her beam. But he did not allude to the fact that the Ark was meant for standing still, and not for going ahead: that she had no masts, sails, paddle, or screw, in fact that she was an excellent, capacious floating warehouse for the accommodation of living creatures. The honourable member's friend referred to the Ark in its bearing on the navigation of the present time, and he told us the story of his juvenile days, and of his riper experience, when he planned and ultimately constructed a vessel like Noah's, only six times her beam, and a most excellent vessel. Now, the point of interest for me is this, and you will no doubt see it—Is it surprising that ship-owners and ship-builders should differ in opinion as to the size, dimensions, and construction of ships, when the honourable member and his supporter differ so materially as to be 50 per cent. asunder? The honourable member takes us back 30 years ago, and speaks of four times the beam, while his supporter refers to the time of the flood, and proves his calculations to be correct by his own experience, that six times the beam is better than four times. Am I not at liberty to ask, that if the one gentleman supporting the other increases his friend's figures by 50 per cent., I may go 50 per cent. further, considering that there was no iron used in such constructions in the time of Noah, nor yet to a

great extent 30 years ago? It would have been difficult in the time of the flood, or even 30 years ago, for those gentlemen to have made the Menai-bridge out of balks of timber. The truth is, that now-a-days we can make an iron vessel of any strength we please, and it is not of much importance what the proportion of length to beam is, provided we give the proper depth and the proper arrangement of material. But let us look more into the question of the style of ship thirty years ago. Am I not right in stating that the vessels which carried the mails between England and North and South America, thirty to forty years ago, were the old gun-brigs, which first gave the name to unseaworthy ships, copied by our sensational agitators of to-day, as "coffins?" It was in her Majesty's navy that "coffins" were first introduced to public notice, and these vessels were so named because, as they were short, deep-waisted vessels, with high poops and forecastles, and heavily rigged, they were not safe. The honourable member assured us that it was the system of tonnage measurement which was at the root of the evil in the production of unseaworthy ships. I beg to differ with him on this. Just as with reference to his quotation from the *Moniteur de la Flotte*, and to M. de Lessep's letter, referred to at the last meeting, there is no wonder that the Suez Canal Company wanted the measurement upon the gross tonnage instead of the net tonnage, seeing it would pay more dues. But their desire to have more dues does not prove that steamships are too highly favoured in having an allowance for the propelling power, or that English legislation should be fitted to suit the interests of the Suez Canal Company. One other error the honourable member made. He said that under this tonnage law the Cunard steamers were able to stow cargo where they carried passengers; but he ought to have known that the cabins in the Cunard Company's steamers, like other steamers' cabins, are included in the gross tonnage, and pay dues whether they are filled with passengers or with cargo. The serious statement made by the honourable member respecting the decline and fall of British shipping, is however, the one which has most astonished me. On this point he spoke as follows:—"Since the repeal of the Navigation Laws in 1849, just a quarter of a century ago, the marine carrying trade of our commerce has gradually been melting away from our flag and falling into the hands of other nations." And the honourable member added, "At the present moment a very large proportion of our own commerce is carried in foreign bottoms." I ask you to look into these two statements with me. I do not wish to discuss with the honourable member the questions involved in the abrogation of the Navigation Laws. Somewhere about thirty yaars ago, there were only four steamers running on the Atlantic. The whole communication between America and Europe was conducted by the Cunard line. There were then on the Atlantic the four steamers of that company: and these vessels had taken the place of the gun-brigs already referred to. The total capacity for cargo which these steamers had was eighty tons each, and the whole amount of space available in the steamers upon the Atlantic at that time was somewhere about eighty tons a month. The whole of the carrying trade between Europe and America was then in the hands of the Americans. Their fast sailing packet ships carried the passengers and the goods. But what is the position at the present day? There are now despatched from the port of Liverpool every month, equal to 100,000 tons of cargo. Compare this with the 80 tons of about thirty years ago, and say who has the carrying trade between America and Europe? Has it dwindled away from English control? It is entirely in English hands, and I know of only one American line of steamers running between the old world and the new. The American packet ships have in a great measure disappeared, and I ask you, in so far as concerns the trade between America and Europe, h s the British carrying trade melted away from our flag? The trade between India and England before the abolition of the Navigation Laws in 1849, was almost altogether in the hands of the English ships. Has the abrogation of the Navigation Laws taken away this advantage from the British flag? Or am I right in stating that whether round the Cape, or through the Suez Canal, by far the greater part of the carrying trade is in British bottoms? Is there an American ship running now between England and India? Do American or French ships bring Indian produce to England? Am I right in stating that three-fourths of the whole steam shipping passing through the Suez Canal is under the British flag? The honourable member may bear to be reminded that in the year 1850, English shipowners were awakened to a sense of their position by a remarkable passage made by the American clipper *Oriental*, which brought teas from China in 91 days. I well recollect that this type of vessel, built of light wood, and rapid sailing, intended to last a few years, and to make her value more than once within that time, was constructed for the very profitable trade between New York and California, able thence to run across to China and astonish the owners of our China clippers trading to England. It was then stated that "the glory of England had departed." But in a very few years there was not a single American clipper left in the China trade, and to-day it is a thing unknown to see the stars and the stripes engaged in the tea-carrying to this country. In what trade do foreigners gain any advantage over us? In what trade has the commerce been melting away from our flag? With your permission I will give you the statistics which will certainly strike you with surprise. I will go back thirty years ago, the time referred to by the honourable member. Now, in the year 1840, 5,216,1[illegible] tons of British shipping were entered and cleared in the United Kingdom, compared with 2,281,674 tons of foreign shipping. In 1853, shortly after the abrogation of the Navigation Laws, British shipping had increased to 9,064,705 tons, but the foreign shipping had increased to the large proportion of 6,316,456 tons. In 1872, however, where was the British shipping? It had increased to 25,714,276 tons, while foreign shipping had only increased to 11,440,016. Now, if you take into account the alteration in the system of measurement of the tonnage of British shipping since 1854, compared with previous years, you will find that the difference in favour of the British shipping is much greater than it appears by the figures which I have quoted, seeing that until 1868 our tonnage was measured partly by old and partly by new measurement, while for the year 1869 and subsequent years it is all new measurement. If you will take the steam tonnage entered and cleared in the United Kingdom from 1848 to 1872, you will find that in 18[illegible] there were 1,340,151 tons of British steam shipping, and 257,229 tons of foreign steam shipping, while in 1872 there were 17,410,029 tons of British steam shipping, against 3,003,703 tons of foreign steam shipping. The same remark applies here to our tonnage as regards old and new measurement, and I do not include transports with troops and Government stores in this return. The aggregate tonnage of the merchant navy of England, the United States, and France from 1840 until this date is as follows:—In 1840, British shipping 3,311,5[illegible] tons, American 899,765 tons (but not including lake and river steamers), and France 662,500 tons; while in 1872 the British tonnage amounted to 7,213,829 tons under the new measurement referred to, while the United States had 1,410,648 tons, and France 1,077,611 tons. It is very remarkable to trace the development of the steam tonnage of this country compared with other countries. In 18[illegible] there belonged to the British mercantile marine 82,71[illegible] tons of steam shipping, to the United States 2,791 tons, and to France 9,693 tons. In 1872 Britain had 1,640,65[illegible] tons of steam shipping, the United States 177,660 tons, and France 177,462 tons. The preponderance in favour

England would be much greater, as I have already said, if the comparison of tonnage were equal. One very important comparison I wish to make, which bears upon this question advanced by the honourable member. Is it true that we were better off in the old times than now? or in other words, has the mercantile marine melted away, leaving other flags to carry our trade? Let us take the number of passenger ships sailing from the United Kingdom, say from 1853 to [illegible], under the Passenger Acts of 1852, 1855, and 1863, distinguishing British from foreign ships. In 1853, 524 British ships sailed, of a tonnage of 354,140 tons, while foreign ships sailed, of a much greater tonnage, viz., [illegible]736 tons. In these vessels there were carried by British ships 109,643 passengers, while the foreign ships carried 192,015 passengers. Compare this with 1873, to see if we are melting away or not. In 1873 [illegible] British ships left England, of 1,219,783 tons, carrying 281,797 passengers, while there were only six foreign ships of a tonnage of 12,658 tons, carrying 970 passengers. I ask you whether we have dwindled away in the carrying of passengers from England, and whether those who leave our shores are entitled to better protection under the British flag, and the care of their countrymen, than left to take their journey to distant parts under a foreign flag? There is a very singular comparison to be made if you will examine the following statement of the lives imperilled, saved, and lost, on the coast of the United Kingdom from 1856 to 1873, which proves that there is great misapprehension of the facts, so far as the same can be [illegible]. I find that in 1856 there were 2,764 lives imperilled, 2,243 saved, and 521 lost; while in 1872, 16 years afterwards, with a tonnage increased [illegible],000,000 tons, there were 5,224 lives imperilled, [illegible] saved, and 590 lost; in fact, there were only 69 lives more lost in 1872 than in 1856, although the tonnage had so largely increased. In 1856, 10,970,128 tons of British shipping were entered and cleared in the United Kingdom, while in 1872 the number had increased to 25,714,270 tons, not including the difference [illegible] measurement. So much for British shipping sailing away from our flag. It is a matter of vital interest to Englishmen that the perils of the sea should be restricted as much as possible, but what am I to answer the honourable gentleman when he says:—"I am prepared to assign to the unsafe and unhandy form of steamer, now unhappily so prevalent, almost without exception, the deplorable cases of foundering with which we are now becoming more and more familiar." I can safely assert that there is no foundation for the statement. The iron ships built now are not greater in length to breadth than the favourite type of ship [illegible] by the honourable member's supporter [illegible] nearly approaching Noah's Ark. The great majority of English sailing ships are six or seven times their beam. The honourable member's remarks may be intended to apply to steamers, but surely he remembers that a great number of lives have been lost in sailing ships. Let us, however, take steamers; then I have to assure him that the vast majority of steam ships have been built with dimensions seven to eight times their beam; and further, that he cannot point out any large number of losses of steamers owing to their great length. I have confined myself to the paper of the honourable member. He has not thought it proper to enter upon the questions of load line or classification, and I prefer to leave those for dispassionate consideration in another way and at another time, seeing that the ship-owners have now before them the Bill of the Government and expect shortly to have the proposed Bill of the honourable member for Derby, and they will have to judge how they are to steer between these two, and what to approve of or condemn in both.

Mr. John Fleming said he must differ from many of the remarks of Captain Toynbee, especially as regards the seamen's wages and provisions. He said, without hesitation, having some knowledge of agricultural as well as seamen's wages, that sailors as a class were better paid than farm labourers, and were paid well in comparison to other classes. At the same time, Captain Toynbee's views on the subject of religious instruction were most admirable, and he should like to see them carried out. He wished Mr. Currie had gone farther in his observations on the question of manning the mercantile navy. How could you expect them to be seamen if they did not learn their business? He thought, therefore, that the carrying of apprentices should be compulsory, even in the interest of the owners themselves. During the last two years, if England had been involved in a war, particularly with a maritime power, he felt sure there would have been great difficulty in manning the Royal navy, and as England was an island, dependent upon her navy for protection, if the men were not always forthcoming, her soil might not be safe from invasion. Everything should be done, therefore, to bring forward a mass of seamen who knew their business; and the admirable institutions mentioned by the member for Hastings formed excellent nurseries for sailors, but they were not sufficient, and therefore he advocated the apprentice system. Without going into figures, he believed there was now about one apprentice to every 50 seamen, whereas a few years ago there was one to about 16, and in the Royal Navy there was a boy to every six men. He could not agree with all that had been said by Capt. Pim, for he did not believe the state of the mercantile navy was as bad as he had represented. He would suggest that much might be done for the comfort and improvement of sailors, and he did not think legislation was necessary in this direction. It might, perhaps, be well to insist on a medical examination of all the men before starting on a voyage, so that those who were unfit for duty should not be allowed to sail, because the only consequence was that on getting to sea such men fell out, and the other sailors had to do their duty. He believed that many wrecks were traceable to this cause alone. Then, when you had good men on board, everything should be done to encourage amongst them a taste for reading, by establishing a little library; and, if possible, he should like to see more ships sailed on temperance principles. Give the men a little extra allowance in the shape of coffee, sugar, &c., with some other advantages, and you would have better sailors, no risk of accident from drunkenness, and a very good moral effect on the captain and officers. These things would tend to raise the tone of the sailor; they would then make better voyages, there would be fewer accidents, and a nucleus would be formed for the manning of the navy in time of need. If these things were done, and the religious wants of the sailor were attended to, he did not think much legislation would be necessary, and he was not in favour of too many Acts of Parliament.

Mr. Young (of Lloyds), as representing the underwriters, said the underwriter was a man who had been very much abused in Parliament and out of Parliament, as if he was at the root and bottom of all the mischief. Marine insurance was to some extent the cause of disaster, no doubt, and if every man was his own underwriter he would take care of his ships; but that it was the root of the whole evil was as absurd as saying that banking was at the root of all the evils in the commercial world, and if they were going to stop banking simply because men lost money, it would only lead to the extinction of credit, and do no good. As to the limitations of marine insurance which had been suggested, they had been tried abroad and signally failed. They had also been tried at home, for there were certain limitations which were, however, systematically evaded, and abroad, wherever the limitation was, the insurance was sent elsewhere. At the same time underwriters were the police of the seas, and practically they prevented much of the loss which all deplored. The more legislation there was the better it was f

the underwriter, because the loss would be less, and ultimately he supposed it would become so lucrative a business that they would not be able to keep people out of it. They knew perfectly well who were the bad ship-owners, and they put a fine upon them, and sometimes they ostracised them. He could adduce scores of policies "Warranted not to be shipped in Blank and Blank's vessels," or "in Blank and Blank Company's (Limited) vessels,"—hundreds he might say. They knew them. They took care of them. And they were perfectly able to look after those men. He agreed with the honourable member for Gravesend in some remarks he had made as to the absolute necessity—he might say, with reference to the whole criminal procedure of the country—for the institution of a public prosecutor. In every other civilised country they had one. As for the extension of Lord Campbell's Act, it would do no more injury to the ship-owner than to the cab-owner or the common carrier. He would extend it, but with such restrictions as would prevent its improper use. The great misfortune in regard to the matter, in his opinion, was, that they were all crying out for legislation. If they were in any way touched in their pocket or limb. they cried to Government or some Hercules, whether Adderley or Forster, to help them, and asked for an Act of Parliament. He agreed with what had been said by a learned writer on the subject—Herbert Spencer—who said that commerce was self-regulating and custom becomes law. Commerce practically created regulations, which, in course of time, had all the effect of custom, and, in fact, they became practically law, by being embodied in decisions of Courts of Justice. That was better than legislation, for one Act was piled upon another, and there was one Act to amend another, and another to repeal that, and then another re-enacting or varying that, till they were in such a state of confusion through over-legislation, that it was impossible to know where they were. In conclusion, while agreeing with some of Captain Pim's paper, there was much in it he did not agree with; but he thought they were all deeply indebted to him for the interesting discussion which had ensued upon it. They must not, however, forget the main question was simply this, were they to go on with this legislation or were they to stop? He did not agree with the honourable member for Gravesend that the commerce of the country was fading away, for he was confident it was increasing, and if it was only let alone it would go on increasing. A statesman had said, "I see nothing but progress, and I hear nothing but cant," and he echoed his words entirely and completely.

Dr. Sandford said:—In rising to address you, and take part in this important discussion on the able paper lately read by the honourable and gallant member for Gravesend, I have to thank you for the privilege accorded me to put forward in as limited a space as possible, a few remarks on the present condition of the seamen of the mercantile marine of Great Britain, and how far immunity of disaster at sea is influenced thereby. This is a subject in which I feel sure all here take a deep interest, one from which you will not shrink, as you are bound to recognise the importance of a matter, the supremacy of which, you are well aware, the very vitality and maintenance of this little island and her important possessions depends. As lately a medical officer of her Majesty's navy as well as army, subsequently holding the appointment of inspector of seamen, lime-juice, shipping, &c., appointed by his Grace the Duke of Rutland, under the Shipping Act of 1867, as well as that of medical superintendent and P.M.O. of the Hospital for Seamen of all Nations, Cardiff, it may be presumed I have some practical knowledge of the subject that now occupies the public mind, I therefore may be pardoned if I say I with no slight confidence submit that which I have to say for your favourable consideration. And I deem it the care and concern of all who are in possession of special knowledge on any points and facts touching this inexhaustible question to state that knowledge for the bene of the community, and so strengthen the hands of tho now contemplating legislation, or the improving th sanitary condition of our seamen, and maintaining th future prestige of Great Britain as a maritime power; by this means we may, I hope, with some reasonabl confidence, anticipate that legislation will eventually take such a form that we shall shortly have a new an complete Shipping Act, meeting with the approval the ship-owner, the sailor, and the community, witho in any way interfering with commercial spirit or interes I am well aware the Merchant Shipping Amendme Bill of 1867 was brought before the House under ma manifold disadvantages at the last hour of the Sessio moreover, the "representation of the people" took pr cedence of and well nigh annihilated all other legisla tive proceedings; but now, after the late sitting of th honourable Commission on Mr. Plimsoll's motion, we ha a right to expect something more concerning the sanita condition of our seamen than permissive clauses. Th desirable consummation, I trust, will be obtained th Session, although I regret to say that I see no refere to the subject in the President of the Board of Trad measure; and I do confess, with all due deference to th honourable Commission lately sitting on the question the mercantile marine, the subject of the shipworth ness of the men seems to have received but scant rec nition. Very full and complete information has, I kn been laid before the Commission in all respects but th one—which I maintain is paramount—the phys capability of the men for fulfilling the arduous duties sea life. My experience at sea and information gained the various ports I have visited relative to this qu tion, the "shipworthiness" of a crew, if I may the words of the hon. and gallant member for Graves fully equals in importance the seaworthiness of the ve itself; for, give you the best vessel afloat, with all im provements, &c., what becomes of her chance safety if you have not the wherewith to guide and ste England has made such gigantic strides in co merce, her interests have greatly increased, but legisla tion has not kept pace with the call and requirem of her mercantile marine of the present day, and it is this I, in a great measure, attribute the present deg rate condition of the sailor of that service. I pleased to see the ship-owners come forward to enter arena of discussion and throw down the gauntlet defence of their rights and good name, with an hone of purpose equalled only by the manly and huma endeavours of Captain Pim and others for the regene tion of a service that was at one time England's boa and it is scarce necessary for me perhaps to remind who enter that arena that the stained banner of par and party feeling should be laid aside, that one and should join hand-in-hand for the common weal in p moting and advocating a cause so imperative for saving of human life and vast interests. The hon. gallant member for Gravesend has divided his inter ing paper into two sections, that relating to the sea and that to the ships. It is to the former sectio am desirous of confining my observations. The la I leave in better and other hands than mine; but I prepared to say this, that I fully endorse the statem in the petition relating to the berthing accommodati of the sailor, and I deem it essential for the health the crew that greater cubic space and drier accommo tion should be afforded them, even at the expense portion of a ship's cargo. We have already had pleasure of hearing several able gentlemen eloque and lengthily express their views on the subject of paper before you, more especially may I mention Merrifield, Mr. Scott Russell, the honourable mem for Hastings, and the honourable member for H As regards the remarks of the latter gentleman, I only say his statement is not in accordance w my experience, an experience—I may be pardoned I remind you—gained in a widespread and vari

of research in the interests of this momentary question. Mr. Norwood ignores the grievance of the sailor. We have heard how at one blow he has attempted to set aside the statement set forth in the paper before you, as to condition of ship and men, but such attempt is no argument for or against it, for the honourable gentleman's remarks are pertinent only to the knowledge and experience he has of his own fleet of vessels and their crews; and if the honourable member's statement be true in substance and fact, then must I consider him as being a model ship-owner—one of those for whom (as Mr. Scott Russell observed in his able and practical remarks) it was not necessary to legislate, one and of whom England may be proud. I congratulate the honourable member on having such ships and such men who have not a grievance—and the men on having such an owner; but there are ship-owners and ship-owners, and seamen and seamen, for whom it is necessary to legislate. Legislation of such a character (no permissive clauses, mind you) will at once bring back to England the old supremacy of her merchant navy, and put an end to the wholesale slaughter of life and property, the details of which appear daily in the press. In alluding to the objection taken by the British seaman to the admission of foreigners into the service in preference to themselves, the honourable member for Hull mentions the Scandinavians as the representatives of that class in British ships. Now, this is an error, and it will at once prove to you how limited is that honourable gentleman's experience, and I here have much pleasure in bearing strong testimony to the physique and moral worth of the Dane, the Norwegian, Swede, Fin, and German—better sailors, better men, more able men, ship-owners could not have; they may form a portion of a British ship's crew in the Baltic trade, and fortunate is the ship-owner who can get them, but my experience is that to that trade are they limited. No, the foreigners, sir, to whom exception is taken by our own men are Southerners, Greeks, Italians, Portuguese, Spaniards, the outcasts of their own nation, who are constantly to be seen hanging about our ports, and whose presence on board is ten times more prejudicial to a vessel's safety than their absence. Yes, these are the men shipped, and as many, a few hours prior to proceeding to sea—victims of disease, many not capable of understanding a word of English. Yes, to these men are many good seaworthy vessels confided—to these men incapable of understanding their commander's orders—to these has a vessel to trust her safety. Now give you that vessel afloat, she is bound to become a victim to such a crew as this, however able her captain, however good and worthy her owner. The law, I think, will legislate in such a case as this to great advantage to all concerned; for, to press this point further, how unfair, how unjust it is to those seamen who may form part of the crew—those who are able, willing, and physically capable of performing their duty—to have the duty of others thrust upon them within three days of leaving port, and for the rest of the voyage, to say nothing of having to share scurvy within the same confined space, occupying sleeping berths little better than lazarettos. And because the captain finds to his cost within that time that he has shipped those for his crew who should be inmates of a hospital, the victims of disease of the most revolting description. Now, sir, such disease would not be patent to a captain's eye less than to mine, more especially as both British and foreign seamen take every precaution to disguise the presence of anything like physical disability, enshrouding themselves in clothes which when taken off reveal a hapless state of things. The result of all this means the vessel proceeds on her voyage short-handed and badly manned, meets with bad weather, and, the old story, goes to the bottom. This fraud of the sailor, you will say, is a ship-owner's grievance; so it is. I mention it as such, but it is one within their power to remedy by supporting and advocating that clause relating to the compulsory medical inspection of the men prior to shipment. The praiseworthy efforts, and their name is legion, that of late have been made to remedy the evils of the shipping trade, must in some measure be recognised, the general objects of which commend themselves to the consideration of all, as they aim at improving a crying evil existent for years; but how far, sir, have the results fallen short of the necessity. For instance, Government gave ship-owners, by a permissive clause in 1867, the power to have the men inspected prior to shipment, appointed medical men for the purpose of inspection, myself amongst others, my district being that of South Wales, extending from Gloucester to Aberystwith, including the ports of Bristol, Cardiff, Swansea, and Pembroke; but permissive legislation in this instance proved a farce, as it always does. To substantiate what I say, I may mention that it is estimated seventeen thousand men are shipped annually at the Port of Cardiff; out of this number, the year I held the commission, I inspected four men, all of whom were rejected, and sent to the *Hamadryad* Hospital. The ship-owner may wish, in all good faith, to engage a sound and healthy crew; and it would be well if all could be made to understand how much financially they would benefit thereby; but their arguments have invariably been, on my pressing on them the importance of medical inspection as a guarantee of their getting an efficient crew—granted, say they, but as matters stand now between master and man, we dare not risk selection. Seamen—good, bad, and indifferent—are already scarce enough, and medical examination, and rejection of the bad, means increased wages and a higher status for the good. Government gave us the choice; we act as we deem best for our own interests. Now, how can you have any stronger arguments to make inspection compulsory than that one advanced, I will not say by all ship-owners, but by the majority with whom I have had the pleasure of discussing this subject. However, so much for permissive legislation, and the little back door that seems inseparable from any English Act of Parliament. If the Legislature did not recognise the importance of the inspection of the men, why on earth was the permissive clause of 1857 relating thereto introduced at all? On the principle of watch and wait? Well, we have waited and watched for the last seven years, with the glaring fact staring us in the face, that vessels went down, fearful sacrifices of human life and destruction of property were entailed from the fact of vessels being short-handed, or having on board those only whose presence was ten times more prejudicial to the vessel's safety than their absence. Sir, I trust I have said sufficient in support of my argument as to the necessity of man inspection, to induce those ship-owners who may now be present to support the clause in the petition relating thereto. The men—that is, the good—do not oppose it, why should the ship-owner be adverse to it? I feel sure if our Legislature was put in possession of facts on this point, the importance of it would not be ignored in any forthcoming measure; and, Sir, I believe further, that until the health and physical ability of seamen for their calling forms part of insurance as well as the seaworthiness of shipping, any impartial or judicial investigation and Act founded thereon will prove a failure, as it hitherto has done, for procuring an immunity of disaster at sea. Ship-owners can have but pecuniary and personal objections to the inspection of their men to counterbalance proved advantageous results, of the necessity for which abundant proof has been adduced. Sir, hitherto my observations would appear as against the sailor. Let me say I am neither for the ship-owner or sailor. I am neither for or against one or the other; that which I am desirous of seeing is a greater reciprocity of feeling existing between master and man; a due application of each other's merits. If such a state of things could be induced, the time is but short ere our merchant service would become once more efficient, when it formed no

unimportant part of the defence of this country, and if such is the expectation of Government and the public in case of war, am I right in saying the sailor of that service has a strong claim to State protection as well as he of the navy? One word in defence of poor Jack. Has he that protection? I say he has not. Why is it, may I ask, that the merchant sailor is debarred from participating in the beneficial results of sanitary legislation, that has proved of such service in the army and navy? Why is he left out in the cold, thus uncared for when he most needs help? When sick, is he not a man—aye, and often a good one, too—lost to the service because there was no friendly hand of Government held out to him in the hour of sickness? This, I take it, is often the reason that many a good man temporarily disabled is induced to commit the fraud before mentioned of shipping as an able man when he well knows he should be in hospital. But he has no hospital. What can he do? He has no home. He gets into the hands of crimps and John Charlatan, who sticks to him so long as his half-crowns last, when the latter gentleman retires, having done all the harm he can to the pocket and body of poor Jack. Gentlemen, do not think I am drawing an exaggerated picture. You may not have witnessed it, but I have, in the various ports that surround our coast—one I may may mention more perhaps than others, that is Cardiff; here matters became so bad, so many men were so continually becoming inmates of the hospital wards of the workhouse, that at last a strong move was made in the right direction by the Marquis of Bute and the town authorities. The Admiralty were petitioned to grant a ship similar to the *Dreadnought*, to be called the Hospital for Seamen of all Nations; the petition was acceded to, and I had the honour of fitting her out, and was principal medical officer and superintendent the first two years of her existence as a hospital at the port of Cardiff. What I would wish to see is, the Government legislate for hospital provision on shore for poor Jack at our large ports, similar to that now bearing such good fruit in America. This, combined with preliminary inspection to shipment, would insure the preservation of many a good man; he may be suffering from temporary ailment that inspection reveals, and which a few days residence in hospital would cure. Am I right in saying such a boon for the poor sailor is feasible? As for its necessity, I do not anticipate a doubt exists in the mind of one man present here this evening. Gentlemen, you have heard from Captain Pim the report of the revising medical officer of the United States, that in the year 1873 no less than 14,000 men were inmates of the mercantile maritime hospitals, where, in addition to this provision, Government insists that every man be inspected prior to shipment. Now that report I can vouch for as being correct. If, I ask you, there is such need of hospital accommodation for the mercantile fleet of America, how much more think you is it required for that of great Britain, when our ships are, numerically speaking, as ten to one. Recollect, gentlemen, one of the hardships of a sailor's life is that of celibacy. You cannot inculcate marriage in these men, who of a necessity spend their lives at sea, whose earnings are insufficient for the support of a wife and family; they are the more, therefore, exposed to temptation, temptation of a grosser kind than other men. The habitual privations they endure may perhaps be considered some excuse for the recklessness and indulgence that marks their brief respite from toil. The landsman when he contracts enthetic disease may avail himself of means at hand for recovery, so the same in the navy, but poor Jack of the merchant ship can obtain no remedy except that laid down in the ship's guide, and a captain's knowledge of the healing art; maladies therefore readily curable prior to shipping, become greatly aggravated by neglect and unfavourable surroundings, and attain to those grave types they are seen to assume. I am much impressed with the fact, that the British merchant sailor would be more subservient to discipline and have greater respect for himself, if he was not thus left out in the cold. A compulsory clause as to inspection, hospital accommodation for the sick on shore, increased berth accommodation, supervision of medicine chest, food, and last, not least, pure water, with an efficient organised staff to carry out the wishes of the Legislature; all this is proper and feasible. Such would not only insure immunity from loss at sea, and improve the sanitary condition of the men, but would on reflection, I feel sure, be received both by owners and captains as a great boon, in no way obstructing commercial interests. Sir, in conclusion, I must thank you, and those ladies and gentlemen who have with such kind consideration granted me their time and patience. The view I have taken of Captain Pim's paper is the view of a medical man, as said; I hope I have in no way offended good taste, or outraged those who may have different opinions to myself on the question. I shall trust that the important points on which I have dwelt perhaps somewhat lengthily, will not be ignored in forthcoming legislation; but in the name of common sense let us have no more permissive legislation in the shape of an Act that cannot be too binding and obligatory, and which, if it does nothing else, at least will separate the corn from the chaff.

Mr. C. F. Henwood said:—The question, I take it, is not whether our ships and our sailors are as efficient as in days gone by, or are even better, but whether the condition of our mercantile marine is such as it ought to be; whether it has progressed as it ought to have progressed; made equal progress with other cognate arts and sciences—such as railways and marine engineering. The reply to these questions from persons practically acquainted with the subject will be most certainly in the negative. We have, it is true, a vast number of steamships and vessels, the creation of the last few years, but is ship-owning prosperous; are they a source of wealth and profit? At the present time I believe the contrary is the case, and one can well understand this from the fact that a ton of goods can now be sent all the way to New Zealand from London for one-third the cost of transporting the same goods from Manchester to London, owing to our ocean-carrying trade being open to all comers. It must be remembered that our ship-owners are only carriers by sea, as our railway-owners and Pickfords are carriers by land. Our land-carriers have only to compete among themselves; our sea-carriers have to compete with the whole world, on free-trade principles. But recently we have had a great outcry against free trade in ships and sailors, and it is proposed to introduce stringent legislative enactments to protect ships and sailors; and so the marine carrier (ship-owner) will have to carry on his business on "free-trade" principles as far as it concerns competing with foreign shipowners, but under protective restrictions as regards British ships and sailors. This does not appear to be fair and just to the British ship-owner, and its tendency will be to drive capital into other channels or the sale of ships under foreign flags. If ships and sailors are to be protected, so also must be the ship-owner, or he will disappear, and with him British ships and sailors. The aspect of the question will have to be faced and grappled with, but as it concerns more particularly the ship-owner and the Legislature, I leave it and pass on. To consider the fifth remedy proposed by the gallant and learned gentleman, "An honest tonnage law, with taxation removed from ship to cargo." Now, let it be borne in mind that the object of a tonnage law is purely for fiscal purposes, and it must be obvious to all that dues should be levied only on business done—on that from which profits may and ought to be made, and should be capable of being ascertained and measured, without imposing impediments, restrictions, and limitations as to the form, proportions, and capacity of ships. Fancy the result if dues were levied on land carriers (railways) according to the capacity of their carriages and trucks

We should have their engineers scheming how to combine the maximum of accommodation with the minimum of capacity. How absurd it would be to charge heavier dues against a coal merchant who delivered one ton of coals in a four-wheeled wagon, instead of a two-wheeled cart. The new, or it may be said revived, method of fixing the tonnage of ships and vessels proposed by the gallant and learned author of this paper, would rid us of the present objectionable method, and in a simple and effectual manner supply a substitute, which, when thoroughly understood, will not fail to be appreciated by all concerned in shipping and ship-building. To carry out the plan properly it would only be necessary that the builder or constructor of every ship should, with the builder's certificate, furnish in triplicate what is well known as a "scale of displacement," which should be worked in the following manner:—The depth taken from the under side of keel to the main or weather deck of every ship, or vessel; this deck to be that to which the ship or vessel might be immersed without actually sinking, or that which forms part of the main structure of the ship herself, as regards strength (not a spar or awning deck), and such depth would be the depth of strength, taking the ship as a girder, in its vertical longitudinal aspect. We should thus have three principal elements—length, breadth, and depth for structural purposes well defined. The strength of the ship or vessel would be proportioned to the total weight, or displacement to the load water line, in combination, of course, with the length, breadth, and depth of structure. The strength of structure should not be according to the internal space or capacity. Now, how shall we ascertain the light and load water-line? Nothing easier—nothing more simple. (*a.*) The light line should represent the weight of the ship or vessel complete for sea, except cargo and consumable equipment. Consumable equipment would represent coals, provisions, and water, the weight of which should accompany the ship's manifest, and be deducted therefrom as tare. (*b.*) The load-line should be so fixed that a margin of at least 25 per cent. of the total displacement should be above water, such a tonnage law would be of incalculable benefit to the shipping interests generally, and especially to naval constructors, who are hampered and controlled by the present system. It would moreover help to free us from that incubus, Lloyd's registry, which acts prejudically on the shipping interests, and the safe and efficient designing and construction of ships and vessels. It operates to control and bring down to one level mediocrity the ship-building talents and experience of the country, without, on the other hand, adding to the safety and security of life and property at sea. It has exceeded the legitimate limits for which it was established—a registry simply. Now it dictates and controls. I maintain that Lloyd's, like the Board of Trade, should confine their operations to surveying and recording, and discard hieroglyphics—such as A 1 100 years—which convey no meaning and are absurd, and instead give the names of the builder and constructor and surveyors. I noticed that Mr. James Anderson said the other day, "The first thing an underwriter looked at, in taking a risk, was the name of the owner of the vessel." But what if the owner had been designated by a hieroglyphic? And so in marine engineering. Instead of the names of a Penn, a Maudslay, and a Napier, would it be equally satisfactory for their engines to be classed with some unknown makers all as A 1? The Board of Trade, I am glad to observe, "decline to certify the whole mercantile marine of the country." This, however, is practically what Lloyd's attempt to do; but with what miserable results! Witness the *London*, *Amalia*, *Knight Templar*, and a host of others. Some not 100 days old have foundered on their first voyage, and it is a fact that more "classed" ships are lost than "unclassed." Now, the only objection worthy of notice to the proposed measurement for tonnage is that taken by Mr. Scott Russell, and quoted in the paper now before us, but which I have anticipated and answered. He creates the difficulty by saying, "If you are to be quite fair you should allow all the coals as well as all the engine room, &c." Well, I do allow for all the coals, but not in the way he imagined and illustrated. Nor can the proposed method be abused to so great an extent as is the present method by long poops, or short poops and long coverings in midships, and all kinds of dodges to obtain capacity or space exclusive of the register tonnage or capacity. It may be asked how should dues be levied on those ships and vessels which carry only passengers, or passengers and cargo. The answer has already been given. Dues should be levied only on business done—that from which profits may and ought to be made. Hence, dues should be made on the number of passengers carried, as well as on the number of tons of merchandise. I do not entertain so strong an objection to long vessels as does the gallant and learned author of this paper. I concede to him, that in the true sense of the word they are not ships; they might, perhaps, be designated as marine wagons; they certainly are not suitable for carrying passengers; but as it is quite possible to give them adequate strength, floating power, and good locomotion, and they appear to answer commercially, they must be accepted under the present system, of which they are the offspring. But under the proposed system of tonnage measurement, better vessels might be designed, realising an equal if not superior economy. And the gallant and learned gentleman must not suppose it necessary to retain the ratio of breadth to length which obtained in our old sailing ships, because, as the size of the ship increases, the breadth of beam may be in a less ratio to the length, still retaining that buoyant quality so characteristic of old sailing-ships, and other desirable qualities. Yet there is no doubt that a long narrow ship must go through the waves, and this she may do safely if strong and as tight as a bottle, while a short ship will ride over the waves. But there is one practical advantage in a long ship over a short ship, in that the long ship is not so readily got out of trim; and it may be said that a badly trimmed or badly stowed vessel, is as bad, or perhaps worse, than an over-loaded vessel. A badly-trimmed vessel becomes utterly unmanageable in a heavy sea. The dangers arising from a badly stowed and badly trimmed vessel are not sufficiently well-known and understood. Objection has been taken to casting the burden of saying what was and what was not a seaworthy ship upon the ship-owner; but I cannot see any force or reason in the objection. Railway companies have the same burden cast on them, and they look out to obtain competent professional advice, and this is all that can be done. It is not the duty of the Government to supply the ship-owners with such professional advice and assistance. With regard to the second proposition, viz., "A Maritime Lord Campbell's Act," I was glad to hear from Mr. Norwood that it did apply, and was surprised that he made no objection to it, but I find that it was only in operation for about eight years, and in 1854 was amended to meet the objections of the ship-owning interests; but at present it is practically inoperative on account of the difficulty of proving the death and identity of persons drowned. In the case of railways, and other cases on land, you have the bodies and the *débris* as evidence, but in marine disasters generally such evidence is not obtainable. But the gallant and learned gentleman does not, as I read it, propose "A Lord Campbell's Act" pure and simple, but a marine Lord Campbell's Act, which should and would doubtless be just and fair, as between the carriers by sea and the public, which I do not think the act as it stands would be; it would press unjustly on the ship-owner. Lastly, as regards the first remedy, which is of the highest importance, "A Responsible Head to the Mercantile Marine." I consider that a "Board of Commissioners" would prove more efficient than a Director-General, and such a board should consist of three professional men of the highest

eminence, a naval officer, a naval architect, and a marine engineer, with a secretary, for you cannot have responsibility unless you have the capability. To the incompetency and inefficiency of the Marine Department of the Board of Trade, as at present constituted, is, I fear, to be attributed many marine disasters which might and ought to have been averted, and I thoroughly agree with the recent remarks of Mr. McIver, M.P.; they supply a very apt commentary on the Bill recently introduced to the Legislature:—

> "It was but natural to suppose (he said) that the Bill of Sir Charles Adderley was based upon the recommendations of the Royal Commission, but, although the Commission got at some of the truth, he could not but feel that it did not get at all the truth with regard to unseaworthy ships. From the constitution of the Commission, it had a bias towards the justification of the past policy of the Marine Department of the Board of Trade, and that policy, he ventured to say, had in many respects utterly and completely failed. Any real amendment of the law must commence by sweeping away all that was wrong, and starting afresh with an intelligible enactment which all could understand, and which should provide for the re-constitution of the Marine Department."

Mr. George Duncan could not agree with Captain Pim in recommending that Lord Campbell's Act should be enforced on ship-owners. One of the ways in which it would act would be to make ship-owners liable, like railway companies, for the negligence of their servants; but they were already liable if any loss occurred by reason of negligence or bad seamanship, to the extent of £8 per ton for goods, and £15 per ton for loss of life; and if that liability were increased so as to extend to the whole property of the ship-owner, the consequence would be that all substantial men would leave the business or would register their ships abroad. In this view he was borne out by the Royal Commission of 1853, for when an Act was passed extending Dr. Campbell's Act to ship-owners, as common carriers, it was stated that a leading ship-owner, Mr. McIver, had in one day sold 28 vessels. He had a large fleet of passenger steamers trading on the Clyde, and he felt that if by any error of judgment on the part of a captain, or negligence of a seaman, his whole property was at stake, he had better get out of the trade immediately, and another gentleman on the Commission said he had not much to lose, and he bought them all. He (Mr. Duncan) had some practical knowledge of this question, having worked his way from the forecastle to the quarter-deck, and he believed the same effect would be produced by any other step in the same direction. Another witness before the Royal Commission who put this matter very prominently forward, was the late Mr. Lambert, of Liverpool, and he said that even the £8 a ton liability had an injurious effect upon the handling of low class ships. He also gave an instance from the experience of his own firm of how it would work to make the owner's liability unlimited. They had in their employ a very excellent, respectable master, who had saved £2,000. There was a ship lying in the docks which he could buy for £3,000, and he was very anxious to have her. He therefore came and asked Messrs. Lambert to join him, and take one-third share. They would have been pleased to do so, but they reflected that if any accident happened, as the captain would have nothing more to loose, all the responsibility would fall upon them, and therefore they were obliged to decline, since the liability of £8 per ton for goods, and £15 per ton for lives, was a serious consideration with a ship of 1,000 tons register. They lent the captain £1,000 on mortgage to enable him to buy the vessel, but being so limited in his means he was obliged to be much more economical and sparing in fitting her out than if Messrs. Lambert had joined him in the purchase. He was quite sure, that Captain Pim would not knowingly traduce ship-owners, but he had evidently gone into this subject without making sufficient inquiries, and had been led to make statements which were not well founded. One charge which had cut him to the quick, was that seamen were not properly fed; he did not care what was said about their being hard-worked, because that they took their chance of, but he should feel much hurt if any man in his employ came home and said he had not had enough to eat, and he felt that this charge was not true in general. Mr. Norwood had dealt very ably with that part of the question, but he had been perhaps in error in taking too low a standard with which to compare the provisions of seamen. He had taken agricultural labourers, whose diet was unquestionably not to be compared with that of sailors. The better way would be to take the soldiers and sailors in her Majesty's service; and if it was admitted that these men were properly fed, it would not be hard to show that sailors in the mercantile marine were as well and even better provided for. He had in his hand a comparative statement of the allowances in the Royal Navy and in merchant ships, the latter being from 15 to 25 per cent. the better. Thus while the Queen allowed one man 1 lb. of beef, private owners gave 1½ lbs., and as against ½ lb. of sugar they allowed 1¼ lbs. He had sent to the shipping master at Poplar, who was a thoroughly practical sailor, the scale ordinarily allowed by respectable owners, and asked him if such was the usual scale put upon ships' articles, and his reply was that it was a fair ordinary scale, though many owners made it better. Now, the Legislature had done one very good thing for the seaman in providing that on the articles which he signed should be placed a list of the provisions which he was to receive. They did not lay down any rule as to what the scale should be, leaving that to be agreed upon between the employer and his servant, but the owner was obliged to provide what he had agreed, if he did not, the sailor could enforce compensation, even if the deficiency arose from accident. For instance, he had known numerous instances where from a sea breaking on board the sugar had been spoiled and the men had been paid for it. And the same with regard to ill-usage; if it occurred the men could immediately obtain redress before a magistrate. Besides, the men were generally about ten to one to the officers, and as the latter did not, in British ships use knuckle-dusters, there was not much chance of oppression. Considering the large number of ships constantly being paid off he did not think the per centage of cases which came before the police-courts was very large. He did not say there were no bad captains, or no bad owners, because there were bad men in all classes. There were always pick-pockets about, but they did not ask Government to send a policeman to walk by the side of every man going along the street. That, however, seemed to be the idea with regard to ship-owners, that they could not be trusted for a minute. He felt very strongly that the one thing wanted more than any other, was to raise the standard of education amongst seamen, and if this was accomplished, it would do more than anything else to remedy the evils complained of. The question of seaworthy ships had been very properly brought forward, but that he believed the Board of Trade were quite competent and prepared to deal with. No doubt there had been a great rush into the shipping lately, and some vessels had been built too weak, and not of the best shape, but ship-owners soon found that was not for their benefit. Mr. Young, and gentlemen of his class, would soon educate them to that point. Neither captains nor sailors would go to sea for the purpose of sending ships to the bottom, and underwriters were quite sharp enough in increasing the premiums or refusing ships altogether to cut any man's career very short who attempted to make money by over insuring. Another charge was that sailors had bad or insufficient accommodation, and that might be so in some cases, and in small vessels it was very difficult to manage otherwise; but the evil was not confined to ships. Colliers, and many other classes had the most wretched accommodation, but they were willing to put up with it. One of the members of the Royal Commission, an ex-president of the Board of Trade, had spoken up very bravely in behalf of small ship-owners, and had taken care that evidence was brought forward, showing that by means of these small

vessels a large number of people were enabled to earn an honest livelihood. There was many a master navigating a small coaster (which Captain Pim probably would not like even to go on board of), who brought up a family in respectability out of her earnings, and with two or three men under him who were doing the same, and why should they not do so. They generally made short voyages; they knew the risks they ran, and the accommodation they had to put up with, and when the Board of Trade provided that they should have a good boat on deck, they had done all that was requisite. In his opinion it would be a great mistake to crush out all these little men. It was a most beneficial enactment which allowed owners to deduct crew space from the tonnage on which dues should be paid, and he was sorry when it was proposed to reduce it from 7½ to 5 per cent. At that time, feeling it was a great mistake, he had the measurement taken of all his ships that could be got at, and found that in eight or ten of them the men had over two tons measurement each, which he believed was no more than was allowed by other people. Captain Pim no doubt could speak as to the space allowed each man in the Royal Navy, and he should like to know if it exceeded that proportion. In conclusion, he would only ask Captain Pim to go down to the docks and inspect the large iron vessels which were now becoming so general in the mercantile navy, and then say if the sailors of this country were not afforded as much accommodation as the nature of their occupation admitted.

Captain Bedford Pim said he should like Mr. Currie and Mr. Glover to point out any part of his paper in which he had spoken of the commerce of this country or its tonnage dwindling away. They had made a great point of that, but he was not aware of having made any such statement. What he said was that the number of sailors was palpably dwindling away, that their physique was deteriorating, and also their seamanship, and that subordination was almost at an end.

Mr. Glover said he would only read a few lines from the second page of Captain Pim's paper:—

"Now, under what aspect and in what form does this great matter really present itself to us? To such an inquiry the answer is as simple and plain as it is both lamentable and startling. Since the repeal of the Navigation Laws in 1849, just one-quarter of a century ago, the marine carrying trade of this vast commerce has gradually been ebbing away from our flag, and falling into the hands of other nations."

Captain Pim said that was the very point he had been insisting upon, that the trade was falling into the hands of foreigners.

Mr. Glover added that time only had prevented his mentioning one other fact, viz., that in the ten years between 1860 and 1870, the increase in the entries and clearances was 11 million tons, of which over 10,000,000 tons was under the British flag, whilst less than one million was foreign tonnage.

Captain Pim said he had not asserted that the commerce or tonnage of this country had dwindled away, because every one knew this was not the case.

Mr. Scott Russell then moved the resolution of which he had given notice, saying it was of great importance that any fresh legislation which took place should be of a wise and beneficial character, and therefore, he hoped a committee, representing ship-owners, ship-builders, and sailors, would be appointed to watch the progress of the Bill which had just been introduced.

Dr. Sandford seconded the motion.

The Chairman said he was quite sure that any suggestions which such a committee might make would receive the careful consideration of the Government.

Mr. Carnegie moved, as an amendment, that the motion be not put, thinking the Society would be stultifying itself if it in any way countenanced the paper read by Captain Pim, none of whose propositions had been in his opinion substantiated.

Mr. Scott Russell said Captain Bedford Pim would not be a member of the committee if appointed, the only object of which would be to watch the progress of the Bill through Parliament, and suggest any improvements in it which might appear desirable.

The amendment was not seconded, and the resolution having been put and carried unanimously,

The discussion was adjourned to Wednesday evening next.

INDIAN SECTION.

A meeting of this Section was held on Friday, the 12th inst., Sir Charles Trevelyan, Bart., K.C.B., in the chair.

The Chairman, in introducing Mr. Drew, called attention to certain books placed on the table for inspection, including several dictionaries, and some books kindly sent by Mr. Allen, and said he should be happy to present to any one interested in the subject a copy of "The Sermon on the Mount" in the four southern languages of India, viz., Tamil, Malayâlam, Kanarese, and Telugu, in the Roman character.

The Paper read was:—

THE POSSIBILITY OF APPLYING THE ROMAN ALPHABET GENERALLY TO THE LANGUAGES OF INDIA.

By Frederic Drew.

Forty years ago our chairman, Sir Charles Trevelyan, in conjunction with four others—Dr. Duff, Mr. Yates, Mr. Pearce, and Mr. Thomas—originated in Calcutta the scheme of applying the Roman alphabet to all the vernacular languages of India, and they fought hard in defence and worked hard in prosecution of that scheme.

Already the transliteration of Eastern writings into the Roman character for limited purposes—as in quotations from books or for proper names—had been practised, and so long before as the year 1788 Sir William Jones had established an admirable system for that purpose. But the idea of introducing our characters as the general alphabet for all the languages of India, and causing it to replace the various native alphabets, until by gradual steps it should become the universal writing throughout the country, was not entertained until the year 1834, when those five men, of whom Sir Charles (then Mr.) Trevelyan and Dr. Duff were the most powerful in advocacy of the undertaking, joined together in order seriously and energetically to prosecute what they rightly understood to be a great cause.

Their endeavours have had a not unimportant measure of success, and I believe that they have both shown the way and made some part of the road to the completion of the task. Still, though a generation has passed since the commencement of this undertaking, far more remains to be done even than has been effected. The Roman alphabet has not been adopted generally in India or in any one portion of India. It has indeed been brought into use among certain sections, chiefly among those who are influenced by the missionaries—a body of men to whose credit I count it that they were the first to perceive the advantages of the Roman plan, and who have been the most successful in

using it. By the missionaries much has been done in writing and publishing Hindostānī books in the Roman character, so that now a not inconsiderable literature is attainable by those who will learn to use our alphabet in this application of it. But it must be remembered that in this forty years, during which the Government of India has done much to further general education, the use of native alphabets also has much spread; so that, although perhaps the ratio of Roman to the others has been increasing, yet the native characters enormously exceed in their use the Roman. That being the case, it cannot but be counted right by those who have at heart this change, which they believe will carry great advantages to the people of India, that again the subject should be agitated, that the arguments which before were brought forward in favour of it (and which, as far as I have been able to judge, have never been answered) should be repeated, that steps should be taken, that action should be urged, which shall give a promise of the completion in a not distant future of what was so well begun.

I come forward therefore—myself believing strongly in the cause—to endeavour to enlist in its aid the Society of Arts. It will be my duty to put before you the general argument in favour of the proposed change. It will be your duty to weigh the arguments for and against, and, if the judgment be favourable, to consider what other steps may be taken by the Society towards the proposed end.

It may seem a startling and too bold assertion, yet in the next half-hour I will endeavour to justify it, that among all the advantages which our Government of India is bringing to many of the millions who inhabit that continent, there have not yet been provided for them opportunities of acquiring the great though simple blessings which should be the possession of those who can read and write. Much as has been done by us towards the education of certain sections of the nations whom we there rule over, much as has been attempted by us for the wider spread of education among the huge numbers there to be dealt with, we have hitherto neither effected nor attempted the introduction of such a system as would give to anyone who shall learn to read the superiority over the ignorant which that degree of learning might naturally lead him to hope for, or to those who may acquire the art of writing, the advantages which we are accustomed to associate with that accomplishment.

If to those who remember that now for many years large sums have been expended, and great efforts have been made, by the Educational Department in India, the above statement seems paradoxical and incomprehensible, I will illustrate my meaning by supposing for a moment those circumstances to be transferred to our own country which in India bring about the situation I am regretting. Let us imagine a Wiltshire labourer, ignorant of all school learning, but, conscious of his own deficiencies, determined that his son shall at all events be taught to read and write. With some sacrifice of the help the boy might give towards earning the daily bread for the household, and even with some misgivings lest his son, in acquiring too much knowledge, should become unfitted for the life of labour he was born to, the man sends his boy to a school aided by public funds, and periodically inspected by Government officers, until, after some years, the child has reached to that degree of education which had been promised him. Then our countryman, let us suppose, proud of his son's knowledge, wishes to make a first essay of its practical value by taking him on a day's holiday excursion to the capital of his county. Secure in the thought that his companion can read and write, he goes to the railway station, and asks him to look over the time-tables, and find out the route and the fare to Salisbury. The boy is nonplussed; his learning for this purpose at all events proves to be useless; for the railway bills are all written out in the Russian character! and in Russian, too, is printed the superscription on the ticket. At last arrived at the city, they think to recognise the parts of it they had heard tell of by consulting the finger-posts and the street-names; but though these are written in two ways for the information of various kinds of people, they are for our friends useless, since they are either in the unfamiliar Gothic writing, or in the unknown Greek characters! Only arrived at the cathedral does the boy find himself more at home, for the prayer and hymn books there are in the sort of printing which he has been used to. But this, the father thinks, does not counterbalance the practical deficiencies before experienced, and he returns home revolving the disappointment in his mind, and concluding that until every one writes in the same way, it is not such a fine thing to be able to read after all.

I firmly believe that I have here represented, without exaggeration, the state of things in most parts of India; for so various are the characters, the alphabets, there in use—various those taught in Government schools, and yet more numerous those in use among different classes of natives—that when the pupil leaves school familiar with, let us say, two of them (and few become masters of more), he finds that for ordinary purposes of life his use of letters is greatly restricted, that a majority of those able to write, whom he comes in contact with, write in some character different from either of the two that he has learnt, and that he and they might as well have remained ignorant for all the good their learning can do towards enabling them to communicate by letter.

But now let us by a detailed examination see whether the impression I have given is true or not. I cannot indeed, to prove my case, go this evening over the whole area of India, but I will give a statement of the alphabets and languages used in one of our provinces, which may be taken as a sample, and as to the degree to which our conclusions concerning this one apply to other provinces, there are many here who will be able to speak with authority. I take for my example the Panjāb, choosing it not that I think the case to be stronger for that country than for other parts, but simply because I myself am more familiar with it than with other portions of British India, and therefore less likely to fall into errors of detail concerning it.

In the Panjāb, then, we find the teaching of the government schools to be, for the most part, in three different characters, the Persian, the Devanāgarī (or Sanskrit), and the Roman; the two former, at the option of the learner, for the Hindostānī language,

the last, necessarily, for English. But here, in the teaching of the Government schools, is not included the mother tongue of the greater part of the people of the Panjāb; one who should wish to learn to read and write in this must do so through a fourth character, the Gurmukhī. Nor is this all; none of these will enable a native to look over his account at a merchant's or at a banker's, if perchance he should wish to verify an item; for these purposes one would have to learn two more kinds of writing, the Banyā and the Lande. Yet others will one come across in the Panjāb, though but occasionally; still some of these are used in business by Government officials. On the currency notes will be some writing which anyone who has mastered the above six kinds will think he ought to be able to understand, yet he will fail to decipher it, for this is in the Bangālī character; while a receipt for money paid into one of the Government treasuries will likely, among some writing of some of the sorts we have above enumerated, have writing not readable except by those whose education has taken a different line, for this is in the Kaithī character. Nor have we yet come to the end of the enumeration of alphabets in use in the province of the Panjāb. If we go to the hills, to the Kāngrā district, we find yet another form of writing; and, further among the mountains, in the Lāhol valley, we reach to where the Tibetan character is used. After this enumeration I think you will be ready to allow that I under-rated rather than exaggerated the confusion of hands.

That you may appreciate at one glance the great number of characters used in the Panjāb, I here show you a list of them, in the left hand part of the accompanying table:—

TABLE I.—CHARACTERS and LANGUAGES IN USE IN THE PANJAB.

Characters.	Languages.
Persian Devanāgarī, or Sanskrit Kaithī	........Hindostānī
Gurmukhī Banyā Lande	.... Panjābī
Kāngrā	.... Hill Dialect
Bangālī	.... Bangālī
Tibetan	.... Tibetan
Roman	.... English

Some of these, it will be understood, are much confined locally; of some the use is confined to one class or trade; others, though to some extent used in the Panjāb, belong to distant parts of India. But all, whether separately important or not, may fairly be said to have a cumulative effect in the argument.

What though some of the effects of such a multiplication of kinds of writing can easily be conceived, and require no demonstration, yet others do not occur so readily to the minds of those who have never lived in the midst. A result that soon forces itself on the notice of any who have to deal with the people who use these writings is this, that although a good many even of the poor people begin to learn to write, yet they seldom acquire more than a very imperfect knowledge either of reading or writing. The fact is, that the practice to be obtained in their own particular character is small; they have not the opportunities of perfecting themselves in reading by that incessant use of the faculty which, with us, one who has once got over the first difficulties can hardly help exercising. Hence for the many—setting aside those whose profession is letters—the time spent in learning to read and write is almost entirely wasted, first on account of the imperfection of the result, secondly by the contracted application of it. Often do we meet with men who can write but who cannot read what they have written, and to be able to readily read a stranger's hand is counted for a high degree of clerkly skill. Of the other matter—the partiality of the use of any one alphabet—it is not uncommon to meet with such an instance as this, that in one's own establishment four or five men can be found to write, and no two of them shall write the same character.

I should not fulfil the task which I conceive to be mine—that namely of putting the meeting in a position to form a judgment for itself on the whole question—were I not to show how far this curious multiplicity of writings depends upon the variety of tongues. To show this for the Panjāb even we must extend our survey of the languages beyond the area of that province, and include in a general view the whole of Northern India.

In the plain country which extends from the Indus to the Brahmapūtra, a distance of 1,200 miles, are spoken, in the first place, by the mass of the people, the three languages Panjābī, Hindī, and Bangālī. These have pretty distinct territorial boundaries. But there has of late centuries sprung up a fourth language, which has spread wide, though as yet but superficially, not only over the areas in which these three languages are mainly spoken, but over nearly the whole of India. Now, the increase of this fourth language is still going on, and since it is, as we shall see, closely connected with the subject of this paper, we must elucidate the matter by going somewhat into the history of it.

The Muhammadan conquerors of India settled about Delhi, where the Hindī language was spoken. Their followers, though of different races, yet had, most of them, a knowledge of Persian, and Persian was the court language, and the language of official writings. Hence there sprung up a mixed dialect, of which Hindī was the foundation, but which contained very many Persian words, and Arabic words as well, which already had their place in the Persian. This new language was called Urdū (from the Turkī word for *camp*), and now is also commonly called Hindostānī. It is clear that, the foundation and structure of the language being always Hindī, there may be any degree of admixture of the Persian words, which are found in it whole and unaltered; and, therefore, there may be said to be a gradual passage from the most Persianised Urdū down to the old Hindī. Hindostānī may be taken to denote the medium dialect, that which now is acquiring such a wide extension.

When the British came to Bengal they did not at first adopt for their purposes this Urdū, or Hindostānī, nor, probably, did they come much in contact with it. Persian was still the court and official language of the emperors and of the nawābs, and Bengālī was the vernacular of the province which we first obtained. But in the course of years our power spread further up the country, and in reaching to what are called the North-West

Provinces, we came to that part where the mixed dialect was commonly spoken. Then we found its use as a general means of communication, as a *lingua franca*. We found that while its structure was such that it could be understood over great areas by the illiterate, yet it contained within itself those words from the Persian which were necessary to be retained for the transacting of complicated business which had originally been carried on through that language. The advantage was obvious of fixing on one language which all British officers should know, which should enable them to communicate with almost all of any education, and with also many millions of their uneducated subjects in the most important part of their possessions. Hence the British Government has nursed and encouraged the Hindostānī, and introduced it wherever it was possible to displace by its use the local dialects.

I do not know at what period it was that we adopted it for our law-courts in the North-West Provinces, probably not long after our acquisition of them. On our annexing the Panjāb, Persian, which then still prevailed as the language of the courts, was continued by us for a short time, but it was soon afterwards changed for the Hindostānī. Therefore in the North-west Provinces and the Panjāb we have Hindostānī as the language of the courts, and as the general communication between the English rulers and the people, and with much admixture of Panjābī as the language of the towns.

This slight historical disquisition was necessary that the relationship of the different languages spoken in the Panjāb might be understood. We are now prepared to consider the list of languages there more or less in use, shown on the right-hand side of Table I., and to consider the ways of writing them, present and possible.

By a comparison of the two columns of the table, we perceive that whereas there are ten kinds of alphabet in use in the Panjāb there are only six languages that they are used for. Three of the alphabets are used for one language—Hindostānī; other three are used for one other language—Panjābī.*

It is clear from this that four at least of the alphabets are redundant; that even if it were necessary to have a separate alphabet for each dialect we have four too many. But this is by no means necessary. The Hindī part of Hindostānī and the three languages here bracketed together—Panjāb, the Kāngrā (hill dialect), and Bangālī—are closely allied to one another. I think there is no sound in either of these that is not found in the others. From this it follows that an alphabet that will do for one will do for all; that there is no *need* of this multiplication of alphabets to write these four or five dialects or languages. So far as the nature of the languages as we find them is concerned, one character would suffice for all. Then there is the Persian part of Hindostānī. For this these alphabets are by no means very suitable; hence the Persian alphabet (introduced by the Muhammadans) has spread; it suits best for the Persian words in Hindostānī, and it has been added to so as to do pretty well for the Hindī words. But it is applied to no other of the languages than Hindostānī, and, as we see, it is not the only one applied to that. *It has not proved itself good enough to drive the others out of the field.* The confusion still remains, although, as we saw, there is not a necessity for it in the nature of the circumstances. The confusion has even been increased by the addition of Persian.

We will go on down the list. The Tibetan language has sounds not found in the others enumerated; their alphabets are therefore unfit to express it; the Persian alphabet would suffice as to separate sounds, but it is unable to represent the compound consonants that so prevail in the Tibetan. Tibetan has a systematic writing-character of its own; at the same time the Roman has been found well to suit it. And this brings us to the last on each list—the Roman character and the English language. The English language, it must be known, has already a very considerable position in the Panjāb; it is already in use to a very important degree. At the present day, almost every young man, ambitious either of learning or of political employ, chooses English as his instrument. To so great an extent had lately the eagerness for a knowledge of English spread, that the young Panjābīs (supported in this by their fathers) wished to begin it without having laid a foundation of knowledge in any native language, and Government had to pass an order that none should be taught English in Government schools who were unable to read and write the vernacular. Doubless, also, the tendency of it is to spread, and a knowledge of English will become a necessary mark of a liberal education, unless, indeed, a late movement for the teaching of Western learning through the oriental languages should check this tendency.

Now the English language no one has been bold enough to write in any but its own character. To apply either Persian or Devanāgarī to it would be, either to attempt a phonetic representation of the sounds of our tongue by signs by no means specially suited for the attempt, or to make a transliteration of our irregular spelling that would cause inextricable confusion. No one who has thought at all on the subject can believe in the possibility of writing English in any of the native Indian characters. The results produced by natives in writing our proper names and reproducing the sound from the writing are warnings sufficient.

It follows from this that if one and one only alphabet is to be applied to all the languages in use in India (English being of them), that one must be the Roman; that the only course towards complete uniformity of writing, whether for the Panjāb only or throughout India, is to apply the English or Roman character to all the languages spoken.

But it is not enough for me to prove that *if* we are to have a uniform system of writing for India that writing must be Roman. I am called upon also to demonstrate that uniformity is possible, to show that no such difficulties exist for the application of Roman to the eastern languages as prevent their alphabets from being

* In the list I have put nothing to denote that Roman is used for Hindostani, for indeed in the Panjab its employment for that purpose is very limited. And there are certain other cross uses of the different alphabets which I have not expressed, for simplicity's sake, and on account of their not being of much importance. It should also be remarked that the number of ten alphabets and six languages could be increased were we to take in some of less use.

used for English, to show that their sounds can be sufficiently expressed and distinguished by our characters; not until this has been done will my case approach completeness.

It would be possible for me to rely, as a proof of this proposition, on the results already effected in this direction. There are before you some of the works published by the missionaries to which I before alluded. The test of the system adopted by them is one which I have often tried, and found conclusively to prove its completeness; one is able from these books to read words that one is unfamiliar with, that one is ignorant of, and to give them their right pronunciation. The task of constructing such a system has been lightened by this fact, that nearly all the native writing is thoroughly phonetic, so that a transliteration into Roman at the same time gives a regular representation of the sounds; the exception to this is in some of those Persian words which were derived from Arabic, which have kept their original letters while the sounds have been assimilated to others already existing in Persian; the difficulty arising from this however has been satisfactorily got over. Another evidence of the completeness of the Roman system is given by this which I hold in my hand, taken from the Proceedings of the Asiatic Society of Bengal. In 1867 that Society decided on enforcing a uniform system for the Romanising of Oriental words in their Journal, and they circulated this key to the transliteration, by which not only every sound but every letter also of the languages in use from Arabia to Orissa finds its representative Roman character.

But I will not ask you to assent to this proposition solely on authority. I will not let it rest even on such good supports as those which have been provided. I had rather, without going too much into detail, explain to the meeting how many sounds have to be expressed for Hindostānī, and demonstrate in what way the Roman characters can be used for that purpose. Since Hindostānī includes words both of Persian and Hindī origin, we see that a plan which can suffice for Hindostānī will include both the technical and recondite words that come from the Persian, and all the words in the several languages allied to Hindī; what therefore may be proved for Hindostānī is proved for nearly all the languages we have met with.

In Hindostānī, then, there are this number of sounds:—

TABLE II.—SOUNDS THAT OCCUR IN HINDOSTANI.

	Vowel sounds.	Conso-nants.	Total.
In Hindī words........	10	37	47
In Persian words but not in Hindī	0	8	8
Grand Total	10	45	55

For this table I have reckoned up the sounds, not the letters, the sounds as they are actually made in the mouths of the natives of India. The task now before us is to represent these 55 sounds with our 26 letters.

In the first place we reduce the number of available letters to 25 by dropping our *x*, which represents a compound sound, and the use of which creates unnecessary confusion; we have now but five vowels and twenty consonants wherewith to represent ten vowel sounds and forty-five consonantal sounds; thus the problem comes to look yet a little more hard, but you will soon see the difficulties melt away. The next accompanying table will explain the means that are used:—

TABLE III. — SHOWING THE APPLICATION OF THE ROMAN ALPHABET TO HINDOSTANI SOUNDS.

	Number
Vowel sounds:—	
Five English vowels (a, e, i, o, u)............	5
Three accented vowels (ā, ī, ū)	3
Two dipthongs (ai, au)	2
Consonantal sounds:—	
Twenty English consonants	20
Eleven aspirated letters, expressed by combination with *h* (kh, gh, chh, jh, th, *t*h, dh, *d*h, *r*h, ph, bh)............................	11
Two combinations with *h*, conventionally to express what are not really aspirated sounds (sh, zh)	2
Six marked consonants (t, d, r, g, kh, n, with some diacritical mark to be attached)	6
Apostrophe to represent the Arabic 'ain	1
Three sounds to be denoted by the position of the letter *n* (as of *n* in ring)	3
Two sounds not separately expressed (a sharp *sh* and a strong *h*)	2
	55

We may judge from this, as well as from the examples of results before shown, that it is practically possible to express, without any great complication, all those shades of sound the representation of which seems to be necessary. By the invention of one or two more signs the last differences could be shown; on the other hand, it might be possible to simplify still further, to use fewer marks. I have put down what, in my own judgment, is necessary to form a thorough yet easily-worked system, but I am quite prepared to hear that, in the opinion of others, more or less of elaboration is necessary. For this degree of completeness which I have chosen, there is a necessity in the first place for three accented vowels; this system of accents is distinctly simpler than that of the French language, for here is only one kind of accent (whether the long mark or any other form be used) to represent the long sound of the three vowels, *a*, *i*, and *u*. Then there is an underlining, or some other special mark, to be applied to six consonants, and this, I think, one cannot do without. In Hindostānī, the two *t's*, two *d's*, and two *r's* are so very distinct, that to slur over this difference would be a great imperfection. Again, the marks for *g* and *kh*, to represent the sound of the Persian letters, *ghain* and *khe*, are necessary if one would express the sounds as they come from the mouths of the Muhammadans; the nasal *n* also one can hardly dispense with.

With all this I do not count the system as too much complicated; there are but twenty-six forms to learn (including the apostrophe)—nine modifications by marks, fifteen combinations of letters, and three sounds implied by position. If one contrasts this with the Devanāgarī, where, for Hindī words only, there are 47 letters, besides half-a-dozen other marks and innumerable combined consonants, of greater or less complication, their number reaching to hundreds, we need not be ashamed of

our alphabet, especially when we consider that the forms of our letters are more easily recognisable, are much simpler, and decidedly more quickly written. Comparing it with the Persian, we find in that alphabet 35 letters and three separate vowel-marks, besides other diacritical marks more or less in use; further, all these letters have either two to four different forms, varying according to their position in the word; yet for all this complication, the expression of unusual words in the Persian character is sure to be imperfect.

After this comparison with the two alphabets which are either the best or the most widely diffused in India, are we not justified in maintaining that the Roman is applicable to Hindostānī and to the languages allied to that which forms the foundation of Hindostānī?

I must here pause to remark that I have followed the Jonesian system of transliterating (which is that in which the books before you are written), without discussing any alternative one. My present object is to prove that according to one system or another the Roman alphabet may be usefully applied to these Eastern languages. If anyone should succeed in showing any other system to be better for the purpose than that here followed, I should, while wondering at, welcome the result, inasmuch as it would show that the Roman was even more applicable than I thought.

Let us now in a few words review the steps we have ascended, and, from the stage now reached, let us see what more is to be done. I hope that I have convinced you, first, that there exists a necessity for change from the present confused state of things as regards the writings in use in India; secondly, that the change required is the introduction of a general alphabet applicable to all the languages there spoken; thirdly, that there is no other way of making an alphabet general than by applying the Roman alphabet to the purpose; and fourthly, that such an application of Roman is mechanically possible.

Now I shall bend my endeavours to show that this application of Roman is not only possible from a literary point of view, but that it is also politically practicable. And I shall add something as to what, in my opinion, are the measures to be taken to gain the proposed end. Let us first consider the progress that has in the last forty years been made with Roman-Hindostānī, and derive from the consideration what lessons we may. We must remember that in that time the system has been started, has been brought to a practical form, and has been put to use. This is no small gain. The use of it has spread, but has not spread wide. As I said in the beginning (if I am wrong there are some here who can correct me) it is used most chiefly, almost entirely, by those who are under the influence—not necessarily the spiritual influence, the educational influence it may be—of the missionaries. I confess I see no prospect of the general spread of the Roman system if the efforts for it are to be confined to the same methods as have hitherto been used. These efforts have, at all events for many years, been expended in steady, quiet, literary and educational work on the part of those—not yet many—who are interested in the matter. But during this time the multifarious native alphabets have been receiving distinct aid from Government. Government has undertaken to educate India, and—putting aside the English language—in all its own schools, and in the greater part of the aided schools, its help goes to the teaching of some of the many local alphabets, or of the more general Devanāgarī and Persian characters. This is why Roman has not spread further. It has been met by the rising tide of the other alphabets encouraged by Government. And not only does the action of Government lie in teaching these in the schools, but for all Government purposes, until the stage when English comes in, either Persian or Hindī or Bangālī, or some character allied to these last, is made use of. I maintain that while this goes on our cause cannot prosper as we wish; that the course to take must be to *convert Government* to our views, to convince those who hold the reins of the justness of these views, and to persuade them to give, at all events, an equal chance to the system; and even, after the first measures have borne some fruit, to aid yet more actively the growth of Roman to that wide-spread state when it would be of so much advantage both to the people and to Government itself.

But those responsible for the Government of India, supposing them to have been convinced of the advisability of the plan were it practicable, will at once ask—Can we make this change? Dare we do it? Will it not too much shock the prejudices of the natives?

In answering this question I shall not be ashamed to make use, among others, of the arguments brought forward long ago by Sir Charles Trevelyan. The people of Northern India have received a new alphabet from their Muhammadan conquerors; the Persian alphabet is learnt by many a Hindū; there is nothing to show that the Delhi government ever forced it, or took other means to encourage the spread of it than to continue using it for their own purposes; yet this is now among the most wide-spread of the alphabets. This foreign alphabet is the one which our Government, in North-Western India at all events, chiefly favours. You cannot then say that the people will not willingly take to any new alphabet; nor can it be said that it would never do for Government to favour any but those connected in the minds of the people with what they hold most in reverence. If Hindūs have taken to Persian, much more easily, under corresponding circumstances, will they take to Roman.

But we have a nearer instance of the people of India taking to new, to foreign, ways in the matter of letters. The very great growth of the knowledge of English; the still greater appetite for the knowledge, whose acquisition is chiefly limited by the time that the children can afford for school; their eagerness, as told above, to commence the study without knowing how to read or write their own language in any alphabet at all; all this is surely convincing that there is no obstacle of deep-seated prejudice standing in the way of the change we propose, and that the natives will certainly learn what they see to be to their advantage. If they were once to see clearly that Roman writing was to rule the future, they would not take long to recognise the advantages attaching to a system which, with the labour of learning but one set of characters, would enable their children to advance from the knowledge of their

mother tongue to that of the *lingua franca* of India, and thence to the English.

It is the want of the general applicability of such knowledge of reading and writing as the poor people can get, that makes the anomalous state of things which is thus depicted in one of the Panjāb Education Reports:—

"The rule (that which obliges children to learn to read in their own language before commencing English) is still highly unpopular in many localities, especially so in Lahore. The truth appears to be that there is scarcely anywhere a genuine desire for the study of the vernacular. . . . . That which now stands in special need of encouragement is vernacular education. . . . The great drawback against which it has to contend, is that it possesses no market value."*

Yes, it is true, in the presence of a multiplicity of alphabets, the learning of any one alphabet is of little use, and the natives feel it to be so.

Can it now be said that the natives are so wedded to their own kinds of writing that it would be impossible to attempt to replace them? No, the opposition to the change proposed would not come from the body of the people, who will be beneficially affected by it; it will come from certain sections of natives, with whom I grant it will be thoroughly unpopular. In the Panjāb, and probably in the North-West Provinces, the opponents of this scheme will be the experts in Persian writing; in other provinces also the same class is represented, they are those who, by the knowledge they possess of the writing through which our Government in the districts is worked, are enabled to prey upon our more ignorant subjects; their profits would diminish as the people through some knowledge of letters became able to take care of themselves. For the vested interests of these men I do not feel myself called upon to show how a provision could be made.

So much in answer to the doubts whether Government could safely interfere on behalf of the Roman scheme. It is now to be considered whether it is likely that, even with Government aid, the great change could be effected. We must remember what a great power of influencing is possessed by our Government in India. It is the power of a well-organised Eastern despotism, combined with that which arises from the interested good-will of the governed. Some things, indeed, there are which our Government could not do, even if it stretched its arm beyond the limits of what, according to our recognised principles, would be legitimate. It could never, for instance, make the English *language* general. To get that strange tongue, which is native to but a few thousands in India, adopted by its hundreds of millions is quite beyond what a Government can effect. But to institute a general alphabet, and cause it to spread, so as for all practical purposes to displace the old ones, is distinctly within its power. For this does not depend, as does the matter of language, on imperceptible hourly teaching from the earliest times of consciousness, but it is a matter of school learning, and the more important schools already depend on Government.

With the influence of Government for our motive power, the instruments would, in the first place, be that considerable number of natives engaged in education who know something of English. From the facts I have brought forward, showing the facility with which the letters of our alphabet can be fitted to the various sounds that have to be expressed, it will have become evident to you that anyone who has at the same time a knowledge of one of the vernacular languages of India and of English would, in a very short time, learn to adapt the writing of the latter to his native language. We have, therefore, almost ready-made, a large staff of teachers for the new art; for observe, for the present purpose a good knowledge of English is not necessary, only a familiarity with the forms of the letters; many second-rate English scholars—and of these there are indeed many—might be good teachers of Roman. A week or two's instruction in some central training college would enable these men to become instructors in their turn. To aid them there would be required a few simple authoritative books on the system—a handbook of instructions, say, and a dictionary. When the way had become by these means prepared, Government might allow nothing to be taught in its schools, or in schools aided by its grants, until the pupil had learnt to read and write either his own vernacular or Hindostānī in the Roman character. Also, from those now entering college or the higher schools for an English course this additional test might fairly be required.

But the work must be begun from more sides than one. In judicial proceedings steps should be taken in the desired direction. In the first place, all petitions before a court of law should be allowed to be written either in Roman or in whatever character is now in use, at the option of the suitor. For some time the Roman would be used side by side with the old character. As the native officers of the court became gradually acquainted with the Roman system (either by each learning it or by their replacement in the natural course of things by those who had acquired it at school or college), so might the petitions be absolutely restricted to the Romanised form. A similar course might be pursued with regard to depositions; wherever the clerk of the court had qualified in Roman, the evidence should be written down in it. Steps might be taken to hasten the time when all these officers should thus be qualified. The Government of India know well how to tempt those under them, by advantages distinct or implied, to exertions for any strongly wished-for end. In every branch of the administration like measures should be taken. All writings—proclamations, notices, &c.,—should be given out in the Roman character, here also at first side by side with the old alphabets, which should gradually be disused as the knowledge of them diminished. Again, many things are now published in English which yet ought to be made known to the body of the people; for these Roman Hindostānī would be a good channel, since by this they would reach the natives, and would also be understood by almost every Englishman in India.

If more is wanted than what I have said to tempt the men who wield the power of the Government of India on to what I am myself convinced is, though a long, yet a smooth, but not a slippery, course, I would ask them to look at some of the direct, immediate, positive, ben-

* Panjāb Education Report for 1869-70. Captain Holroyd, p. 43.

that we may see would be sure to flow from the measures lately indicated.

Any improvement in the administrative machinery of our Government in India is a thing to be welcomed equally by those engaged in the working of it and by those on whom it operates. Now our proposed change would be for this great machine like a fresh turning of the bearings on which the various parts of it work; smoothness of motion, lessening of friction, would be the almost immediate result. A few instances of the present roughness in the working will convince you that some improvement is indeed wanted.

All here know of the great amount of judicial work done by our civil servants and our soldier officers in civil employ in India, and all must have heard how much confidence native litigants have in the integrity of these Englishmen. But only those who have been in India and watched proceedings in some District court are aware to how great a disadvantage the English magistrate is put by the evidence being taken down by the clerk of his court in a running native hand. Though the Englishman has passed an examination in that very writing, yet practically he is unable to read it, that is to say he is unable to read it with such facility that he could take up the record and turn over the leaves, and get at the bit of evidence he wished to look at. The following words, quoted from a circular of the Panjāb Government, which was sent a couple years ago to all the Commissioners and Deputy Commissioners of that province, will prove that I am not exaggerating:—

"The petition and deposition writers, as a rule, write hands that are only legible by an expert, and the presiding judge or magistrate is unable to detect intentional or accidental errors, or indeed to decipher a writing which is more a short hand than an authorised style."

This refers to the Persian writing, by means of which proceedings in the Panjāb courts are carried on. To how great a degree the magistrate from this cause is dependent on the writers under him the suitors well know; often they find—oftener still they fancy—that the advantages of integrity in the judge are counteracted by the intrigues of those about him.

If we walk from the Kachahri, the court, across to the Post-office, we shall there observe quite as clear proofs of the need of some improvement. We there see letters directed in English, in Persian, in Hindī, and in other writings. The Postmaster has a good knowledge of English; the sorter has a fair knowledge of it, and a knowledge of one other alphabet, in the Panjāb probably Persian; the letter-carriers usually know neither of these two but some other writing, imperfectly; by means of it they with difficulty jot down on each envelope the names as they are read out to them by the sorter. The results may be expected, or rather they are not quite so bad as might be expected, but they are bad enough. The English letters are delivered with fair punctuality, especially those addressed to Englishmen; the native letters may or may not reach their destination; the percentage of miscarriages is very large; a poor native, when he commits his letter to the post, does so without much confidence that it will be delivered; often have I known one, when simply writing to get news from his home, pay the sixpence (equal to two days' pay) to have his letter registered, thinking that a simple letter will have little chance of reaching; thus the poor are shut out from the blessings of cheap postage which the Government intended to provide for them. The mere stating of these facts is proof enough that the one remedy is a general alphabet.

I might follow this subject through every department of Government, and show how the action of our administrators is crippled by the want of a general means of communicating. But it would take too long for this occasion. I must be content to assure you that the above are merely instances of difficulties that are met with in numbers. I think that some of those present who have held high office in India will be ready to confess how glad they would have been to possess such a means of explaining their policy to the people and obtaining their co-operation, as would be provided by an alphabet readable by all who can read.

Sir George Campbell, in his address to this Section, desired the Society of Arts to pay its attention to the material improvement of India. We cannot, I think, be doubtful that *some* of the advantages of the plan we are discussing will come under the head of material improvement. Sir George would turn education to more useful and practical channels. May I ask if the establishment of a general alphabet would not be the very opening of a sluice-gate to those channels? Take for an example the matter of trade between this country and India. I think it has been felt that there is often a hitch, or more than one hitch, in the chain of communication between the exporting merchants at the great ports and the native producers in the interior, or between the importer and the ultimate native consumer. The waves of variation in price are too long in transmission; there are weak places in the cable, along which information does not easily pass. The result has often been a glutting of markets alternating with high profits not fairly diffused, all which is against a healthy state and a steady increase of trade. Among the causes of these phenomena, a careful examination would, I think, show these to have a place, namely, the absence of a ready means of communication between European merchants and native agents or correspondents in the interior; and the state of helplessness in which the peasantry are held by the native produce-dealers, a state to which it is true they are brought partly by their improvidence, but in part it is due to their ignorance. A more general knowledge and use of writing in a generally-known tongue like Hindostānī would tend to remedy both these evils.

Another branch of inquiry along which I could have wished to ask you to join me had time allowed, is the question of the future of the Hindostānī language. I have said that Hindostānī has in a measure become the language of the towns in a great part of India. There can be no doubt that, now that communication between different parts is becoming so comparatively easy and general, such a common tongue—to supplement, not necessarily to displace, the local dialects—gives immense facilities in transacting affairs. Now the adoption for it of the Roman alphabet would have a great effect not only on the furtherance of its spread, but

as on the development of the language itself. For the Hindostānī language is not fixed. There is continually going on in it a struggle between long and short words, and between Persian and Sanskrit words. As long as the writing of it is in the hands of a few experts, whose natural tendency is to pedantry, the long words, incomprehensible and almost unpronounceable by the masses, have an unfair advantage. Again, while the chief writers are those who have learnt the Persian character, there is always an inclination towards Persian and Arabic terms, even when those derived from Sanskrit roots would be quite as expressive, and would come more naturally to the mouths of the people. The adoption of Roman would have a very direct and weighty effect on the growth, or the perfecting, of a common dialect; it would aid towards a fusing of Urdū and Hindī, by which the best-chosen words from Arabic and Sanskrit sources should be brought together; it would tend to bring the literary language into accord with that spoken, that which we saw to be widely spreading; for with one only kind of writing there would be a more general criticism, which would bring what was written to a comparison with the general standard that would gradually be formed. For another effect on the literature, I will quote some words written long ago by Sir C. Trevelyan:—

"There cannot be a doubt that English scientific terms will be much more readily and accurately adapted into the vernacular dialects, and that both the words and spirit of the English language will become much more rapidly diffused through them, after they shall have been united with English by the bond of a common written and printed character."

But I must now refrain from further development of my ideas of the probable and possible effects in the future of the change proposed. Only one more prophesy will I venture. I believe that a general diffusion of the power of reading—of reading all that is put forward by Government—would enable the people of India to assert their personal independence of all assumed authority, which now so often oppresses them; it would relieve them from the fear of the lower ministerial officers of Government, would lessen or render impossible the indignities and injuries often inflicted by these in their "insolence of office." I have hopes, too, that it would form the link now wanting between the English governors and the governed, that it would diminish the distance of sympathy between them. We should, in the effort to bridge over this space, be meeting the natives more than half way, we learning their language, while they should learn our alphabet.

The reform which I advocate is a sweeping one if the word "sweeping" does not imply a greater suddenness than can be expected in the carrying out of such a measure; a thorough change, at all events, it must be if all the looked-for results are to accrue. But it would be one the action of which would be spread over long years. During those years there would be required an active influence, steadily, continually, exerted. With this, it might, I believe, be carried out, without violence to the feelings of the natives, almost completely within one generation, while its good results would last distinct and recognisable for centuries.

DISCUSSION.

Dr. Leitner said he had always had the greatest regard for the spirit by which Mr. Drew had been actuated during his residence in India, but at the same time he felt constrained to differ from him on many matters of detail, and almost entirely from his conclusions. The substitution of the Roman characters for the various characters which existed in India—and the reasons for which had been very clearly put forward—had difficulties of its own to encounter quite as great as the present alphabets had to meet. These were looked upon by the natives with the reverence which they attached to their own learning; but the Roman characters came to them in the guise of something perfectly strange, imposed by the Government, and not apparently answering any purpose but the very doubtful one of bridging over the difficulty of acquiring the vernacular languages by the English. It had been said that there was a great disinclination in the Punjab to study the vernaculars in Government schools, but that was simply because these languages were already taught incidentally through Arabic and Sanscrit by the priests, in whom the people had confidence. After a long residence, and a somewhat intimate acquaintance with the natives of that province, he was prepared to say that the education, as distinguished from instruction which they obtained was not that given by the Government, but that which they provided for themselves. Whilst there were about 22,000 pupils in the Government schools in his district, there were at least 148,000 studying in the porches of mosques and near the temples. Very often the learning which they thus imbibed proved a powerful mental discipline; but it was strongly connected with the feeling of disappointment which was so common amongst the natural leaders of the people, who found themselves unduly ignored under the English system. The vernacular education we offered was not that which the people cared for. In the first place, our knowledge of it was but slight; and then, instead of adapting our ideas to their wants we had gone on translating European ideas, forgetting that words were made intelligible only through their histories, and that the words of our civilisation especially were made up of concrete ideas which ultimately concentrated and crystallised in one term. Unless those associations and that history could be supplied, the approximate translation of mere words would never make those who learnt them better men, or give them more disciplined minds. The people did not consider it necessary to learn Urdu because they learned it through the Persian or through the Arabic, nor Hindi because they learned it incidentally through Sanskrit; but as to the Roman character, its difficulties were great, even to an English child learning to write and spell its native language. Then, again, there was the question, what system of Romanisation should be used; more than one had been in vogue, but with due deference to the great authorities on the subject, he considered them all more or less impracticable and unphilosophical. For instance, in the system put forward by Mr. Thomas an apostrophe was given for "*ain*," though it was really a consonant which was accompanied by a number of vowels, and might be read in, at least, three different ways. When you came to the phonetic laws of other Oriental languages, such as Turkish, you met with sounds peculiar to them, and transliterators commonly forgot that the phonetic laws of various Oriental tongues were not the same. If you applied a law which might do pretty well for the way in which Europeans mispronounced Urdu, it would not not do at all for Arabic, or Persian, or the complicated vocalisation of Turkish. It was quite clear that to teach the Indian children to spell as the English did would never do, because Englishmen in after-life had the greatest difficulty in getting rid of the false associations of sound with the Roman alphabet in which they were brought up. It was extremely desirable no

doubt that Englishmen should acquire a knowledge of other languages besides their own, but the difficulty of their position in India was that they had too much power, and might easily give a direction to education not really suited to the millions of docile people there, who, unfortunately for themselves and for us, had not yet learned to speak out. At the present moment India suffered from what was termed the scientific system of transliteration, one of the first results of which was that every British officer thought the letter *u* was something to be avoided, that it marked an Englishman of the old school, unacquainted with right spelling, and therefore they substituted *a* for u, and if they wanted to be thought very learned put an accent over it. Even a Mussulman was now called a M*a*ss*a*lman; Jullundur, J*á*l*a*nd*a*r, and so on. In this question, as in every other, the first requisite was to view the matter from the native stand-point, to be willing to learn from them as well as to impart knowledge to them. The first thing which struck him in Table 3 was the altered sound of *n*, according to its position, and it had been said that its sound in the words *dent* and *ring* was essentially different. The sound of *ng* was the French *ton nasal*, produced by suddenly finishing a long vowel, and had nothing to do with the pure sound of *n*, but where there was the sound of *n* followed by *g*, it was still, to all intents and purposes, *n*, and it formed in fact the connecting link between vowels and consonants. He did not think the way in which Table 2 was constructed was quite fair to the Punjab. *Devanagari* was used by all classes who considered Sanskrit a sacred language, *e.g.*, for *Hindi*, but it was not fair to say that these three alphabets of Persian, Sanscrit, and Kaethi represented *Hindostani*. The Persian alphabet no doubt was used in Hindostani, simply because it had worked its own way for utility. No doubt the people in the Punjab, as elsewhere, as they saw the power of Government more and more established, would gradually learn, not only the character in which the language of their rulers was written, but also the language itself to a certain limited extent; but if you inflicted upon them a character without consulting their natural leaders—for whom Mr. Drew made no provision whatever—failure would be inevitable. But, to take another side of the question, suppose you encouraged what the people revered, their sacred languages—Arabic and Sanskrit—and that in which their most elevated thoughts were expressed, the Persian, then, by conciliating the leaders you would affect the multitude, and identify them with your own interests, and more would be done in one year than by half a century of ill-directed, however well meant, supposed reforms. He had the greatest respect for reformers, but he did hope that for some time to come a little peace would be allowed to India, and that for at least ten years there should be no attempt at anything beyond letting things work their own way. As he had already shown, the argument for the neglect of the vernacular education offered by the Government was worth nothing, and when you came to translation the matter was even more difficult. There were many tracts published by missionaries in which the words used—say, to represent "salvation"—conveyed quite a different meaning to that which was intended. The proper way to get over the difficulties and the native character was to improve that character itself, and though this might appear a gigantic task, it was not greater than had been achieved in other cases. They all knew the difficulty which sometimes attended the deciphering of the scrawls they received from their friends, and he could well recollect the labour he had, some ten or twelve years ago, in making out the meaning of the writing in the Rolls and Record-office. Looking nearer home, what difficulty was often found by Englishmen in reading the running hand of a Frenchman, and many an English firm would not employ a German clerk because of his unfortunate habit of making his figures all so much alike. The great aim should be to try and develop the native character from within, and this was quite possible in all the forms derived from the Sanskrit. As regards the Perso-Arabic alphabet, he believed that his Excellency the Persian Ambassador had, after the labour of twenty years, succeeded in achieving this great result, and had devised an alphabet which would be respected by the natives, because it was identified with their own sacred learning, and yet should be read, without previous instruction, by the mullahs, scribes, and others in Constantinople, in India, and in Bokhara. If so, he had settled the question, because this would be a means of developing education and literature without upsetting those national prejudices and feelings without which no people was worth anything, but which, if made the basis of an indigenous civilisation, would not only develop all that was good in them from within, and thus make it permanent, but would also form a vehicle for conveying to them all the treasures of Western civilisation. The beauty of the Arabic language consisted, in its perfect form, in the tri-literal root, by which was attained that wonderful development of which Arabic words were capable, and these three letters would be recognised if written either in Persian, Hindostani, or any similar native character. If, however, you endeavoured to transliterate them on any system, however elaborate, and supposing you could get everybody to agree upon it, which you never could, you utterly lost the key to the word. Who could recognise in such a word as *istighfar* spelt in Roman character, the word ghufûr; yet it was the same, and anybody who had only learned the beginning of Arabic would at once trace it. What would English etymology be worth if *light* and *fight* &c., were spelled according to the phonetic views of the claimant? At the same time he was quite ready to admit that the natives did sometimes presume upon the little knowledge which, as a rule, Englishmen possessed of their alphabet and language by careless handwriting, but that difficulty might be got over. He held in his hand two letters received within a week of each other, from the same person, one written in a manner which anybody worth his salary in India could read fluently, whilst the other had defied all the efforts of the most skilful decipherers. They came from Tamstein, the Siah Posh Kafir, whom the Society entertained about a year ago; one was evidently written by a Munshi at Peshawur, before he crossed the hills, and the other apparently came from Kafirstan itself. This showed that the native character might be so developed as to be perfectly readable. Complaint had been made of the broken hand of the Serishtadars, but it was, in his opinion, the duty of those who had to administer justice in India to make themselves acquainted with this running hand, which might be done by a little application and perseverance, and not depend solely on the good faith of their native clerks. Unfortunately, the great idea of most of us Anglo-Indians was to benefit the natives in our own way, instead of looking at matters from the standpoint of the people themselves, and this habit, more than anything else, retarded the progress which might be made. It was not merely the character, however, which was puzzling, and which gave the native clerks opportunities of which they sometimes availed themselves, but there was actually a language spoken in the very ears of the judges of the court at Peshawur, which was quite unrecognised until he had drawn up a rough outline of its grammar and construction. His main point was that all attempts at elevating and improving the people of India must start from the native standpoint as a foundation, and to this end he believed the character which the Persian Ambassador had spent so many years in perfecting, would be far more useful than any attempt at the universal introduction of the Roman alphabet.

Sir George Campbell had listened with much pleasure to Mr. Drew's paper, which had placed the matter in an extremely clear and practical point of view. So far as his plea for uniformity was concerned there was nothing

wanting in his argument; but then came the question whether the Roman character was the right one, and on that point he had hardly made up his mind. The truth was, most characters were adapted to the language for which they were originally designed. There were a great variety of sounds in different languages, and it was almost always found that when a character was applied to a language for which it was not originally intended, considerable awkwardness ensued. A striking example of this was to be found in the application of the Roman character to the English language, for which it was not originally intended, nor for any Germanic language; and the consequence was that great anomalies and incongruities arose between the phonetics of the language and the arbitrary way in which it was spelt. He had not quite followed Dr. Leitner's argument, and did not quite understand what view he took; nor when he spoke of the vernacular did he quite know what he meant by it, because there were a great many vernaculars in India. He was inclined to think if it was a question of using an Arabic character for the Arabic language, and the Devanagari for the pure Hindi language, that it would be better to sacrifice uniformity, and write those languages in the characters designed for them. But, then, both Arabic and the purely Hindoo languages had become very much mixed, and it was a peculiarity of the native habits that they were extremely ready to adopt foreign languages into their own, so that there was nothing like a pure language to be found. There was Hindostani, which was mixed in the same way, and that being so, it was impossible with these mixed languages to have any one character altogether suited to these languages. There was no one alphabet fitted to properly express them all, and therefore they must weigh the advantages and disadvantages on each side; and he confessed he had not yet fully made up his mind on the subject. His view, however, was very much opposed to that of Dr. Leitner, with regard to the question of the higher education of the natives, for it seemed to him monstrous that those who came to rule as foreigners, and teach Western civilization, should attempt to teach the natives a foreign Oriental civilization, which they were much less inclined to learn than they were the English language and Western literature. Therefore, so far as any foreign improvements were superadded to the vernacular languages, they ought to be English. It was also politically desirable to encourage as much as was fair and feasible that language, and he believed the natives to be much more willing to accept it than any other foreign languages. Seeing that these vernacular languages were exceedingly adaptable, he thought the result would be a language in which English bore the same proportion to the pure vernacular which Persian and Arabic now did to Hindostani in the upper provinces. This, however, was a strong argument in favour of adopting the Roman character as distinguished from any other, whilst at the same time the Persian character had many advantages, being written with extreme facility. Hindi and Devanagari had considerable advantages, but, upon the whole, he should say that he was inclined to think that the Roman character was more fitted than any other for universal adoption.

Mr. Raees Uddin Ahmed said he did not think it was necessary to enter into the scientific part of the question, how far it was possible to write the Arabic language in Roman characters, but he would deal with the Urdu, which was to all intents and purposes the same as Arabic, though it had some additional letters adapted into it from the Sanskrit. There were 55 sounds in this language, and as in the English alphabet, there were only 26 letters, out of which w, x, and y might very well be taken. There only remained 23 to represent the 55 sounds, so that a large number would have to be represented by some conventional signs. Supposing these were devised, it would be also necessary to keep the Arabic or the Hindi in use, or otherwise in l[illegible] of time the proper pronunciation of the words was sure to be forgotten. As he had said, Urdu was mostly Arabic, and in his view the fate of Arabic had already been secured by the Koran. There were in India about eighty or ninety millions of Mohammedans, and these would never give up the Urdu character so long as they were followers of the Koran, not from prejudice, but because they were enjoined in the Koran to read it in the Arabic language, and in no other. It might be said that the Urdu and Roman character might go hand-in-hand, but then, instead of affording any facility to native education, there would only be added one more difficulty in learning, and he did not think those who desired to benefit Indians would really like to add any burden to the present inconveniences under which they were labouring. They stood in great need of education, and no further impediments should be thrown in their way. Urdu was more or less understood in every part of India, and therefore he thought it the duty of the Government, if they were inclined to supply the country with one universal language, to uphold and to favour it. English was the dominant language now, because it was the language of the rulers, and it would be accepted everywhere; but to substitute the Roman character for the Urdu he believed would be impossible.

Mr. Hyde Clarke said the valuable paper, no less than the able speech of Dr. Leitner, had chiefly referred to the application of Roman to Hindustani. Although this language was used by many millions, such a test did no justice to the importance of the subject, which dealt with the destinies of progress of many nations, some of them in the hills of India, reclaimed from savagery by us, and furnished with a written tongue. He (Mr. Clarke) therefore wished to bring back the matter to its true relations, for he had long felt an interest in it, and what he had written in 1858 had been embodied in Sir C. Trevelyan's work of that time. He still entertained the same views, and he concurred with Dr. Leitner in regarding most of the transliterating or scientific alphabets as unscientific, tested philologically. The subject, to his mind, was not to be treated as one of abstract science, or for the convenience of a few Italians or German philologists, nor even for our own men of education. At the same time it was not one of literary or religious prepossession. It was most mischievous to represent that the discouragement of the alien Arabic was an act of oppression on the natives of India who did not accept it, for this was a part of the disloyal agitation too prevalent. There was no intention to employ the force of the Government to compel the use of English, an Indo-European tongue, nor of English forms; least of all was there the slightest justification for representing that the Mussulmans of India would be prevented by the Government from reading the Koran in the Arabic character or in Arabic, which was no more the native or domestic language of Mussulmans in India than it was in China, in Turkey, or in Africa. Each man, Hindu, Mussulman, or other, could read his own Scriptures, as people did all over the world, in the sacred language applicable to them. It was, however, of great moment, on every practicable ground, that not only the Roman alphabet, but English should be encouraged as much as possible. The wonderful progress and development of India was due to the labours of Englishmen in every department, and the adoption of the accepted scientific terms of the world at large was a matter of necessity. With regard to Dr. Leitner's suggestion, that the civilian should be sacrificed to the Serishtadar, there was no justification for it. Judge and suitor were equally interested in remedying an abuse, which was prevalent, not only in India, but in Turkey, and in the country of his distinguished friend, the Persian Ambassador. The experience of England was, however, often applicable to India, and in England we had formerly numerous scripts and court hands, a separate one in each court or depart[illegible]; the English judge and suitor were as

much at the mercy of such obstructives as a clerk of the Hanaper as those in India were with the Sherishtadar. Here, however, we had got rid of the abuse, and in the courts, as elsewhere, had only the print and the running hand; for it must be borne in mind that, simplify as we will, there must be always these two forms. The civilian in India was too valuable for the advancement of the country to be detained by court-hands, in which no one could obtain the proficiency of the specialist. It was necessary that the natives of India should have the means of inter-communication and of learning each other's languages. It was no less material that they should have access to the thousands of Europeans sent every year to India—the railway men, the soldiers, the workmen—and that all these should be able to learn something of the local languages. At present impediments were put in the way. The Sonthal, the Rajpoot, or the Punjabi, was taught an alphabet of a conventional and exceptional character. When he came to learn English, as he must do if he wanted to learn anything practical, and even if he wished, being a member of the higher races, to extend his literary knowledge, he found he must unlearn what he had been taught, as the values of the letters have been purposely made un-English. The more the people are taught the vernacular the more they will want to learn English, for the same reason that the Welsh-taught Welshmen teach themselves English, from the thirst for knowledge and the paucity of practical books. There is, too, this consideration, that with the Roman type all the languages can be printed, and that in English there is a large store of printed books. When the Englishman, high or low, wishes to learn an Indian language, he seldom gets over the alphabet, and if he does, like the native, still finds that he must master numerous complicated alphabets to get at the translations of the various sections of society. If, however, he resorts to Roman vernaculars, he has still to acquire a new fangled alphabet, a matter of great trouble to the mass of our population. The recent alteration of the topographical names was an impractical embarrassment and not an improvement, and no one would countenance it if applied to our home names. The new nomenclature was of a piece with the sham purism that would admit an Arabic or other law term to be worked with a Hindi, but would not allow an English law term to be so worked. Then, again, there was the monstrous delusion that Hindustani could be kept classic with Arabic, Persian, and Turkish words, and that English were inadmissible. The common sense of the people of India revolted against these untenable pretensions, and English was working its way there as it did in so many languages of Europe and of other regions. The whole question of Roman letters, and consequently of English teaching, was of much importance, and Sir George Campbell had given some practical illustrations. The progress had been such, and the benefits achieved so great, that he trusted Sir Charles Trevelyan would persevere in the mission he had so long and so successfully conducted.

His Excellency the Persian Ambassador said—Je regrette de ne pouvoir m'exprimer facilement en votre langue. Je suis obligé de vous parler dans une langue qui m'est également étrangère. Mon nom ayant été prononcé ici d'une manière si bienveillant, je tâcherai de vous dire en quelques mots le rapport qui peut exister entre moi et votre savante société. J'ai appris que vous discutiez en ce moment le projêt d'introduire les caractères romains dans nos langues d'Orient. Il n'y a pas, messieurs, une question plus importante pour l'avenir de l'Asie que celle dont vous vous occupez en ce moment. Nous connaissons malheureusement trop bien cette prodigeuse différence que le progrès Européen a mis entre vous et les peuples d'Orient. En recherchant les causes de cette différence, si accablante pour nous, je suis arrivé à cette conviction profonde que l'obstacle de notre progrès ni vient ni de nos principes religieux ni de l'infériorité de nos races; l'obstacle vient principalement—je pourrais dire uniquement—de notre système d'écriture. Ce monstreux système qui nous a été imposé par des circonstances exceptionnelles, a acquis avec le temps le caractère immuable de nos institutions sacrées, et aujourd'hui ses innombrables difficultés enchaînent si complétement notre développement littéraire que la régénération de l'Orient me parait tout à fait impossible avec un pareil système d'écriture. Depuis longtemps le changement de ce système est une de mes préoccupations personnelles. En Perse, en Georgie, et en Turquie, beaucoup d'esprits distinguées ont consacré des longues années à l'étude de cette question. Tous les alphabets étrangers ont été soigneusement examinés, et on a longtemps entretenu l'espoir de pouvoir adopter les caractères romains. Mais, en poursuivant des essais de ce genre, des considérations intimes et des obstacles inhérents à la nature de nos langues ont prouvé que l'introduction des caractères romains n'offrirait aucune possibilité pratique. Ces obstacles il serait difficile de développer ici. Tout ce que je puis dire c'est que vu la nature de nos grammaires, et les relations multiples de nos littératures orientales, la difficulté serait immense, insurmontable. La seule voie qui nous paraissait ouverte c'était de demander à notre alphabet même les perfectionnements, qu'on allait chercher ailleurs. Le problème était ceci: modifier notre alphabet de manière qu'il offrirait tous les avantages voulus tout en conservant assez de ses formes actuelles pour que ceux qui ne connaissent que l'ancien alphabet puissent lire le nouveau sans l'aide d'une étude nouvelle. Le problème parait insoluble. Cependant à la suite de longs efforts on croit pouvoirs' assurer qu'aujourd'hui le problème est resolu. Plusieurs modèles ont été déjà gravés, et s'ils n'ont pas été publiés c'est parceque certains travaux typographiques ne sont pas encore achevés. Mais puisqu'un heureux hasard m'a amené aujourd'hui à vous parler de ces essais, je serais heureux de pouvoir soumettre dès à présent tous ces travaux à ceux qui voudraient bien m'apporter le concours de leurs lumières. Il ne me reste plus que de vous remercier sincèrement de cette généreuse initiative qui vous porte à vous occuper d'une question en apparence si aride, mais qui, selon moi, renferme tout l'avenir de l'Orient.

The Rev. James Long said that soon after he arrived in India, he became engaged in the Romanising controversy which was then going on, and he must say that the result showed him that so far as the Bengali languages were concerned, and they were spoken by more than forty millions of people, the Roman character was a failure. The Government was by no means opposed to it, and he believed the experiment was fairly tried, but only one book of any consequence was produced in it, and that was the New Testament, which was printed at the expense of the Bible Society. He had, however, never known a native who took it, except for nothing, for the value of the paper, and he certainly never met ten who could read it. Dr. Duff, who had been a great advocate for it, had admitted to him that he had come to pretty nearly the same conclusion, viz., that the Roman character was inapplicable to the Sanskrit and Persian languages of India. With respect to Urdu, it was a different question altogether, and there the change would, he thought, be desirable, though the conclusion come to at a missionary conference some years ago was that it had as yet made no progress amongst the natives, who did not seem inclined to adopt it. He should like, however, to see further efforts made in this direction. In speaking of uniformity throughout India, it must be recollected that that country was not like England, a little island of 30 millions, but it possessed a population of 250 millions, so that it was much like talking of uniformity in Europe. Uniformity was practically impossible, with so many different races of people. With respect to the Urdu being a kind of *lingua franca*, which was known everywhere,

he had unfortunately found, in travelling in the Madras and Bombay presidencies, that it was nothing of the sort, and Dr. Pfander, the great Oriental scholar at Agra, had confirmed this view, saying that beyond the influence of the Mohammedans and in the large towns it was practically unknown. And more than that, the development of education in the north of India was leading to a feeling of aversion for it, so much so, that at Benares and other places deputations had waited on the Lieutenant-Governor asking to have it given up in the Courts, and Hindi substituted for it. He considered this language, which had been forced on the natives by their Mohammedan conquerors, was looked on as a badge of servitude; and he believed the time would come when they would fling it off, and when the Hindi would resume its rightful place in the north-west, as the natural language of the masses of the people.

The Chairman, in proposing a vote of thanks to Mr. Drew, referred to the illustration made use of by the last speaker, as to there not being uniformity in Europe, saying there was practical uniformity in printed and written character, and it was obvious how greatly the difficulty of learning French, German, Spanish, and Italian would be increased if one language were expressed in Persian character, another in Bengalee, another in Tamil, and so on. With regard to Dr. Leitner's remarks as to the inapplicability of the Roman letters as they are pronounced in England, that was an argument which told the other way. The Roman character was never properly applied to the English language, as Sir George Campbell had remarked, but had been, as it were, pitchforked on to it in time of ignorance, the result being that the same sound was represented by half a dozen different signs, whilst the same sign represented half a dozen different sounds. This was an evil which all successive generations of English children had to get over as best they could, and likewise all foreigners who learned English, and he could not see at present any remedy for it. But at the present time he could assure Dr. Leitner that there was really no controversy as to the mode of applying the Roman letters to the Indian languages. More than a generation ago, in the time of Gilchrist, Roebuck, and the Asiatic Society, there was a considerable difference of opinion about it, but since then the subject had been fully considered, and all were agreed as to the superiority of the Jonesian system. He could not agree with Dr. Leitner or Mr. Raees Uddin Ahmed that it was necessary to retain the Arabic character in order to trace the changes of the different words from their roots to their most perfect developments. The German Orientalists were considered good authorities on this subject, and to save the great expense of printing books in the native characters, they had published a whole series of Oriental classics in the Roman type at a few shillings each, whereas, in the original character it would have cost twenty times as much.

Mr. Raees Uddin Ahmed said the Mohammedans were forbidden to read the Koran in any language but Arabic.

The Chairman said there was no doubt, for religious purposes, the Arabic character would be retained; but, happily, all educated Mohammedans in India now learned more or less English, and a very slight smattering of it would enable them to read their own language printed in Roman character with perfect ease. Mr. Drew had not exaggerated the obstacles to intellectual, moral, and religious progress arising from the diversity of alphabets in India. The English parallel is even more complete than he supposes. Take our provincial dialects as they existed fifty years ago, before they began to be assimilated by popular education and railways—Somersetshire and Devonshire, Dorsetshire and Wiltshire, Eastern Counties, Lancashire and Yorkshire, and Northumbrian. When conversing together these provincials could with difficulty understand each other, but, having only one alphabetical system, they met on common ground, and all their differences were merged in the inexpressible blessing of one comprehensive national alphabet and literature. But how would it have been if the dialect of Somersetshire had been clothed in one alphabetical system, that of Dorsetshire and Wiltshire in another totally different, the Eastern Counties dialect in a third, and so on? But this is not all. To complete the parallel, we must suppose that our general merchants kept their books and carried on their correspondence in a peculiar set of characters, our shopkeepers and bankers in another, and that our standard English, which occupies the place of Hindustani as the common medium of communication, was expressed by an alphabetical system based upon different principles from all the rest. Then, as to the suitableness of the Roman letters to the high function proposed for them of expressing all the different languages and dialects of India. The system to which Mr. Drew gives the name of "Jonesian," is merely a return from the corrupt, confused modern application of the Roman letters to their original use. Nothing can be simpler or, in its way, more beautiful. The Roman letters have been proved by recent philological research to have a common origin with the Eastern alphabetical systems; and, as remarked by Mr. Drew, Eastern writing is still thoroughly phonetic, that is, the due relation of sign and sound is consistently maintained throughout, so that a simple transliteration into the Roman character gives a correct representation of the sounds in all the native languages. The invention of printing found the Roman letters in possession of the Western world, and adopted them as its principal medium. During more than three hundred years their typography has been elaborated with all its accessories of punctuation, capital letters, italics, and other mechanical helps, until the Roman letters have become infinitely better adapted for expressing the languages of the East than the various alphabetical systems in actual use there. I am prepared to maintain this against all the world. The Roman letters would return to their original Eastern seat, laden with the accumulated improvements of the West, and would confer upon the people of the East far greater benefits than the letters now in use among them. There is no one in this room who, after an hour's study of the system, could not read off with perfect correctness any sentence in any native language, however ignorant he might be of the meaning of the words. Take, as an example, the beautiful Hindustani translation, embodying words derived from three different sources, Hindi, Persian, and Arabic, of the prayer in our Litany:—"In all time of our tribulation; in all time of our wealth; in the hour of death, and in the day of judgment, good Lord deliver us!" "*Hamáre har ek dukh men; hamáre har ek sukh men; maut ke waqt, aur kiyámat ke roz, Khudáwand-i-niámat humen bacha!*" Nay, natives of India themselves can read their own languages in the Roman character with a fluency to which they cannot attain through their own alphabetical systems. Its superiority over the Persian character, in which Hindustani is ordinarily expressed, is most marked and decided. Nothing can be more inconvenient and perplexing than the Persian letters. The forms of the consonants are elongated and sprawling, the reverse of our compact, symmetrical Roman type; and if the vowels are expressed at all, it is done by little dashes above or below the line. But the moment running hand is attempted the vowels altogether disappear, and it becomes difficult even for the writer to read his own writing, still more for others, and above all, of course, for Europeans. The Persian running hand, in which the business of our courts and offices is transacted, is justly called *shikasta*, *i.e.*, scattered or broken. The Arabic and Persian character is really nothing more than a syllabic system. When this system was originally adopted by the Greeks they added the vowels in the same line, and the Romans, with the wonderful practical talent which always dis-

tinguished them, perfected what the Greeks had improved. Mr. Drew has, I think, conclusively shown that the large number of influential natives in every part of India who have already become familiar with the Roman letters in their application to English, are prepared to use them in printing, reading, and writing their own languages; that the great obstacle is the exclusive manner in which the Government has hitherto patronised the old alphabetical systems; and that if they were all regarded with equal favour, the inherent advantages of the Roman letters would soon bring them into general use. One of the earliest objects to which I directed my attention, when Governor of Madras, was the establishment of the new police. This was composed of persons representing the four prevailing languages of the peninsula, Tamil, Telugu, Canarese, and Malayalim, besides the Mohammedans, who spoke Hindustani; and much inconvenience arose from the variety of characters in which the daily reports were sent to the different head-quarters. As the easiest and best solution, it was arranged that, whatever might be the language of the reports, they should be written in the Roman character. Manuals were prepared, and there was every prospect that the system would come into general use throughout the department, when my recall took place, and the matter relapsed into its former routine. Another work initiated by me was to prescribe that, except in a few familiar cases, in which the corrupted form had practically taken the place of the original word, names of places and persons in official documents should be correctly expressed according to the Jonesian orthography. This great improvement was not only carried into practical effect in the Madras Presidency, but has since been adopted by the Supreme Government, and has thus been extended to the rest of India. Further progress in the use of the Roman letters has been facilitated by this arrangement, for every educated person in India, European and native, has thus become habituated to the transliteration of native words. Mr. Drew says he does not know at what period Hindustani was substituted for Persian as the language of the courts of justice and offices of Government. This great change was made between the years 1833 and 1836, under the governments of Lord William Bentinck and Lord Auckland, on the double ground that as Persian was not the language either of rulers or subjects, it acted as a barrier between them, giving undue influence to the native officers of the courts, and that the necessity of learning Persian for official purposes occupied time which ought to be given to more useful studies. Unfortunately, while the Persian language was discarded, the Persian character was retained, and the Hindustani used in the courts is, therefore, so completely Persianised—so saturated with Persian and Arabic words and idioms—that it is almost as unintelligible to the body of the people as the original Persian; and the native officers (amla) still hold their intermediate post of vantage against both rulers and people. All this would be changed if free course were given to the Roman letters, not at first by any compulsory proceeding, but as proposed by Mr. Drew, by simply permitting their use to those who prefer them. The English authorities would then be brought into direct personal relation with the body of the people, and, as all the Indian languages and dialects would be comprehended in a single alphabetical system, and it would be seen at once how far they agreed or differed from each other, mutual intercourse would be facilitated in an extraordinary and most beneficial degree. As regards the languages themselves, a process has set in similar to that gone through in England after the Norman conquest. While the official language remains the same, the popular language has become powerfully modified both in idiom and vocabulary. High, pure Hindustani and Bengali are no longer in vogue, and numerous English words and phrases have come into popular use, partly scientific, literary, and official; but partly also expressive of moral ideas which have received new life from contact with our nation, such as "family," "character," "duty," "gratitude," and others. (I speak on this point from somewhat exceptional experience, it having happened to me to return to work in India after an interval of more than 20 years, so that I saw the actual change in this respect that had come in with a new generation.) Even when synonyms are in common use in both languages, the English word is preferred if more than usual emphasis is intended to be given. For instance, the wife of a native clerk will say to her husband, "*Ab office jane ka time hai.*" "It is now *time* to go to office;" the value of time according to English ideas being greater than when it is spoken of in connection with old native associations. So completely are these two different forms of the same language in concurrent use, one official the other popular, that English officers have been known to insist upon native pleaders using either entirely English or entirely Bengali, and not what they were pleased to call a 'jargon' compounded of both. Those who take this line do not reflect that the growth of the national mind must find its expression in development like this. Hindustani and Bengali are asserting their composite character by a free assimilation of words from the new world to which they have been introduced, just as Anglo-Saxon was moulded into English under corresponding Norman influences. I must not attempt now even a slight sketch of the consequences of the general application of the Roman letters to a state of things like this. It would be the salvation of the native languages (and I would beg particularly to recommend this view to Dr. Leitner's consideration), which have a hard struggle in their competition with the all-powerful English, freighted, to native apprehension, with so many substantial advantages. While it would establish practical harmony among all the Indian languages, it would combine them in indissoluble connection with English. They would all derive their inspiration from our language and literature, and would in time become penetrated with the spirit of our pure religion. The circumstance alluded to by Mr. Drew—that our missionaries have been the consistent, persevering supporters of the system, and that it has made steady progress in their hands notwithstanding every discouragement—is in the highest degree significant. I think all will agree with me that we are much indebted to Mr. Drew for the very able way in which he has brought this subject before us this evening; and to myself it is a matter of peculiar interest and satisfaction to find this question, on which I spent much time and trouble in my younger days, and which I still feel convinced to be a question of great importance—of great promise to the masses of our Indian fellow-subjects—and a matter of perfectly practical application revived in a manner likely to awaken a fresh interest in its behalf, and to inaugurate, as I would fain hope, a practical re-consideration of the benefits that would follow its adoption.

The vote of thanks was then unanimously passed, and having been acknowledged by Mr. Drew, the Conference terminated.

TENTH ORDINARY MEETING.

Wednesday, February 17th, 1875; Lieut.-Col. A. STRANGE, F.R.S., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Batcheler, John, jun., Dagnall, Hemel Hempstead, Herts.
Evans, William Herbert, Tintern-house, Primrose-hill-road, N.W.
Gilbert, Mason William W., 43, Rathbone-place, W.
Hartley, Joseph, Ormskirk, near Liverpool.

Hewett, Edward, Elvetham-mount, St. Leonards-on-Sea.
Hewitt, Richard, F.R.G.S., 3, Princes-square, Hyde-park, W., and the Green, Esher, Surrey.
Hooper, William, 113, Victoria-street, S.W.
Houghton, James, 41, Rodney-street, Liverpool, and 4, York-buildings, Dale-street, Liverpool.
Lloyd, John, Kingsbury-brewery, St. Albans.
Pargeter, Philip, Red-house Glass-works, Stourbridge.
Ross, Lewis Buttle, Southend-laboratory, Driffield.
Thatcher, John H., Brook-mills, Oldham.
Smith, Edward, F.C.S., Strand, Torquay.
Spencer, Thomas, 32, Euston-square, N.W.
Ventura, Signor M., 49, Coleman-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Addison, William, Broxbourne, Herts.
Anderson, Richard, F.C.S., 130, Strand, W.C.
Kirk, Benjamin Reed, M.R.C.V.S., Huddersfield.
Leigh, William, Stoneleigh, Heaton Moor, near Stockport.

The paper read was—

DESCRIPTION OF M. KASTNER'S NEW MUSICAL INSTRUMENT, THE PYROPHONE.

By M. Dunant.

Sound is in general, according to natural philosophers, a sensation excited in the organ of hearing by the vibratory movement of ponderable matter, whilst this movement can be transmitted to the ear by means of an intermediate agent. Sound, properly called musical sound or tone, is that which produces a continuous sensation, and of which one can appreciate the musical value. Noise is a sound of too short a duration to be appreciated well, as the noise of a cannon, or else it is a mixture of confused and discordant sounds like the rolling of thunder. For a single sound to become a musical sound, that is to say, a tone corresponding to one of the intonations of the musical scale, it is necessary that the impulse and, consequently, the undulations of the air should be exactly similar in duration and intensity, and that they should return after equal intervals of time. In its change to the musical state, however dull and confused the noise may be, it becomes clear and brilliant. Like the diamond, after having been polished and cut according to the rules of art, it has the brilliancy for the ear which the former has for the eye. This is what takes place in singing flames. Very imperfect in its beginning, hoarse, roaring, or detonating, it does not come nearer the musical sound, properly so called in the chemical *harmonica*, as it is termed, still, by means of reiterated trials the sound of the single flame in the tube, the *lumen philosophicum*, as it is elsewhere called, can it be musically produced in every case.

It has long been known that a flame traversing a glass tube under a certain pressure produces a musical sound. The eminent savant Professor Tyndall, to whom the greater part of the deep questions in physics are no mysteries, has studied singing flames, but it must be admitted that singing flames have only penetrated into the dominion of art in consequence of the discovery made by M. Frederic Kastner of the principle which allows of their being tuned and made to produce at will all the notes of the musical scale, to stop the sound instantaneously and mechanically; as in keyed instruments the sound is regulated and subdued as desired. It is thus that the modest *harmonica chimique, lumen philosophicum* of natural philosophers has, in the pyrophone, attained to the character of a real musical instrument; this happy result supports the remark that the observation in nature of the phenomenon of sound may conduct man, if not exactly to the invention of music, at least to endow the art with resources which increase its power. The sound of the pyrophone may truly be said to resemble the sound of a human voice, and the sound of the Æolian harp; at the same time sweet, powerful, full of taste, and brilliant; with much roundness, accuracy, and fulness; like a human and impassioned whisper, as an echo of the inward vibrations of the soul, something mysterious and indefinable; besides, in general, possessing a character of melancholy, which seems characteristic of all natural harmonies. The father of this young philosopher, a member of L'Institut de France, and a learned author, who died in 1867, treating on cosmic harmonies, insists on this peculiarity:—

> "The harmonies of nature," said he, "which in their terrible grandeur as well as in their ineffable sadness, have ever charmed the philosopher, poet, and artist, are most often stamped with a character of vague melancholy, from the influence of which the mind cannot escape. It is especially when the noise of the world is hushed that these powerful harmonies produce the most overpowering and poetical effects."

It characterises, for example, the sound of the echo, the sound called harmonics, and many others which are included in the range of musical tones, defined further on under the name of *chemical and sympathetic music*. We have the most remarkable examples of these in the sound of the Æolian harp. Science, as well as philosophy, poetry, and musical art, is interested in the further study of these sounds. In Germany, Goethe and Novalis, in France, Jean Paul, and many others, have eagerly appreciated the bond which unites natural harmonies to the most elevated instincts, and to the most ideal aspirations of the human soul.

Professor Tyndall has recognised the fact that in order to render a flame musical, it is necessary that its volume be such that it should explode in unison with the undulations of the fundamental note of the tube, or of one of its harmonics. He also asserts that when the volume of the flame is too great, no sound is produced; he demonstrates it, by increasing the flow of gas. Professor Tyndall has also called attention to this fact, that in order that a flame may sing with its maximum of intensity, it is necessary that it should occupy a certain position in the tube. He shows this by varying the length of the tube over the flame, but he does not specify the proportions which must exist between the flame and the tube for obtaining this maximum intensity of sound. M. Kastner's merit is in having shown that when two or several flames are introduced in a tube, they vibrate in unison, and produce the musical maximum of sound when they are placed one-third the length of the tube, and if these two flames are brought in contact, all sound ceases directly, a phenomenon M. Kastner demonstrates to be caused by the *interference of sounding flames*. Here is a question, lately scarcely thought of, of which M. Frederic Kastner has determined the laws, at the same time making a

most remarkable application of them in creating an instrument which reminds one of, and may be mistaken for, the sound of the human voice.

A very simple mechanism causes each key to communicate with the supply pipes of the flames in the glass tubes. On pressing the keys the flames separate and the sound is produced. As soon as the fingers are removed from the keys the flames join, and the sound ceases immediately. These new experiments made by M. Kastner upon singing flames should cause all makers of musical instruments to turn their attention to inventions connected with sound. If two flames of suitable size be introduced into a glass tube, and if they be so disposed that they reach one-third of the tube's height, measured from the base, the flames will vibrate in unison. This phenomenon continues as long as the flames remain apart, but the sound ceases as soon as the two flames are united. If the position of the flames in the tube is varied, still keeping them apart, it is found that the sound diminishes while the flames are raised above the one-third until they reach the middle point, where the sound ceases. Below this point the sound increases down to one-fourth of the tube's length. If at this latter point the flames are brought together the sound will not cease immediately, but the flames will continue to vibrate as a single flame would. M. Kastner, for his first experiments, used two flames derived from the combustion of hydrogen gas in suitably constructed burners. The interference of the singing flames is only produced under special conditions. It is certain that the length and the size of the tubes depends upon the number of flames. The burners must be of a particular shape; the height of the flames does not exercise much effect upon the phenomenon. From a practical point of view, the numerous experiments effected by M. Kastner during several years, have resulted in the construction of a musical apparatus of an entirely new principle, to which he has given the name of *Pyrophone;* it may be called a new organ, working by singing flames, or rather by vibrations caused by means of the combustion of these flames. This instrument may be constructed from one octave to a most extended compass.

The *British Review* humorously remarks that the pyrophone will naturally be valuable in winter, and that in America it has already been recommended to families as a means of warming small apartments, and perhaps an economical stove may be added to it for the culinary exigencies of straitened households.

The pyrophone will have in the future a poetical mission to fill in the music of concerts. A great number of composers and musicians have already admired this new organ performing by the singing of flames, or rather by vibrations determined by means of the combustion of these flames. They think it will be of great advantage in cathedrals and churches, as the most extended compass can be given to the instrument.

L'Année Scientifique, by M. Figuier, declares that the pyrophone is assuredly one of the most original instruments that science has given to instrumental music. In the large pyrophone which M. Kastner has constructed, and which they have not yet been able to bring to London, an artist can produce sounds unknown till the present time, imitating the human voice, but with strange and beautiful tones, capable of producing in religious music the most wonderful effects. So says *Le Journal Officiel de l'Exposition de Vienne.*

Journals and reviews abroad have unanimously mentioned with praise this new instrument, both from a musical as well as from a scientific point of view.

M. Henri de Parville, in *Les Causeries Scientifiques*, gives a large space to the consideration of "Singing Flames," and states that "gas music" made its *debut* at the Vienna Exhibition of 1873. *La Nature* and *La Revue des Sciences*, edited by M. Tissandier, believe that this new instrument is destined to produce the most remarkable and unexpected effects in the orchestras of lyric theatres and in large concerts. The chandeliers of the theatre, besides serving to light it, may be converted into an immense musical instrument:—

> "When the pyrophone is played by a skilful hand, a sweet and truly delicious music is heard; the sounds obtained are of an extraordinary purity and delicacy, recalling the human voice."

The inventor has prepared a large and beautiful singing lustre, with a dozen or fifteen jets, which can be placed in the richest or most comfortable drawing-room. This lustre may be used at concerts or balls, for it can play all the airs in dance music. It will be worked by electricity, so that the performer who plays may be seated in a neighbouring room. The effect will be perfectly magical. The future has other surprises for us for our houses. The most unexpected applications of scientific principles are daily the result of the skilful efforts of learned men.

Without reckoning Professor Tyndall, who is so well known and esteemed on the Continent, many other learned men, English, German, Austrian (like Shaffgotsche), and Frenchmen have already studied singing flames, but no one had previously thought of studying the effects produced by two or several flames brought together, till M. Kastner, who, by means of delicate combinations and ingenious mechanism, has produced the pyrophone.

Frederic Kastner, the inventor of the pyrophone, showed from his earliest age a very decided taste for scientific pursuits. His parents, whose fine fortune permitted them to satisfy the taste of their son for study, gave him facilities often denied to genius. They frequently travelled; the first thing which arrested his attention was a railway; this pleased him much; he had a passion for locomotives, just as some children have for horses. He was only three years old when he examined the smallest details with a lively feeling of curiosity. Later on, when he tried to reason and explain his impressions, he overwhelmed with questions those who surrounded him, wishing to learn the mechanism of these great machines, and the mysterious force which sets them to work. But what more especially charmed him was, when the train stopped at the station, the fiery aspect of the jets of gas emerging suddenly from the darkness. At this sight he shouted with delight; such was his enthusiasm that he seemed as if he would jump out of the arms of those who held him, in order to rush towards the jets of flames, which exercised upon him a sort of fascination.

Steam and gas, in their modern application to

locomotion and lighting, were the first scientific marvels which struck the mind and the sense of the child. He studied music under the skilful direction of his father. From the age of fifteen years, in studying gas particularly, his attention was directed to singing flames. The mysteries of electricity were also at this time the object of his study. The researches to which he gave himself up carried him on to invent a novel application of electricity as a motive force. He patented this invention. On the 17th March, 1873, the Baron Larrey, member of the Academy of Sciences of Paris, presented to the *Institut de France* young Kastner's first memoir on singing flames, which laid down the following new principle:—

"If two flames of a certain size be introduced into a tube made of glass, and if they be so disposed that they reach the third part of the tube's height (measured from the base) the flames will vibrate in unison. This phenomenon continues as long as the flames remain apart; but as soon as they are united the sound ceases."

Passing on to his experiments, M. Kastner thus gives his account:—

"I took a glass tube, the thickness of which was 2½ millimètres; this tube was 55 centimètres long, and its exterior diameter measured 41 millimètres. Two separate flames of hydrogen gas were placed at a distance of 183 millimètres from the base of the tube. These flames, while separated, gave F natural.

"As soon as the flames are brought together, which is done by means of a very simple mechanism, the sound stops altogether. If, letting the flames remain apart, their position is altered until they reach one-third of the total length of the tube, the sound will diminish gradually; and it will cease completely if the flames go beyond one-half the length of the tube; under this (one-half the length of the tube) the sound will increase until the flames are brought to one-fourth of the tube's total length. This latter point being reached, the sound will not cease immediately, even if the two flames are placed in contact one with the other; but the two flames, thus united, continue vibrating in the same manner as a single flame would.

"The interference of the singing flames can only be obtained under certain conditions. It is important that the length of the tubes should be varied according to the number of the flames, the height of which has only a limited action or influence over the phenomenon; but the special shape of the burners is a matter of considerable importance.

"These experiments, which I undertook two years ago, induced me to construct a musical instrument, possessing quite a novel sound, which resembles the sound of human voice. This instrument, which I term the Pyrophone, is formed by three sets of keys (claviers) disposed in a similar manner to that employed for the conjunction of the organ-key tables; a very simple mechanism causes every key of the different sets to communicate with the supply pipes in the glass tubes. As soon as a key is pressed upon, the flames, by separating, emit a sound; but when the keys are left untouched, the flames are brought together and the sound stops."

In consequence of this communication a Commission from the Academie des Sciences de Paris was selected for the examination of this curious invention, consisting of Messrs. Jamin, Regnault, and Bertrand, three distinguished members of that academy, who showed a lively interest from a scientific point of view in M. Kastner's discovery. After fresh experiments, M. Kastner has succeeded in substituting the ordinary illuminating gas for hydrogen gas in working this pyrophone, and his friend the Baron Larrey, was again the interpreter to l'Academie des Sciences of this new discovery, which much facilitates the employment of the luminous musical instrument. M. Kastner thus expresses himself in his new report presented to the *Institut de France*, 7th December, 1874:—]

"The principal objection which has been made to the working of the pyrophone is the employment of hydrogen gas. From a practical point of view, this gas presents several inconveniences. It is difficult to prepare; it necessitates the use of gas holders, whose size may be considerable. Besides, there is some danger in its use. I have therefore given up using hydrogen gas, and for a year I have experimented on the means of applying common illuminating gas to the pyrophone, which it is always easy to procure. In the first experiments which I attempted with two flames, with illuminating gas, in a glass tube, I was unable to obtain any sound, which proved unmistakably the presence of carbon in the flames. Whilst the sound was produced in a very clear manner with the pure hydrogen gas, that is to say, without there being any solid foreign matter in the flames, it was impossible to make the tube with illuminating gas vibrate, when placing the flames in an identical condition. It was necessary, then, by some means or another to eliminate the carbon, a result at which I arrived by dint of the following method:—

"When the flame of ordinary gas is examined, and this is introduced into a tube made of glass, or of any other material (metal, oilcloth, cardboard, &c.), this flame is either illuminating or sounding.

"When this flame is only illuminating, that is to say, when the air contained in the tube does not vibrate, it presents a lengthened form, and is pointed at the top. Besides, it swells towards the middle, and flickers on the least current of air. On the contrary, when the flame is sounding, that is to say, when the necessary vibrations for the production of sound are produced in the tube, its form is narrow, and large at the top. Whilst the air of the tube vibrates, the flame is very steady. The carbon in a great measure is eliminated as if by some mechanical process.

"Sounding flames proceeding from lighting gas are in effect enveloped in a photosphere which does not exist when the flame is merely luminous. In the latter case the carbon is burnt within the flame, and contributes in a great degree to itsi lluminating power.

"But when the flames are sounding, the photosphere which surrounds each of them contains an exploding mixture of hydrogen and oxygen which determines the vibrations in the air of the tube.

"To produce the sound in all its intensity, it is necessary and sufficient that the whole of the explosion produced by the particles of oxygen and hydrogen in a given time, should be in agreement with the number of vibrations which correspond to the sound produced by the tube.

"To put these two quantities in harmony, I have thought of increasing the number of flames so as to increase also the number of the explosions from the mixture of oxygen and hydrogen in the photospheres, and thus determine the vibration of the air of the tube. Instead of two flames of pure hydrogen, I put four, five, six, &c., jets of lighting gas in the same tube.

"I have besides observed, that the higher a flame is, the more carbon it contains.

"I have then immediately been obliged to diminish the height of the flames, and consequently to increase the number so that the united surface of all the photospheres may suffice to produce the vibration of the air in the tube.

"The amount of carbon contained in the whole of the small flames will always be much less than the quantity of carbon corresponding to the two large flames necessary to produce the same sound. In this manner I have been able with separated flames to obtain sounds whose tones are as clear as those produced by hydrogen gas. When these flames, or rather when the photospheres which correspond to these flames, are put in contact, the sound instantly ceases. The carbon of lighting gas, when the flames are sounding, is certainly almost entirely eliminated—in fact, it forms upon the interior surface of the sounding tube at and below the height of the flames a very visible deposit of carbon, which increases whilst the air of the tube vibrates. I can now affirm that the Pyrophone is in a condition to act as well with the illuminating gas as with pure hydrogen. The phenomenon of interference is produced exactly in the same condition with the two gases, the same flames occupy the same position in the tube, that is the third part of the tube's length measured from the base. In addition to the phenomenon of interference, I believe I shall be able to describe a novel process by aid of which the sound produced by burning flames in a tube can be made to cease.

"Supposing that one or several flames, placed in a tube

third of its height (measured from its base), determine the vibration of the air contained in this tube; if a hole is pierced at the one-third of the tube, counted from the upper end, the sound ceases. This observation might be applied to the construction of a musical instrument, which will be a species of flute, working by singing flames. Such an instrument, from a musical point of view, will be very imperfect, because the sound will not be so promptly or sharply stopped as when the phenomenon of interference is employed. If, instead of making the hole at the third, it is made at a sixth, the sound will not cease, but it will produce the sharp of the same note. In all these experiments I have clearly detected the formation of ozone while flames cause the air in the tube to vibrate. The presence of this body can, moreover, be ascertained by chemical re-agents scientifically known."—Given before the *Academie des Sciences*, 7th December, 1874.

Professor Tyndall, at a lecture on 13th January, at the Royal Institution, showed experiments, according to the new principle, with an apparatus of nine flames, which worked during the evening in tubes of different sizes.

DISCUSSION.

The instrument having been sounded and played upon, by itself and with a piano lent for the occasion by Messrs. Broadwood,

The Chairman stated that he was informed the tuning of it depended, in a great measure, on the regularity of gas supply, and the instrument now exhibited not being furnished with a regulator, such as was attached to the more finished one in Paris, certain imperfections were noticeable, for which the gas companies were responsible.

Mr. Blackie suggested that if music of a livelier character than that of the "National Anthem" were played, the audience would be better able to judge of the quality of the instrument. It was stated in the paper that it was available for dance music.

The Chairman thought this was purely a mechanical question, depending on the rapidity with which the gas jets could be opened and closed.

Mr. Pearsey thought this would have been a most interesting instrument prior to the invention of the organ. It might also be available for special purposes of its own, for it struck him that when the light afforded by the lantern of a lighthouse has failed, these tubes might be adapted to produce most penetrating and portentous sounds, which would warn vessels off the rocks.

Sir Julius Benedict asked if there were any means of regulating the intonation, which at the present seemed rather defective, for there was some difficulty in bringing it into accord with the piano. If it were to be used with other instruments in an orchestra, there must be some means of tuning it.

The Secretary said he believed it admitted of tuning readily, but the want of a regulator for the pressure of gas, which had already been alluded to, affected the purity of the intonation.

Sir J. Benedict said there seemed some cause which rendered the sound very uncertain; it got sharper after the first sounding.

The Chairman remarked that in this experimental instrument the organ bellows was replaced by the gas holder, over which there was no control, and, consequently, the same regularity of pressure could not be expected as where the bellows was especially constructed to produce a uniform blast. It appeared that to the more perfect instrument in Paris a regulator was applied.

Mr. Wills said there could be no doubt of the great ingenuity displayed by M. Kastner in the construction of this instrument, but if it were to be practically introduced it was as well that the difficulties to be got over should be clearly stated. Having had some experience of sounding flames, the difficulties appeared to him to be these:—In the first place, the position of the burner in the tube was a matter of considerable importance; its size must be always the same, and its position, both vertically and laterally, must be fixed and absolute. Besides this, the gas used must be of definite quality, and perfectly under control. These points might each be secured singly, but, taking them in the aggregate, he doubted the possibility of making an instrument which should be practically useful. But if this were accomplished, there was always the danger that when there were several pipes in close proximity, the sounding of one would start another, this being a very common lecture experiment. Another difficulty was that there was always a tendency in sounding flames to go out suddenly, when, of course, the sound would cease. Again, in an instrument of this kind, as it would be impossible to use "stopped" pipes, great length would be required for the lower notes, a 16-feet open pipe being required to produce the same tone as an 8-feet stopped. An instrument in this form was no doubt new, but the pinciple was not, because Professor Tyndall, some four or five years ago, exhibited an octave of pipes sounding with a flame, and he had been followed by others, himself among the number. No attempt, however, had been made to construct a musical instrument on this principle, because the difficulties he had mentioned appeared insurmountable. M. Kastner said the cessation of sound which took place when the flames were joined together, was due to the interferance of vibrations, but he doubted if this were the true explanation. The flame must be supplied with a certain quantity of air in order that little explosions should be produced, and it was the rapidity of these explosions, the sound intensified by the column of air in the tube, which produced the musical sound. Now if the jets were brought together they produced one long flame only supplied with air on the outside, and to so limited an extent that an explosive mixture was not formed; but when the flame was opened out it formed a series of small flames, each of which was surrounded by air, forming the explosive mixture, and the tube spoke. M. Kastner was probably not a chemist, for his ideas with regard to the carbon in the gas seemed somewhat vague. He spoke of its elimination, by altering the position of the flame, as if it were a mechanical process, but such could not be the case; the only means of getting rid of the carbon being by burning it into carbonic acid, which was effected by allowing a sufficient amount of air to come in contact with the flame. The reason why the effect was not produced so well with coal gas as with hydrogen, was, that in the former case a much larger quantity of air was required in order to produce an explosive mixture.

Mr. Mitchell asked if it were not the case that the difficulty of producing rapidity of execution was rather a physical difficulty than a mechanical one, as had been suggested by the Chairman. The mechanism by which the jets were opened and closed seemed to work with tolerable rapidity, but from a recollection of Prof. Tyndall's lectures at the Royal Institution, he fancied a certain appreciable time had always elapsed before the vibration produced the musical note. If this were so he feared that the pyrophone, though a very interesting philosophical toy, would never be of much practical utility.

Mr. Wills thought the last speaker's view was the correct one.

The Secretary said it would be observed that when the flame was in the form of a tall jet, there was no vibration going on, but when the jets were separated these vibrations were visible. In order to get rapidity of action it would be requisite to separate the flames instantaneously, as to which there seemed a great diffi-

quality. He was, however, informed by M. Dunant that M. Kastner felt satisfied he should be able to attain the desired rapidity of action.

Mr. Goddard said he was much interested in this subject, having made many experiments upon it during the last three years. He had met with the difficulties which had already been mentioned, and though some of them had been overcome, others seemed to increase rather than diminish. The pyrophone of M. Kastner was certainly novel in construction, and had some very good points about it, in particular that of producing a powerful tone by employing several flames in the same tube. This he had found a great difficulty in a little instrument he had constructed with thirty-six tubes, the tone being very weak. Another difficulty was the rapidity of action, and this he feared could not be surmounted. With one flame only in each tube there was great difficulty in making the note speak quickly, and the longer the tube, the longer the time before the sound was produced. This showed that the hesitation was due to the length of time required for the vibrations to reach the top of the tube. The mechanical part of the instrument was very ingenious. He had employed valves; first, at the top of the tube, but with this arrangement there was a perceptible interval between the striking of the key and the sounding of the note, and then at the bottom, in which position the note spoke more quickly. He thought, however, that in enlarging the instrument, and giving it greater power, M. Kastner had in some measure destroyed the sweetness and beauty of tone. There also appeared to be a variation in the note, a gradation of sound, as the jets separated, and unless this could be cured, of which he was somewhat doubtful, he feared the instrument would never be more than a scientific toy.

Mr. Dunant desired to draw attention to that part of his paper in which he claimed for M. Kastner the merit of discovering, by means of the separation of the flames, a method of instantaneously causing the note to sound.

The Chairman then proposed a vote of thanks to M. Dunant for his paper; to M. Kastner for his kindness in constructing and sending over from Paris a special instrument to illustrate it; and to the ladies who had attended and played upon it.

The motion was carried unanimously, and the proceedings terminated.

With reference to the poisonous qualities of colours from coal tar, a German paper states that a decomposed aniline which is sometimes left in the colours imparts to them poisonous properties. A so-called aniline red prepared with picric acid and arsenic is poisonous on account of the arsenic it contains. Rosalic acid and coralline are not in themselves poisonous, but often contain, when not properly purified, some phenol or aniline, which renders them so. Many colours are fixed by sodium arsenite, which remains in the goods, and is of course poisonous. Azaline, a blue dyestuff, when pure is harmless, but it sometimes contains phenol and aniline. A yellow dyestuff prepared from picric and arsenic acids is poisonous. Picric acid in itself is poisonous.

Coal is beginning to attract attention in New South Wales, in some parts of which the mineral is being found in abundance, and it is suggested that the pre-eminence which gold and copper have maintained will be assailed by the increasing importance of the newly worked product. A seam, seven feet thick, has been opened at Brougham Creek, not far from the Moss Vale Railway Station.

The production of petroleum during 1873, in Pennsylvania, was estimated at about 8,000,000 barrels, an increase of nearly 2,000,000 barrels over that of the previous year. The exports from the United States were 237,481,633 gallons against 150,162,419 gallons in 1872. The exports to the United Kingdom were largely in excess of those of previous years, being 21,778,651 gallons, against 7,845,272 gallons in 1872.

MISCELLANEOUS.

PATENT-LAW REFORM.

In the House of Lords on Saturday, the 13th instant,

The Lord Chancellor called the attention of the House to the subject of Letters Patent for Inventions, which, he stated, effected, to a great extent, the manufacturing industry of the country. After adverting to the inquiries which had been made on the subject by Royal Commission, by a Select Committee of the House of Commons, and by the International Patent Congress which met in 1873 at Vienna, he said that the Government had come to the conclusion that some alteration should be made in the existing system in this country, one defect of which was, that it provided no means of investigation by the Law Officers before a patent was absolutely granted. The present Commssioners of Patents were the Lord Chancellor, the Master of the Rolls, and the Law Officers of the Crown, and by the Bill he intended to lay on the table, the composition of that Commission would be enlaegod by the addition of three members on the nomination of the Board of Trade, and of two more on the nomination of the Lord Chancellor. It was also proposed that there should be attached to the Patent-office not less than two nor more than four officers, who would be termed Examiners of Patents, and who would devote the whole of their time to becoming acquainted with the contents of the Patent-office. Whenever application should be made for a patent, it would be required that the specification should describe not merely provisionally and in general terms, but as fully as possible, the nature of the invention, and the specification would be referred to one of the examiners, in conjunction with certain referees conversant with manufactures, science, and art, who would pronounce their opinion whether the invention was a proper subject for a patent, and whether the protection should be limited to seven years as distinguished from fourteen. Among other things, the Bill provided that all patents should, after the expiration of two years, be liable to be recalled, on the ground that the patentee either failed to use his invention or to grant licenses to proper persons on reasonable terms. It was likewise provided by the Bill that for any foreign invention no patent should be granted in this country, except to the foreign patentee or his agent. The Court of Queen's Bench having decided that the Crown was not of itself bound by Letters Patent, the effect of that decision would be, in respect to inventions connected with large ordnance, for which there was not likely to be a customer in England except the Crown, to make the inventor conceal his invention in this country; and it would therefore be provided that, for the benefit of the public service, any Government department should be at liberty to use any invention, and in case the patentee did not come to an agreement as to the remuneration for the use of his patent, the Treasury should have authority to settle the terms. He observed that an arrangement had been made by the Treasury within the last few days to locate the Patent Museum upon an adequate piece of ground at South Kensington, and to transfer the subjects of copyright in trade marks and designs from the superintendence of the Board of Trade to the Patent Commission. The Lord Chancellor concluded by stating that a Bill for the Registration of Trade Marks would be introduced in the House of Commons, and he then laid on the table a Bill for the Consolidation and Amendment of the Law respecting Letters Patent for Inventions.

Lord Granville acknowledged the clearness of the statement made by the Lord Chancellor, but deferred

any remarks he might have to make on the Bill till a future stage.

The Duke of Somerset thought that a better position than South Kensington for the Patent Museum would be some large town in the manufacturing districts.

The Bill was read a first time.

On the same day in the House of Commons,

Lord H. Lennox, in answer to **Mr. Mundella**, was happy to say the Government had decided to provide adequate accommodation in the Exhibition Buildings at South Kensington for a Museum of Patents and Inventions. The nature and extent of it he would announce in detail when he asked for the vote for carrying it out.

SILK CULTURE IN JAPAN.

The rearing of silkworms, Consul Robertson informs us, has always received great attention at the hands of the Japanese, and has now attained to a high degree of perfection. The commencement of the season varies in the different parts of the country, according as the temperature happens to be high or low. When the climate has a pretty equable temperature, the silkworm egg cards are taken out of store about the beginning of April, and hung up in some quiet nook of the house. After the lapse of twenty-two or twenty-three days the worms will appear; they are carefully watched and paper is wrapped round the cards, which are now placed in a basket-tray. They are looked at every morning, and brushed off lightly with a feather fan on to another piece of paper. Mulberry leaves are then taken, cut very fine, and well sifted, tossed so as to get rid of the leaf fibre, and then mixed with a certain proportion of millet bran. With this the worms are fed. Fresh paper is wrapped round the cards, and this course is pursued for three days, when all the worms will be out. The paper with the worms on it is then placed in clean basket-trays over a layer of matting. The worms are fed about five times a day. After three days the paper is removed, and the worms are transferred to matting. This stage is known as the "Kaminuke." One card will probably multiply itself sixty times so far as the number of worms go. As a rule, about ten days elapse before the first sleep is entered upon, but this depends upon the temperature. When the cocoons are observed to be preparing for the first sleep they are sprinkled with millet bran, and covered with a net, mulberry leaves being placed over the net. After a couple of hours the net is raised, and the worms brought away with the mulberry leaves, to which they will have attached themselves. They are then placed in a fresh basket-tray, and the one from which they have been taken is well cleaned. When the worms have roused themselves from the first sleep they are sprinkled with rice-bran and covered with a net as before, after which they are shifted to a fresh basket. The same course is pursued when the worms go through the second and third sleep, but for the fourth sleep the net is not used. The period that elapses between the second, third, and fourth sleeps is from six to seven days at each stage. Much attention is paid to cleanliness, as neglect in this respect exposes the worm to disease. Mulberry leaves are given with an unsparing hand, the leaves being chopped coarser and coarser as the worms grow in size. Sieves of different sizes are used so as to meet the feeding requirements with fine or coarse leaves. As a rule, the worms are fed five times a day, but in hot weather, when the leaves are apt to get dry, they are given as often as eight or more times a day; in cool weather the leaves are given perhaps only three times, but with no reduction in the actual quantity. The leaves are measured out with great nicety. An important feature in the rearing of silkworms is the giving the proper quantity of food, neither overfeeding, nor, on the contrary, starving the worms. After the fourth sleep the leaves are given whole. The worms have now attained full size, and soon cease feeding altogether. When they are observed to be seeking for a place to spin in, the best are picked out and placed on the "mabrushi;" this is a contrivance made either of straw or light twigs, and intended to facilitate the spinning of the cocoons. The cocoons are spun in three days. Those selected for silk are dried in several ways, either in the sun, or by artificial heat, or by steam. If the reproduction of eggs is desired, the cocoons are ranged in baskets. After thirteen or fourteen days the chrysalis will have changed into a moth, which will emerge from the cocoon. The male and female moths are then mated. About 100, 120 or 130 female moths are then placed on a card, which is surrounded with a framework of oiled or varnished wood, so as to prevent the moths from escaping off the card. In a very short space of time, say about twelve hours, the card will be covered with eggs. Strings are then run through the cards, which are strung up in some quiet corner. In autumn, they are stored away in boxes, and so left till the following spring. The great thing to guard against is disease, so that careful watching of the worms day and night is most essential. If the weather is exceptionally hot, then the worms are kept cool; if, on the other hand, cold, then proper warmth is looked after.

There are several varieties of the mulberry. Exposed and open ground is generally selected for a plantation, with a stream near at hand. The ground is always well drained. With worms intended for reproduction, more than ordinary care is exercised in the selection of leaves for their food. The cocoons are used for two purposes, that is, either for the reproduction of seed or for the reeling into silk. In the case of the former, care is taken to preserve the chrysalis, and the cocoons are carefully stowed in a place of safety. When it is intended to use the cocoons for silk, they are dried as above. Two or three days' exposure will ensure the destruction of the chrysalis, and thus prevent the egress of the "uji," or moth. The mode of drying generally in use amongst the Japanese is by exposure to the sun's rays, though drying either by artificial heat or steam is not unknown. If dried in the sun, the cocoons should be left till after sunset, and until they are slightly moist with dew. If taken in when hot from the effects of the sun, it tends to make the silk brittle, and difficulties will be experienced in reeling. With a climate affording equable temperature, say 70° Fahrenheit, the worm takes seven or eight days to change into the pupa; if the cocoons are picked off the spinning beds too soon—in fact, before the change is perfectly effected—it results that when the cocoons are undergoing the drying process the feet of the silkworm are entangled in the cocoon fibre and the silk is consequently damaged. It is a mistake to keep cocoons too long after they are dried; the fresher the cocoon the better the silk; the thread, too, is more easily reeled, and the silk will be heavier. About ten days after the worm has woven its cocoon, the chrysalis has changed into a moth, or "uji," and makes its egress by eating through the cocoon fibre. If the cocoon is intended for silk, great care is taken to preserve it from injury of any kind. When the cocoons are eight or nine days old, they are placed on baskets and laid out in the sun to dry. Two days' drying will effectually kill the chrysalis, and the cocoons are then placed where a draught can play freely on them. If it is intended to steam them they are placed in a basket-steamer, specially made for this purpose, over a cauldron of hot water. Two or three mulberry leaves are put in the basket with the cocoons, and the whole is then covered with stout wrapping paper. So soon as the mulberry leaves have completely changed colour the chrysalid may be reckoned on as killed. Another plan is to place a large box with a series of drawers or shelves over a fire. At the bottom of each drawer a layer of thick paper is

board, and on this the cocoons are laid. Two or three mulberry leaves are then put into each drawer. The drawers should be constantly shifted, so that each may receive the same amount of heat; when the leaves pulverise to the touch the killing process is looked upon as perfected. The water in which the cocoons are immersed prior to reeling is the best and purest that can be obtained, and, however good of its kind, is generally filtered before use. If ordinary well water, or water in the least degree tinged with mud is used, the thread is apt to lose in weight and natural gloss.

Silk is reeled either by hand or by machinery. The latter has been brought to bear recently upon the industry in question; but hand-reeling is most in vogue, and has been so from time immemorial. Hand-reeling is carried out in the following fashion:—About 8½ lbs. of cocoons are taken, and these are divided into thirty parts; a portion is put into boiling water and the thread reeled off first from five or six cocoons, increasing to seven or eight. This number will turn out the best silk; for medium and inferior silk eight, nine, to twelve or thirteen cocoons are used. A small ring, made either of horsehair or human hair, is attached to the edge of the basin containing the cocoons and the hot water. The thread is run through this ring, and then passed in and out of the first and second fingers of the left hand, the right hand meanwhile turning the handle of the reel. The Japanese seem to think that by the hand process greater evenness of thread and more absence of impurities is obtained than by machinery. Cocoons are easily reeled at first, but the process gradually becomes a matter of difficulty, requiring a careful and expert hand. The alleged superiority of hand-reeled silk to that turned out by machinery is combated by the fact that the latter commands a far higher price in the Yokohama market than the former, and the large outlay that has been made on the establishment at Tomioka, where silk is reeled by machinery under foreign supervision, not to mention other establishments in Yedo and elsewhere, tends to confirm the success achieved over hand-reeling.

CLOCK-MAKING IN THE BLACK FOREST.

Clock-making in the Black forest is at the present time mainly confined to Dittishausen, Eisenach, Furtwangen, Saint Georges, Lentzkirch, Neustadt, Friberg, Villingen, and Bohrenbach. Essentially a domestic occupation at origin, and giving employment to whole families, it is only 35 years that watch and clock making have been carried on in factories. Lentzkirch manufactures a large number of what are called Parisian watches, the gold for the case being supplied from Paris and gilded there. The cases, wheels, and other necessary parts are made separately, and the work is divided into various sections; the separate pieces are brought into the workshops, where they are put together, and the clocks are successively mounted, tested, and regulated.

The different sorts of clocks manufactured in the Black Forest comprise:—Clocks with weights, clocks in cases, which include 12-hour clocks, 24-hour clocks, day clocks, clocks which go for a month, tower clocks, regulators, the spring clocks of English or French make, ships' clocks, and figure clocks (amongst which may be classed "cuckoo" and "trumpet" clocks).

The importance of this branch of industry will be seen from the following figures:—In 1871, the Black Forest numbered 1,129 free manufactories of clocks and watches, numbering 7,526 hands, independent of women and children who were occupied in the small details; 13,000 persons lived by this industry alone. The number of clocks produced had risen in 1871 to 1,800,000, of which 100,000 were of first class workmanship. The total represented a value of 10 millions of florins. The most curious branch of this art is without exception the manufacture of automaton clocks. The great musical clocks are called orchestrals. In the manufacture of these clocks the work is not divided, at least for the essential parts. The masters execute nearly all in their workshops, with the exception of the metallic pipes. Last year there were 32 masters and 224 hands employed in making these clocks. The great factories of orchestral clocks produce instruments of 5 and 6 registers, of which the price varies from 1,000 to 20,000 florins. These clocks are in greatest demand in America and in Russia.

BRICK-MAKING MACHINERY IN HOLLAND.

The most important material for building houses, pavements, bridges, &c., in this country is clay, found in nearly every part of the country, but of different quality on the slopes and beds of rivers. The bricks made from it are of red or yellow colour, the tiles red or black, and the size of them differs from 160 to 240 millimètres in length, half that measure in breadth, and a fourth part in thickness. Those bricks are nearly all hand-made and very coarse, 500 to 600 millions being produced this way a year. In the last years, however, English machines for making bricks came in use, and a description of them in the number of this *Journal* for 23rd October last, induced me to say a few words about their introduction in this country. When those machines were introduced in Holland a few years ago, they were rejected, being too expensive, not only by purchase, but also in their working; they did not give any profit with our cheaper manual labour, and were soon laid up in a dark corner to rust away. It was rather a great disappointment, as English machinery in general is much admired in this country, and preferred to our own make. I took the trouble to examine those ill-favoured products of English skill, in the interests of our brickworks as well as in that of the manufacturers in England, and found generally those machines having strings, cutting the bricks from the clay, very inefficient, leaving the edges not sharp enough to our desire, and the bricks wanting in consistence. In Vienna, before last year, my attention was drawn to Mr. Page's clay-pugging mill from Bedford, preparing clay for 5,000 bricks in a day, and to Ruston and Proctor's mill from Lincoln for 12,000 bricks a day with Murray's cutting table, described in the *Journal* of 23rd October last, and also to a very heavy machine of Messrs. Bradley and Craven, Wakefield, of which there are two sorts, both being rather expensive and requiring much motive power, but working very well by pressure. I gave a description and illustration of this useful machine in my report on the progress of industry in the last ten years in relation to the Vienna Exhibition. The bricks are herewith pressed out of the clay as soon as it leaves the pugging mill, and formed on a circular moving mould table, producing two bricks at a time; in this way 20,000 very good bricks can be made in ten hours.

I should like to see English manufacturers improving those kind of machines in this way, that they were less costly and more efficient, and I will give an example how this might be done.

As English machines did not come in favour here, a machine was made in this country of very simple construction, consisting in the usual pugging mill with perpendicular revolving cutter, and a set of screw-like knife blades fixed to it, forcing the prepared clay underneath into two moulds, containing five well-formed bricks, the whole machinery being drawn by three horses. Those iron moulds are wetted, strewn with dried sand before they are filled, and scraped off with rollers after that. In this way 20,000 excellent bricks are made daily at the brickworks of Messrs. Van Keukelom and Co., Utrecht, with a machine costing no more than £150. Those bricks and the masonry made from them were awarded a medal of merit at the International Exhibition at Vienna, and judged by the international jury to be of a very good quality; they are of great resistence in sea-

water and on pavements, and therefore 1s. higher in price than hand-made bricks as a proof of their superiority.

The way of preparing clay for bricks here is somewhat different from that in England, as the bricks are made soft with a large quantity of water, and set up and dried in sheds, before they are burned. English brickmakers hold this addition of water to be useless, but in reality it binds the clay better and gives more coherence and strength to the burnt brick; moreover it makes the working of the machines much easier; bricks made in this way are really metal-like; they sound like metal when they are knocked against each other.

The price of those bricks is different, from 15s. to 40s. per 1,000; that of a cubic mètre of brickwork about £2.

The quality of this building material and the manufacture of bricks are of great importance in the building trade, and for every durable construction; this may justify this communication on the question in Holland and the English brick-making machines sent to that country.

S. W. Del Campo.

CORRESPONDENCE.

CITY OF LONDON COLLEGE.

Sir,—I attended (by invitation) at the prize distribution, on the 11th inst., at the City of London College, when the Lord Mayor (Mr. Alderman Stone) presided, and the Right Hon. Mr. Goschen delivered an address. The services of the Society of Arts in holding examinations were gracefully acknowledged by a special vote of thanks, moved by Mr. Alderman and Sheriff Ellis, and seconded by the Rev. C. Mackenzie. It was to be observed that the leading prizemen had each taken a Society's prize.

The work of the Society appeared to be of a very useful character in promoting commercial education. The candidates, besides those in book-keeping, included many in French, German, Spanish, and Italian. French and German for commercial purposes were subjects of special examination. So far as could be learned, the students of the evening classes of this college, fifteen hundred in number, offer themselves for examination, not with a literary object, but with the view of their improvement for business. Thus the Society has been for years usefully contributing to the promotion of technical education.—I am, &c.,

Hyde Clarke.

32, St. George's-square, S.W., 13th Feb., 1875.

CACAO CULTIVATION IN INDIA.

Sir,—The President of the opening meeting of the Indian Section pointed out how desirable it is to add to the resources of India, on account of its thick population, its heavy charges, and its liability to famine. Many additions to arboriculture were spoken of, but there is one which I did not hear alluded to which may be referred to—*Theobroma cacao*. This valuable tree has already been introduced with success into the Phillipines, Java, Mauritius, Bourbon, and Ceylon, but I have not heard of its having reached the peninsula.

I have a sample of Ceylon cacao taken from a dozen bags, exported as an experiment in 1871, of very fair quality, and remarkably like the cacao of Java. The latter island produces it extensively; it is exported by the Dutch Trading Company, and in 1872 I saw a sample of 200 bags that were offered to a London firm.

Ceylon cacao, like that of Java, is by no means common, being well-cured and thin-skinned, but at the same time the growth might be improved, as the cacao is not of the richest character. Were the tree introduced into India, it would be better to obtain seedlings from a different quarter, Trinidad or Venezuela, the sources of the finest cacao in the world. There are both fine and common descriptions even in those localities, so that there is room for much judgment in the selection.

Sir George Campbell alluded to the great extent of waste lands, a large proportion covered with virgin forest. There might be among it much suitable for cacao planting; it would not be necessary to thoroughly clear the ground; indeed, it is requisite to leave sufficient forest trees standing to afford shelter to the young trees, or they would be burnt up.

The ground between the young cacao might be cultivated with ground provisions, as in Trinidad is the case, which keeps the estates free from weeds, and supports the cultivator during the five years the cacao does not bear. When this time has elapsed, the trees begin to bear regularly, without much trouble, and continue in bearing for thirty or forty years.

In Central America a cacao plantation is looked upon as the safest and most productive industry possible. There can be no better provision imagined by the father of a family than to leave his children a plantation in full production. It was formerly the practice in Trinidad to grant manumission to every slave who could at any time deliver up to his master 1,000 trees planted by himself, in a space expressly allotted to them, in a state of bearing. Many instances of freedom obtained in this way might be cited, as the cultivation of them at any time did not infringe too much on the daily tasks, and where nature had already provided shade and moisture was comparatively trifling.

Cacao requires land good to a great depth, sheltered among hills, with an altitude of from 100 to 1,500 feet; the trees should be planted out from the nursery about 12 feet apart, so that an acre would contain about 300 trees. A cacao-tree in good land will give about two pounds of cacao per annum. Some will give much more and some much less; but if the number of trees per acre be taken as 300, the average produce may be taken at 600 lbs. per annum per acre. When the ease with which this is obtained is considered, of which I have given an illustration, a cacao plantation may be considered remunerative.

I have said enough perhaps to direct the attention of the Indian Section of this society to the idea of the growth of cacao in India—which country lies mainly between the same lines of latitude as the original cacao-producing countries of the new world. At present it is but an idea, and if it were followed out would require good judgment and some perseverance. As, however, additions to the resources of that great and populous country are sought for, it may be worth the consideration of the Section.—I am, &c.,

Hahnemann Epps.

Hampstead, January 30th, 1875.

NICARAGUA SHIP CANAL.

Sir,—In the discussions which have taken place as to the renewed proposition of the Nicaragua Canal, it has dropped out of sight that considerable interest was taken in the matter in England in 1825, and a company was formed, called the Atlantic and Pacific Ship Canal. This was stopped by the panic, and caused my father a loss of several thousand pounds. The promoters had, however, great faith in it, and negociating with Central America continued until 1831 or 1832.

In 1846 and 1848, I was one of those in communication with Louis Napoleon on the subject, more from predeliction than from reason, but in the present state of the matter it appears to me that the most practicable m

is kept out of sight. This the Panama route promises to be, but the main reason alleged against it is that its ports are bad. They have, however, worked the trade for many years, while the railway presents great facilities for carrying on the works in that pestiferous climate. Any other route, as the Nicaragua or Atrato, will require expensive lockage and enormous expense, while, should another canal be made, it will always be subject to the eventuality of a competing canal at Panama. Part of this latter way is by river-beds, while the height of the summit level is within engineering limits.—I am, &c.,

HYDE CLARKE.

32, St. George's-square, S.W., 13th Feb., 1875.

GENERAL NOTES.

Trade of Chili.—The trade between Great Britain and Chili during 1872 and 1873 amounted in value to about half the total value of the exports and imports of that country, and the number and tonnage of the English ships that entered the Chilian ports exceeded by far those of other nations. The total value of the imports of Chili amounted to £7,931,585, of which £3,090,493, or nearly one half was from England. The exports amounted in value to £7,423,893, of which £3,772,235 was shipped for England. The total aggregate tonnage of the shipping in the ports of Chili was 6,584,595, of which 3,304,340 were arrivals and 3,280,255 departures.

The Merchant Shipping Acts Amendment Bill.—With regard to the pending discussion on Captain Bedford Pim's paper on the Mercantile Marine of Great Britain, it may be worth while stating that Sir Charles Adderley's "Bill to amend the Merchant Shipping Acts" has been printed. It consists of forty-four clauses. The first twenty-four clauses deal chiefly with the relations of master and seamen and discipline on board ship. Clauses 25 to 32 relate to "safety," and provide for the particulars to be marked on British ships, for the keeping of a record of the draught of water and extent of clear side, and for the entry of deck cargo in the official log. Clause 29 enacts that it shall be the duty of the owner of every British seagoing ship to see that she is properly equipped with boats, rafts, and other appliances for saving life. Clauses 34 to 40 relate to the manner of conducting inquiries into shipping casualties. Clause 41 provides that when, by reason of a ship having been sent to sea in an unseaworthy condition, any loss of life or personal injury, or any damage to goods, is caused, the liability of the owner shall be unlimited unless he proves that he and his agents used all reasonable means to make and keep the ship seaworthy, and were ignorant of her unseaworthy condition. The owner is also to be liable in damages for the death or injury of any seaman caused by the unseaworthiness of a ship.

Loan Collection of Scientific Apparatus.—A meeting was held at South Kensington on Saturday, the 13th inst., for the purposes of discussing the advisability of bringing together a loan collection of scientific apparatus. The Duke of Richmond, the Lord President of the Council, took the chair, the Vice-President, Lord Sandon, being also present. A considerable number of noblemen and gentlemen attended the meeting. On the motion of the President of the Royal Society, it was agreed that such an exhibition would be most instructive and valuable. The question of the limits of the collection was discussed, and sub-committees were appointed to deal with the various branches of science to which it is proposed the collections should have reference. It was generally understood that the main objects of the exhibition would be to show modern apparatus for teaching and for research; the applications of science to industry; and such apparatus as is historically interesting from the occasions in which, or the persons by whom, it had been employed. The exhibition will be opened at the commencement of June. It is however doubtful at present whether all branches of science will be taken during the year, or whether the exhibition will be extended over two years, as the space disposable in the South Kensington Museum, where the exhibition is to be held, is rather restricted.

Artificial Light for Photography.—At a recent meeting of the French Academy of Science, a communication was made respecting the use of the flame produced by sulphide of carbon burning in peroxide of nitrogen, for obtaining photographic negatives. For some time past chemists have known the photo-chemical properties of this light, which seems to yield in nothing to that of of the sun. It is on this account the most active of any that can be produced artificially. A mixture of chlorine and hydrogen is by its means caused to explode with as much rapidity and violence as by the solar rays. The sulphide of carbon is placed in a receptacle containing a sponge, which is completely impregnated by a current of peroxide of nitrogen, obtained either from a special gasometer or from a producer. This gas becomes saturated with the vapour of sulphide of carbon, and may then be lighted in the same way as gas. A very brilliant light is thus obtained, the volume and intensity of which may be regulated with great facility. An improvement on this has been brought forward by Mr. Spiller, who at a recent meeting of the Photographic Society exhibited a light produced by dropping small pieces of brimstone into fused saltpetre. This method is free from the dangers of the first-named process.

Wages and the price of Provisions at Naples.—Some interesting statistics have been given in a report lately published by the Chamber of Commerce of Naples, showing the rise in the wages of skilled workmen and the increase in the price of provisions in that city. In comparing the rate of wages paid in 1862 with that of 1872 it will be found that the average earnings of an upholsterer has increased from 1·60 frs. per day to 2 frs.; tailors, from 1·20 frs. to 2·50 frs., and even 3 frs.; glovers, from 3·20 frs. to 5·25 frs.; mechanics, from 3 frs. to 5 frs.; hatters, from 1·50 frs. to 3·60 frs.; carpenters and joiners, from 2·50 frs. to 3·50 frs.; tanners, from 2·55 frs. to 3·40 frs. Lithographic draughtsmen, who formerly earned from 50 frs. to 200 frs. per month, are now paid from 200 frs. to 300 frs. per month. Printers, whose wages in 1862 varied from 12 to 20 frs. weekly, now earn from 15 frs. to 25 frs. Makers of lemonade and ices, from 3·50 frs. to 7 frs. per day. So that it is very evident that wages have doubled in 10 years. On the other hand, the price of provisions has increased at a similar rate, as will be seen as follows. To enable them to be more readily understood, the prices are given first in francs and kilogrammes, and then reduced to English pounds and money.

	Price in 1855.		Price in 1873.	
	Kilog.	English lb.	Kilog.	English lb.
Beef	0·90	4d.	1·86	8½d.
Veal	1·14	5d.	2·22	10d.
Pork	0·74	3½d.	1·27	5¾d.
Mutton	0·62	2¾d.	0·94	4¼d.
Lamb	0·68	3d.	1·15	5d.
Bread	0·26	1¼d.	0·53	2½d.
Pastes	0·39	1¾d.	0·64	3d.
	Per Litre.	Per Pint.	Per Litre.	Per Pint.
Wine	0·18	1d.	0·47	2½d.
			0·75	4½d.

House rent has also increased in a like proportion.

The Mont Cenis tunnel cost about £60 per lineal foot. This outlay included, however, the equipment of the road, &c. The Terre-Noire tunnel on the Paris, Lyons, and Mediterranean Railway, cost but £10 per foot. The Hoosac tunnel, which is carried through a formation of mica, slate, and quartz, cost £60 per lineal foot.

It appears from a report on the trade and commerce of Maine, U.S., that the quantity of lobster packed in cans in the factories on the coast in 1873 was 1,600,000 lb., mostly in 1lb. cans. In addition to these, the same firms packed at their establishments in Nova Scotia over 2,000,000 cans, making the total amount packed by Portland houses in the past year, 3,600,000 cans of lobster.

At New York a factory has been established to convert milk into cakes. To the milk is added one-fourth of sugar, and a table-spoonful of carbonate of soda dissolved. It is then exposed to the fire. At the end of three hour the mixture becomes pasty, and it is then mixed or beate until the mass is reduced to an orange-yellow powder. I is then suffered to cool, and formed into tablets by pressure.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

FEBRUARY 24.—Adjourned Meeting for Discussion on Captain BEDFORD PIM'S paper on "The Mercantile Marine of Great Britain."

MARCH 3.—Adjourned Meeting for Captain BEDFORD PIM'S Reply to Discussion on his Paper on "The Mercantile Marine of Great Britain."

MARCH 10.—"The Art of Illustration as applied to the Printing Press," by HENRY BLACKBURN, Esq.

MARCH 17.—"Food Adulteration and the Legislative Enactments Relating Thereto." By WENTWORTH LASCELLES SCOTT, Esq.

AFRICAN SECTION.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

FEBRUARY 23.—"The Social and Domestic Slavery of Western Africa, and its Evil Influence upon Commercial Progress," by THOMAS J. HUTCHINSON, F.R.G.S., F.S.A., late her Majesty's Consul at Callao. Colonel HARLEY, C.B., will preside.

MARCH 9.—"Livingstone's Discoveries in Connection with the Resources of East Africa," by the Rev. HORACE WALLER. Sir F. FOWELL BUXTON will preside.

MARCH 23.—"Civilisation and Progress on the Gold Coast of Africa, as affected by European Contact with the Native Inhabitants." By ANDREW SWANZY, Esq.

CHEMICAL SECTION.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

FEBRUARY 19.—"Air and Ventilation," by W. N. HARTLEY, Esq., F.C.S.

March 12.—"River Pollution, with Special Reference to the Work of the late Commission," by W. THORP, Esq., B.Sc. Lond., F.C.S.

APRIL 16.—"Recent Advances in Photographic Science," by J. SPILLER, Esq., President of the Photographic Society.

CANTOR LECTURES.

The Second Course of Cantor Lectures is by the Rev. ARTHUR RIGG, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

The remaining Lectures of the Course will be delivered as follows:—

LECTURE III.—MONDAY, 22ND FEBRUARY, 1875.

Hammers and Mallets (continued).

LECTURE IV.—MONDAY, 1ST MARCH, 1875.

Picks, Axes, Adzes, Chisels.

LECTURE V.—MONDAY, 8TH MARCH, 1875.

Planes, Knives, Shears, Saws.

LECTURE VI.—MONDAY, 15TH MARCH, 1875.

Saws and Dove-tailing Tools.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

MEETINGS FOR THE ENSUING WEEK.

MON. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Rev. Arthur Rigg, "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft." (Lecture III.)
Royal Geographical Society, University of London, Burlington-gardens, S.W., 8½ p.m. 1. Capt. J. Moresby, "Discoveries in Eastern New Guinea." 2. Mr. E. L. Oxenham, "The Inundations of the Yang-tse-Kiang."
Institute of Actuaries, 12, St. James's-square, S.W., 7 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. Carpenter, "Animal Life of the Deep Sea."
Birkbeck Scientific Society, Southampton-buildings, W.C. Mr. James A. Barnard, "The Chemistry of the Rocks."
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on "The Friendly Societies Bill."

TUES. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Thomas J. Hutchinson, "The Social and Domestic Slavery of Western Africa, and its Influence upon Commercial Progress."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. Alfred H. Garrod, "Animal Locomotion."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Mr. George Findlay, "The Working of Railways." 2. Mr. Wm. Cudworth, "Sorting Railway Trains by Gravitation." 3. Mr. J. Thornhill Harrison, "Railway Statistics, 1873-74."
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Lieut. C. C. de Crespigny, "The Milanows of Borneo." 2. "History of the Heung Noo." Part I. Translated by Mr. A. Wylie, with notes by Mr. H. H. Howorth.

WED. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on Captain Bedford Pim's paper "The Mercantile Marine of Great Britain."
Geological, Burlington House, W., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. Vaux, "Recent Researches in India," by Major-General Cunningham, C.B.
Archæological Association, 32, Sackville-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 8 p.m. Dr. Maxwell T. Masters, "Charles Darwin as a Horticulturist."

THURS....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Dr. Richardson, "Physiology of Sleep."
Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "Electricity."
Inventors' Institute, 4, St. Martin's-place, W.C.
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

FRI.......Royal United Service Institution, Whitehall-yard, 3 p.m. Major-General T. B. Collenson, "Hints for the Defence of Great Britain, drawn from the Spanish Armada."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Mr. W. R. S. Ralston, "Popular Tales; their Origin and Meaning."
Junior Philosophical Society, 6A, Victoria-street, S.W. Mr. G. S. Boulger, "The Evolution of the Sexual Organs of Flowers."
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Civil and Mechanical Engineers' Society, 7, Westminster-chambers, S.W. Mr. Coombs, "The Construction of Gasholders."

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Professor W. K. Clifford, "The General Features of the History of Science."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, FEBRUARY 26, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NATIONAL PENNY BANK.

The Council desire to call the attention of the Members of the Society to the prospectus of this bank, which, with a form of application for shares, is sent out with the present *Journal*.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Alkali Examination is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

GENERAL EXAMINATIONS, 1875.

The attention of the Secretaries of Local Boards is requested to the following paragraphs from the Programme of Examinations:—

"19. A list of each Local Board (giving the exact address of the Secretary) should be submitted to the Council of the Society of Arts before the 1st of February, 1875, and where a Local Board comprises so large a district that, for the convenience of the candidates, Branch Local Boards have to be formed, lists of these must also be given. All changes in the composition of the Board should be notified to the Society of Arts.

"The Secretary of any District Union or Local Board in connection with the Society of Arts, desiring to adopt the scheme of Elementary Examinations, must apply to the Secretary of the Society of Arts before the *1st of February*, stating the number of *male* and *female* candidates respectively desiring to be examined in *each grade*."

ALBERT MEDAL.

Dr. C. W. Siemens, F.R.S., attended on Monday, the 22nd instant, at Marlborough-house, when H.R.H. the Prince of Wales, President of the Society, presented to him the Albert Medal, which has been awarded to him by the Council for his researches in connection with the laws of heat, and the practical application of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts.

The medal has previously been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebeg, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufacturers, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugéne Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

CHEMICAL SECTION.

A meeting of this section was held on Friday, Feb. 19th., Professor Odling in the chair, the subject being—

AIR AND VENTILATION.

By W. N. Hartley, Esq., F.C.S.

In the treatment of this subject this evening, I shall be compelled to omit any consideration of the first half of the title, and confine myself to ventilation simply, or I would rather say, to the pollution of air, and rendering of air fit for breathing. When we analyse very carefully the atmosphere we find it consists of one volume of oxygen diluted with four volumes of nitrogen, the oxygen being

and active gas, diluted with an inactive gas. Therefore, generally speaking, air has the properties of oxygen somewhat enfeebled. Besides this, we have in air a small quantity of ammonia and a small quantity of carbonic acid; that is the common name, but the scientific name is carbonic anhydride, and it is also called carbon di-oxide. Now the quantity of carbonic acid, as I shall call it, is only very small, but nevertheless it varies very widely within very small limits. The properties of this gas form the first part of my subject. To begin, then, with the properties of carbonic acid, there are two which are especially remarkable —one is the very great weight of the gas, and the other is the property it has of extinguishing flame. With regard to the sources of the gas. Before I show its properties, I will show the sources of this gas. First of all, there is combustion; and besides the sources of the gas I shall have to refer to the means by which we detect it when it exists in any considerable quantity in the air, for which purpose lime-water is a very convenient test. To show that carbonic acid is produced by combustion, I place some clear lime-water in a jar in which a gas jet has been burnt, and you see the lime-water becomes turbid in a very short space of time from the separation of the insoluble carbonate of lime. The next source is respiration. This may be easily shown in the same way by the aid of lime-water. Here is an apparatus through which I can draw the air necessary for my respiration. First of all, the air passes through lime-water, and by so passing through lime-water it will show you if there is any considerable amount of carbonic acid in the air; secondly, the air from the lungs passes through lime-water again, and that will show whether there is any excess of carbonic acid in the air of the lungs over that in the ordinary air. You will see that in one of these bottles, the one through which the air passed, the lime-water is clear, while that through which my breath passed is turbid, showing that the breath is a source of carbonic acid. Then I have again to show you the properties of this gas when we take care to have it undiluted with air, and in order to get it undiluted with air as much as possible we prepare it from marble, and any strong acid, such as hydrochloric acid or sulphuric acid. This apparatus is now making carbonic acid, and here is a vessel into which this carbonic acid is evolved. The gas there you see is colourless at any rate. Here is another vessel which also supplies me with a certain amount of carbonic acid, and with this vessel I propose to show you the power that carbonic acid has of extinguishing flame. Both these experiments also explain to you that carbonic acid is a heavy gas; in other words, if the carbonic acid were lighter than air, as there is an opening in the top of this vessel, it would readily escape from such a large jar as this, but as it is a heavy gas, you may remove the top of the vessel, and the carbonic acid will remain in it for a short time. To show that there is carbonic acid in this jar, I will put a lighted taper in it. You see that it is extinguished. But to show it on a large scale, I will take a torch of tow and set fire to it; you see it is at once extinguished in this jar of gas. To show you that it is a heavy gas I will inflate this small balloon with air, and put it into this glass, and we shall see whether the gas is sufficiently heavy to float the balloon. You see it only just floats, half way up the glass; but if I blow a soap bubble it will float on the top of the gas. At any rate, you see these two effects of carbonic acid—first, that it extinguishes flames; and secondly, that it is a very heavy gas. I have to bring before your notice the fact that in the outside air the carbonic acid is so mixed up with the oxygen and nitrogen that the air practically over all parts of the world has the same composition; and, although it has not exactly the same composition, yet the variations are within very small limits. Nevertheless, the air of the mountains on the sea shore of Scotland varies from the air in the streets of London, and this variation, which is occasionally small, you will see is of considerable importance by the tables on the wall. These tables, which are taken from the analyses of Dr. Angus Smith, show not only the variation in the air of towns from the air of the country, but also show the variations between the air of one street and that of another. Here is the air from various places in Scotland on the hills. If this table be read with the first number as a whole number, then we must count it as volumes in 10,000 volumes of air; and that will give us 3·2 volumes in 10,000 of air. At the bottom of the hills it is 3·41 in 10,000. Then we come to London; in the parks and open places the air contains 3·01 volumes of carbonic acid in 10,000; on the Thames 3·43 in 10,000; in the streets, 3·8—that was in April, 1864. Later on, in April, 1869, we get the carbonic acid in the streets as 4·39. In Manchester during fogs, 6·79, which is a considerable variation from Scotland on the hills. Then I come to some large numbers, which I will not allude to just now. In this table we have the analysis of air in duplicate, so as to ensure the accuracy of the analysis. In the north, north-east, and north-western districts, Dalston, Hoxton, Hackney, St. John's-wood, and Belsize-park, we have a series of analyses made, and the average of these, with that of Belsize-park omitted, gives us 4·445 in 10,000. In the west and west-central districts it amounts to 4·115; that is, Woburn-square, Tavistock-square, Regent-street, Oxford-street, Hyde-park, and Sloane-street. In the east and east-central it is 4·745 in 10,000. In looking at these tables it must strike anyone that in the part of the town where it is open, consisting of wide streets and squares, with houses thinly inhabited, that is to say, large houses, and no factories, the air is considerably better than in the east of London, where there are crowded neighbourhoods, such as Bethnal-green, and where there are narrow streets and manufactories of different kinds. This, then, shows that we have considerable variations in the air even in one town, although that town is certainly the largest we can take for the illustration.

Now, as air is vitiated by carbonic acid produced by combustion and by respiration, when a number of people are gathered together in a room, what becomes of the carbonic acid produced by respiration and combustion? Fortunately, the heavy gas is so acted upon that it ceases to be heavy, and rises to the ceiling, and so we have a natural means of ventilation. This I propose to show you very shortly. I have here arranged two little jars, which, I think, will show the same thing on a somewhat smaller scale. They both contain

carbonic acid. That I will see first, by putting in a taper, when they both extinguish it. I will put them under precisely the same conditions, except that I will warm the gas in one jar, and to do that I will put in a little flask containing water, the water in one being hot and in the other cold. After a few minutes I will test them again with the taper, and see whether they are in the same state. While that is in operation, I will show you what becomes of the gas and the vapour produced by an ordinary fire or burning gas. That is easily done by confining the gas produced by the combustion of a large gas burner in an air balloon, and the balloon will soon be inflated and rise to the ceiling, showing the course the burnt gas would take. It is evident that the gas rises to the ceiling. We have there one natural kind of ventilation. Now I will show you with the tapers whether these two jars of carbonic acid are in the same state as they were at first. The taper is put out in one, but in the other it still burns as brightly as it would in the open air; the carbonic gas warmed by the flask of hot water has made its escape.

The next fact I want to show is that if air has once been drawn into the lungs and ejected, it is useless for either respiration or combustion. I can show it is useless for combustion, and you must take my word for it that it is not fit to breathe. If I extract the air from this jar and then return it from my lungs into the jar again I shall be able to test it with the taper, and to see whether it will furnish the taper with sufficient oxygen to cause it to burn. You see the taper is extinguished, all the oxygen of the air has not been taken out, as I will show you directly. The amount of carbonic acid in the expired breath is about 5 per cent. I have a little phosphorus here in a spoon, and as phosphorus is much more combustible than gas or a taper which will burn with less oxygen, therefore, if there is still any oxygen here I shall be able to burn it in the jar—it does not burn quite so brightly as it did in the open air, but it still burns.

The next experiment is to show the deterioration of the air by means of combustion; in the same way if the taper be burnt in the air, and be allowed to burn so as to consume so much oxygen that there is none left, it goes out. But by a little arrangement I can show you that there is still oxygen in the air, that it does not consume it all. There is the taper burning in the jar, and I will close the bottom, and make it air-tight by a drop of water. This wire passing into the jar is getting hot, so that I may be able to touch a piece of phosphorus in the centre. As soon as the taper goes out, I shall by that means be able to kindle the phosphorus, and show that all the oxygen in the jar has not been used up. Now, you see, the taper has gone out, but still that there is oxygen there is shown by the combustion of the phosphorus. The first effect, then, of respiration and combustion on the air is to render it unfit for respiration again, and unfit for combustion. We already see that the carbonic acid produced by combustion and also by respiration to a certain extent being heated, rises to the upper part of a building; and there are other means yet, besides this lightening of the heavy carbonic acid gas which causes fresh air to be introduced into a house. Some experiments made by Fedderson, of Leipsic, show that when there are two atmospheres in two different states, one hot and the other cold, there is between these a porous medium for the passage of the gas from the cold to the hot side. So that it comes to this, if we take a tube and put a porous plug in the centre, and make one side hot, leaving the other side cold, the gas passes from the cold side to the hot side. This is found to take place in houses, where there is a passage of gas through the walls of the building. Before I allude to this point further, I will just give you an illustration or two of ventilation caused by the rising of the heated air. In every room where there is a chimney there is a source of fresh air, not down the chimney, but through the cracks in the windows and doors, and by the constant opening of doors, and this fresh air thus entering drives forward the heated air, which has a tendency to rise, and drives it up the chimney. If we have no chimney in the room then this source of fresh air is practically valueless, because there is no escape for the vitiated air; and this may be illustrated by the jar which I have here with two candles. There is an entrance for the air below by cracks, the jar being raised 1-16th of an inch above the glass plate. The opening at the top is like the chimney in a room, the fire-place is below, the opening of the chimney is below here, and the taper burns steadily below the chimney. Here is a taper burning above what may be called the fire-place of the chimney, and as the vitiated air rises to the upper part in the bell-jar, it will in course of time vitiate the upper atmosphere, and so cease to support combustion, while the lower taper continues to burn as brightly as ever. That is already manifest here; the upper taper is languishing, while the lower one is burning brightly. Now it is out, the lower one burning as brilliantly as at first. Supposing we have a condition of things where we have no chimney, where the source of contamination is down below, such as we have in a coal mine, we must have fresh air entering somehow or other; if it cannot enter from below, it must enter from above. That it does enter from above is shown here, where I have what may be represented as a cellar or a coal mine, this one tube representing the chimney of the cellar, and the other tube a staircase into it, or representing the up-cast and down-cast of a mine. That there is a draft down one chimney and up the other may be shown by the smoke travelling down the left-hand and out of the chimney where the light is. By stopping the down-shaft we may extinguish the light—the light is extinguished by reason of the want of air. That illustrates the ventilation of mines; and here is an apparatus which illustrates it much better, because this represents more nearly what is the actual state of things. A bell-jar with a chimney at the top, in other words a mine with a short shaft, is closed at the bottom so as to make it air-tight, with a little water, and after a time you will see the taper will by no means burn very brilliantly. It is not necessary for fresh air to go down a separate shaft into a mine or cellar, but it may go down the same shaft by which the foul air escapes; but, in order to effect that, if the air is perfectly still, the shaft must be divided, and that I propose to do as soon as the taper begins to languish. I will then introduce a division, which will cause the fresh air to enter down one side and the foul air to

escape by the other. The taper is now beginning to die out; by interposing that division I shall cause it to revive. It takes a little time for the currents to establish themselves. Now, with a piece of brown paper, which gives me a supply of smoke, I will now find out which is the down-shaft and which is the up—down which side the fresh air is entering and which side the foul air is escaping. We have here very plainly shown the action of currents produced by the heating of the gases.

Now, the next part of the subject, the ventilation of a house by means of the passage of air through the walls, can be shown in an exaggerated form by the passage of hydrogen through a porous material. This is not to be considered by any means what takes place in a house, that is to say, we have not the passage of hydrogen, but we have a passage of cold air through the walls of a room into the house, and this experiment is made with hydrogen simply, because it is more easily shown to you than by any other means. Here is a porous vessel which may be taken roughly to represent the wall of a house, and if I bring this jar of hydrogen gas over the porous vessel, you will notice the passage of the gas through the porous vessel causes a pressure into this vessel, which ejects a stream of liquid. It has been proved, by experiment, by Pettenkofer, of Munich, that the passage of air through the wall of a house is very considerable. He examined the walls of an ordinary room in his own house, and found the change of air through the brick walls in a room, the cubic contents of which were 2,650 feet, when the difference between outside and inside amounted to 34° F., amounted to this:—

	Cubic feet.
[illegible]	2,650
With a fire	3,320
All crevices stopped	1,060
With a difference of 7° Fah.......	780
Window open 8 feet square	1,060

This illustrates what takes place in winter, when one's repugnance to cold air causes one to shut the door and windows and have a roaring fire. The air which cannot get in by crevices or by doors makes its way through the walls, that is to say, the doors and windows being shut, a certain increased amount of air passes through the walls into the room. What is the advantage of this? It is this, that we are supplied then with fresh air free from draft. Ventilation is not supplying fresh air, but supplying it free from draft, and this natural source of ventilation gives us really true ventilation. The amount of carbonic acid in the air may be taken on an average as about 4 parts in 10,000, and in order to keep the air fresh we should not allow the pollution of the air to extend to a greater quantity than 2 parts in 10,000 over this. Therefore the extreme of carbonic acid in the air is 6 parts in 10,000. When the amount is more than this, the air begins to be close, that is to say, we begin to feel by the nose that there is a certain pollution in the air which you cannot exactly account for. Six volumes in 10,000 is the amount of carbonic acid which is allowable, and all above this must be considered unwholesome vitiation of the atmosphere. Then in close places, that is to say, in places which contain more than 6 volumes in 10,000, of which there are many—workshops, offices, public buildings, theatres, all contain, generally speaking, much more than this—we have an atmosphere which can be known as unwholesome simply by the nose. The nose tells us there is something in the air which ought not to be there. What is the reason of this? It is not carbonic acid, because we cannot detect carbonic acid by the nose. It is a certain amount of organic matter thrown off from the lungs, and generally speaking from the body in some form or other, and this organic matter rises in proportion directly with the carbonic acid. Therefore, if we measure the amount of carbonic acid in the air we measure the amount of pollution by organic matter, and by determining the carbonic acid in the air, which we can do very accurately by chemical analysis, we also determine the amount of organic matter which vitiates the air. We do not know the organic matter, but we know there is more than there should be. In buildings in which the natural ventilation is not allowed free play, and in which no extensive mechanical appliances are used to contribute fresh air, this vitiation of the atmosphere goes on to a very great extent. For a few examples of this we have the analyses made by Dr. Angus Smith, and we find by this table that in workshops he has found the air so bad that it rose as high as 30 parts in 10,000; that is to say, the carbonic acid was very nearly ten times as much as it should have been. In theatres he found it rose to 32 volumes in 10,000 of air, in mines 78·5, an enormous quantity, and the largest amount he ever found was 250 in 10,000. Here is a table giving an analyses of air in different places, made by Dr. Angus Smith. In a Chancery Court, seven feet from the ground, with the doors closed, he found the proportion was 19·35 carbonic acid to 10,000; in the same court, three feet from the floor, 20·3; in the same building with the doors open, that is to say, when the fresh air had entered, it was 5·07 and 4·5. Then in the Strand Theatre, in the gallery it was 10·1, in the boxes 11·1; in the Surrey Theatre at 12 p.m., 21·8; in the Olympic, 8·17; in the Olympic in the boxes 10·14; in the Haymarket 7·5, and so on. In hospitals, where great care is taken to have large free space in the room for each patient, and a supply of fresh air regularly admitted, the amount does not rise above that of the outside air. In the Queen's Ward of St. Thomas's Hospital no more than in the outside air; in the Edward's Ward of the same hospital it was 5·2. These tables show the large vitiation of air taken in crowded buildings, and in the case of the law courts it was almost as bad as any. There was another case, in the Queen's Bench, in which the air is described by Dr. Angus Smith as the foulest air that he ever found above ground. It seems that law courts were always famous for being filled with foul air. In 1796, Brahmah, the inventor of the patent locks, who was giving evidence in a Chancery suit connected with one of James Watt's patents, complained that he could not give his evidence because he was "much incapacitated by those alkalescent and morbific exhalations ever consequent on large and close assemblies," no doubt the carbonic acid and the organic matter; and he complained that the judge's attention had "become flaccid

through fatigue." This is really because of the small amount of air which is allowed to each person in the building—that is to say, the small cubic space which is available for each person's use—and, furthermore, that the amount of wall space is very small compared with the production of carbonic acid in the interior of the building. In summer, when the difference between the temperature of the inside and outside of a building is small, it is quite possible in a crowded room like a ball-room for the air to be more vitiated than in winter. Therefore, in theatres in summer we may look for a greater vitiation of the atmosphere than in winter, when the difference between outside and inside temperature is much greater. Acting upon this, last year I made some experiments at the two Italian Operas, Covent-garden and Drury-lane, and from several experiments made in each case, I found the following numbers :—April 28th, Covent-garden amphitheatre, amount, 22·5 in 10,000 of air, near what is called a ventilator, although the air which was admitted was not pure, it was 17·6, and near an open door it was 14·8. The people in the building were listless and gaping, and evidently wanting in attention somewhat, and did not seem to be lively and animated, and they exclaimed how delightful was the fresh air coming in from an open door, yet this fresh air contained 4·8 volumes of carbonic acid in 10,000. In Drury-lane the average of three analyses was 25·9. You must not think that because these were taken in the upper part of the house that down below there was any great difference. In a private box, for instance, the space is so enclosed that the air very often there is worse than in the gallery, especially at the back of the box. In the stalls of Covent Garden, between the acts, when the curtain is down, the air is then very hot and very impure. I have not made an analysis of that, but one can feel it when the curtain is down ; the supply of fresh air is practically cut off, because the supply of fresh air comes from behind the scenes, all other entrances being carefully closed by swing doors, and there being a great want of openings to supply fresh air from the outside. There is no doubt the large amount of gas burnt in a theatre, if ventilation had free play, would considerably facilitate the entrance of pure air. We have heard great complaints about public offices, more especially the British Museum ; and last summer I made some experiments on the air of an office of which great complaints had been made, namely in the money-order office in Aldersgate-street. In one room where there were a large number of clerks, a tolerably high room, with large windows, the proportion was 22·2 and something over, in fact it reached up to 25, this being the average of two or three analyses. This is as bad as a theatre. In the same office, on another occasion, without the gas lighted, it was 17·6. In the same office, with the windows open, there were 4·2 volumes, that is to say it was practically the outside air. This gives you a tolerable notion of the amount of carbonic acid, and consequently the amount of pollution in the air in various buildings.

Now, with regard to the amount of fresh air which is necessary for each person. This is far more considerable than you would imagine. The amount of carbonic acid given off by an average size man in an hour, from the lungs and skin, is about 7-10ths of a cubic foot, and if we take it as 6-10ths we shall be below the quantity. A good oil lamp, or a couple of good candles, will also give 6-10ths of a cubic foot. Therefore a man in a room with a lamp or two candles, gives 1⅕th of a cubic foot in an hour. Now I have told you before that the amount of allowable pollution in the air was 6 volumes in 10,000 ; beyond that the atmosphere becomes unwholesome. Therefore, in order to keep the air fresh with two men in a room, or one with a lamp or two lighted candles, would have to require this amount of carbonic acid produced with 5,000 volumes of air. He would therefore require 6,000 cubic feet of fresh air, and one man therefore in occupying a bedroom for instance, would require 3,000 cubic feet for his own use. This is pure calculation. What does the experiment show ? In some experiments made in Paris to determine the amount of fresh air which should be supplied to hospitals it was found, by pure experiment, not by calculation at all, that this should be from 3,120 to 2,470 cubic feet in an hour.

	Cubic Feet.
Hospitals	2,120
„ for wounded	3,530
„ for epidemics	5,300
Workshops	2,120
„ for unhealthy trades	3,530
Barracks, day	1,060
„ night	12,410 .. 1,765
Large rooms for long meetings	2,120
„ short „	1,060
Schools for children	424 .. 530
„ for adults	880 .. 1,060

Now, in order to get this 3,000 cubic feet of air in an hour supplied to a large audience in any public building, it is absolutely necessary, as far as I know at present, to resort to some special means of supplying fresh air, and a very good instance of that is afforded at the Royal Institution. Very great care was taken, there four or five years ago by arranging with upright cylinders going to the roof from under the gallery, in which gas-jets were burnt, and passages connected with windows which entered underneath the seats and above the heads of the audience underneath the gallery, to admit fresh air ; but, nevertheless, on a night when there is a large audience at the Royal Institution the air is undoubtedly bad. It is not so much, perhaps, the contamination by the breath as by the gas and heat—it feels extremely hot. To estimate whether the place is close or the air is polluted by breath, it is necessary to enter from the outside directly. That I have not done. I have gone in at the commencement, when the audience was arriving, and remained there to the end. Still, there is no doubt people complain continually about the air in the upper part of the building being extremely bad. There is no doubt that the Royal Institution, from the very fact that such care was taken in the ventilation, is far better than other buildings of the same kind, but it shows that, in order to supply fresh air to a building crowded in that way, some mechanical means must be resorted to. Such mechanical means are, so far as I know, a rotating fan, which drives air forward through pipes and distributes it to the building, and such a rotating fan is applied in America to the ventilation of hospitals on a large scale. In summer, when the air

is hot, it is passed through ice to cool it; and when in winter it is cold, it is passed over hot-water pipes to warm it; and so a regular supply of fresh air is driven into the building, and allowed to find its way out where it can. In the Stamp-office at Somerset-house, which is below the level of the ground, this means is resorted to, and I should imagine, in consequence of their having such a contrivance, that the air was in such a place wholesome. In this country it is not advisable to change the air of a room more than 4 to 6 times in the course of an hour. It is therefore necessary, generally speaking, to have a sufficient supply of fresh air to begin with, in order to prevent the air being changed too rapidly, and it has been calculated, as stated by Dr. Parkes in his book on "Practical Hygiene," that from 750 to 1,000 cubic feet per head per hour is necessary. In a crowded building where mechanical ventilation could be resorted to, the air could be so warmed as to produce no feeling of draught. I may as well mention what this feeling of draught is, and why it is that diffusion through the walls is unfelt. When the air travels at a lower rate than nineteen inches per second, generally speaking, that is to say, if it is not very cold, it is unfelt. There are around us continued currents of air pouring upwards by the heat of the body, causing the air surrounding us to become warm and rise up with fresh air coming against us; still these currents we are unconscious of. It is only by an extremely delicate instrument placed under your top-coat that these currents can be detected. Then on a day when not a leaf is stirring, not a ripple on the water, there are constantly currents playing about; these are unfelt, and are produced at a rate of something less than nineteen inches per second. That this rate is unfelt may be proved by passing the hand through the air at a speed somewhat less; and of course passing the hand through the air is just the same as passing the air over the hand if it were stationary.

Ventilation then may be considered, generally speaking, as the passage of fresh air to an apartment at a rate of less than 19 inches per second, so as to reduce the carbonic acid in the air to 6 volumes in 10,000. Dr. Angus Smith, who has done such valuable work in the matter of air and ventilation, gives us a means whereby we can estimate whether the air of a room is wholesome or not, whether the vitiation is increased to an extent which is unwholesome, and that is a very simple test. It consists in taking a bottle, which holds 10½ oz. of air when the stopper is placed in the bottle. If I blow the air into this with the bellows, and then take ½ oz. of saturated lime-water, the test consists of this, that if there is more carbonic acid in the air of that bottle than 6 in 10,000, shaking up this ½ oz. of lime-water in it will cause the lime-water to become turbid. Trying the experiment with the air of this room it becomes just turbid, and that is all. I should not think from this experiment that there were more than 6 volumes in 10,000. It just shows the slightest trace of turbidity, and that is all. By taking a smaller bottle and the same amount of lime-water, the amount of carbonic acid in the air may be told to the extent of 1 volume in 10,000, and by means of a flexible bottle and the lime-water contained in another apparatus, we may determine the amount with some degree of accuracy.

I will pass over the determination of the carboni acid in the air, and I will go to another matter, very important one, which is the carbonic acid i the soil. Pettenkofer has shown that if we take gravelly soil, cut a piece out, and measure th amount of water that we can pour into it, th amount of water it will take up will amount one-third the space occupied by the soil. There fore, the soil consists of one-third of air. No Boussingault has shown that the amount of ca bonic acid in the air contained in the soil was ve much more than that contained in the air of th atmosphere. He found that in a field recentl manured it amounted to 221 parts in 10,000 of ai and in another field 974, and in a field of carr 98, a vineyard 96, forest land 86, loamy subsoil 8 sandy subsoil 24, garden soil 36, prairie 179. Yo see then that what may be called the ground-air highly charged with carbonic acid. When warm a house by a fire it creates an upward draug and undoubtedly the air from the soil passes in the house. If you doubt this, a very good case prove it is the one Pettenkofer mentions at Muni of a house in which there was no gas laid on any gas pipe within twenty yards of the house, y the people in the house were poisoned by an esca of gas. This escape from the main travell through the earth and gained admission the house. Nearer home there has occurred case of a still more striking character at Sout gate, Colney Hatch, where one or two sm houses were completely wrecked in November l by an explosion of gas. This gas was not laid on the houses at all, the main passed through t street, the houses stood back from the street so distance; the main was cracked, the gas travell through the soil, gained admission to the hou it smelt for several days, and finally exploded o evening on a lamp being lighted, and complet wrecked the building. Here, then, is striki evidence of gas passing through the soil. Wh does this teach? It teaches that the air of t soil should be as far as possible prevented fr being polluted. If the soil is polluted by a lea drain pipe we have that communicated to the so which, if it gains admission to the house, may le to disastrous results, the breaking out of typho fever, and those other diseases which are alwa traceable to contaminated air and water, which familiar to every one. It is therefore highly i portant that this matter should have attenti called to it. It is not at all an unusual thing the neighbourhood of London for speculati builders to build houses and make drain-pi which have no outlet; they put drain-pipes bel the house, which lead nowhere; the consequen is, that after the house is let the unfortuna tenant is perfectly ignorant of the fact that eve thing which escapes by the drain-pipes is lod in the earth. Of course, after a time, this can fail to be found out, but frequently only whe is too late.

Having mentioned this matter, I think I m now conclude my paper, and I hope sincer that I may succeed in drawing attention to th matters which are undoubtedly of the high importance. In preparing my experiments, I ha to give my best thanks to my friend Mr. Thoms who undertook the trouble for me this afterno otherwise I do not think I could have performed th

DISCUSSION.

Mr. Sight said the statements in the lecture with regard to the class of air existing in London theatres and public buildings were very important, especially having reference to a question which had for some time attracted public notice, viz., the ventilation of the British Museum. Several gentlemen had lately suffered very much in health from being engaged there, and one or two of considerable literary ability had lost their lives by being employed in certain parts of the museum, which were well known to contain air really unfit for human consumption. He alluded particularly to the late Mr. Emanuel Deutsch, who, it was stated, had more than once remarked to his colleagues that after his death no doubt something would be done; but up to the present time nothing had been done, as far as he knew. He should like to know if Mr. Hartley had made any experiments on the air of that building; for instance, in the iron tank, known as the transcribing library, or in that scandalous building employed by many of the people engaged in the service of the museum.

Mr. Hartley replied that he had not experimented on the air of the British Museum, not being aware at the time he was making his analysis that it was so bad. He was not sure that he would have been allowed to make such experiments, but at any rate if he had been aware of the circumstances, and had been acquainted with any of the officials, he would have taken care to have instructed them in such a way that they might have obtained specimens of the air, which he could have analysed afterwards; or as he did in the case of the money-order office, where he instructed a friend how to make the analysis, himself checking the results afterwards. There was no doubt, from all accounts, that the air in the British Museum was very bad, particularly in the transcribing room, for not only was there a deficient supply of fresh air for those engaged there, but in the attempts to remedy that evil by opening the windows, a very great draught was produced.

Mr. Griffith thought it would be useful if Mr. Hartley would take occasion to ascertain the quantity of carbonic acid in some of the smoking carriages on the metropolitan railways, for the atmosphere was often very trying indeed if there were three or four persons smoking, not only from the amount of carbonic acid gas, but from the innumerable particles of solid carbon floating about. It seemed very strange that ventilation should be bad in the open air, but, looking at the ventilators on the South Eastern, they were so arranged as to be practically almost useless. If they were furnished with perforated zinc plates, and communicated with a plate outside, so that the motion of the carriage travelling along would force fresh air into the carriage, they might be very beneficial. Another point of some importance arising out of the lecture was the fact shown by Boussingault's tables, that carbonic acid existed in very large quantities in recently-manured soil. He presumed this referred to farm-yard manure, which had always been considered one of the best manures; and its action might very probably be owing to the large amount of carbonic acid generated, which, when mixed with water, had a powerful action in disintegrating various kinds of rocks. He felt sure that the publication of these tables would draw attention to this important matter.

Mr. Hartley had not examined the air in smoking carriages, but could quite understand that it was very bad. In fact he could not understand how people could sit in smoking carriages, with three or four smoking, and the windows up. The ventilation of such carriages, however, would be a remarkably simple thing, because the velocity of the train, by a very simple contrivance, would cause a small jet of air to enter at the top of the carriage. If a small outlet were placed at the top of the carriage, this small jet would put a considerable body of air in motion over the heads of the passengers, causing an upward current, and carrying off the smoke. At the same time there should be a slight admission of air underneath, and if these were made in the floor of the carriage, the fresh air entering would be distributed by the matting or carpet, without causing any feeling of draught to the feet.

A Member asked if Mr. Hartley had ever tested the air in a brewery. The air in such places was of course heavily charged with carbonic acid gas, but he believed it was a fact that brewers, who were used to it, could work in an atmosphere that would take away the breath of any one unaccustomed to it. He should like to know whether that had been tested, and whether it threw any light on the amount of carbonic acid gas which human beings could breathe in after a little practice.

Mr. Hartley said he had never tested the air of a brewery, but he could quite understand that, although it contained a much larger amount of carbonic acid than the air of a crowded room, it would not be so unwholesome. The cause of the unwholesomeness of the atmosphere in a crowded room was not the amount of carbonic acid so much as the organic matter thrown off from the body; and the proportion of carbonic acid to which he had made reference was only a measure of that organic impurity in the air. The organic impurity could not be measured, but as it rose in the same proportion as the carbonic acid, by measuring the latter the former could be estimated. With regard to the physiological effect of carbonic acid itself, it caused an increase in the respiration and a slight weakening of the pulse, and a decrease in its rate. But, on the other hand, organic impurity in the air gave rise to serious diseases, and more especially diseases of the lungs and chest. This was very forcibly shown at Vienna in a case quoted by Dr. Parkes, of two prisons, the one well ventilated and the other not. In the badly-ventilated one, in the Leopoldstadt, from 1834 to 1837, they had 86 deaths per thousand, of which 54½ were due to phthisis, while, in the House of Correction in the same town, which was well ventilated, there were only 14 deaths per thousand at the same time, of which 7·9 were due to phthisis. This showed that 43·5 cases of death were due to this disease of the lungs, which was due to bad ventilation.

The Chairman said there were two questions he should like to ask Mr. Hartley; first, whether the methods by which the experiments were made, of which he had given the results, were the simple methods to which he had called attention, and the other with regard to the nature of the walls through which this diffusion was noted, whether there was any great variations observed, according to the nature of the wall itself, or its covering; whether, for instance, there was any difference in painted or papered walls, or those varnished over with turpentine and linseed oil.

Mr. Hartley said the analyses of the air were performed with the little bottles he had shown. But at the same time, not trusting to this method entirely, he took samples of the air and confirmed his analyses with the bottles to some extent. Thus, if he made three experiments with the bottles, he took another sample and analysed it in the ordinary way, absorbing the carbonic acid over mercury with potash, so as to confirm the result obtained with the bottles. With regard to the ventilation of the walls, there was no doubt that if the wall was papered and varnished it would prevent the amount of air coming through. Pettenkofer described his experiments as having been made in an ordinary room in his house, which he stated was built of brick, plastered and papered. But there was this matter in connection with the passage of gases through walls. If the stone used in building was not porous it was a hard stone, and the consequence was irregular pieces were used for building, and more mortar was required, and thus a more porous material than stone was used, so that in that way

a curious compensation for the non-porosity of the stone was obtained. Pettenkofer had given a curious instance of this in the case of a house built of iron slag, a substance of the nature of glass, and not in the slightest degree porous. This was cut into regular blocks, so that very little mortar was required, and when the house was built it rapidly got dry; the walls were not absorbent, and consequently the building material was not saturated with water. Very shortly afterwards the house was inhabited, however, it was pronounced to be very damp, and this dampness continued and increased until it became almost uninhabitable, in fact it was the worst house on the estate. The reason was this, that the walls not being porous, the amount of vapour given off within the house, from cooking, washing, and so on, was larger than that outside, and not being carried away through porous walls, or up the chimney by means of air passing into the house through the porous walls, condensed on the walls, which were cold. He might add that Pettenkofer found that in an ordinary wall of his house the amount of air which passed through a square yard in an hour was something like 43 gallons, the difference of temperature between the inside and outside being he believed 16°.

The Chairman, in proposing a vote of thanks to Mr. Hartley for his able and interesting paper, said no further evidence of the importance of the subject could be needed than the illustrations he had himself given with regard to the condition of things in hospitals and various other public buildings. He remembered some years ago having occasion to investigate the mortality at the Lying-in Hospital, for certain periods during which systematic ventilation was carried out, and during other periods in which it was abandoned, and the difference in the mortality was most surprising, though he would not trust his memory to give the exact figures. There could be no doubt that very many lives were lost in that way for want of sufficient attention to this matter, which affected all in a great degree, but the sick in a pre-eminent degree. Mr. Hartley had raised very many practical points, particularly that of ventilation through the walls of rooms; and with regard to the nature of wall surfaces, he had no doubt that what he had stated, basing his observations on Pettenkofer's results, was perfectly true, and that, as a general rule, one wall was much the same as another. At the same time, with regard to plastered, distempered walls, judging from a knowledge of the character of diffusion, he should think in those cases there would be really very little obstacle to the passage of gases; and probably the same thing would apply to the majority of papers. But subject to any accurate experiments upon the subject, he should be inclined to think that varnished papers or painted walls, on which there was a thick layer of either paint or varnish, would in all probability tend to interfere with this result. At any rate, it was well that attention should be given to this subject, for after all there was no doubt that the amount of air capable of entering in this way through the walls was of considerable importance. It might not be of such magnitude in the case of crowded assemblages, such as theatres, but in ordinary dwelling-rooms there was no doubt that insensible ventilation through the walls was a thing very much to be regarded. Another point which was of very practical importance, was the extent of air necessary for comfortable and wholesome respiration, where a large number of people were collected. Of course the larger the area in some sense the larger the surface, and the greater facility for this means of invisible ventilation; but in addition to that there was to be considered the fact that a much longer time was required to render the air so impure as to be prejudicial, and at the same time there was much greater facility for introducing fresh air without experiencing objectionable draughts, those objectionable draughts which, in the majority of cases, interfered with the comfort of rooms ventilated by artificial means. Then again, there was the important question of the amount of carbonic acid contained in the soil, and there arose the question of taking the amount of carbonic acid as the measure of the impurity of the air. Mr. Hartley had drawn attention to the fact that in the majority of cases the discharge of carbonic acid gas into the air by human bodies was so great as to render the discharge from other sources insignificant, and that therefore the amount of the carbonic acid in a crowded room occupied by a large number of people might fairly be taken as the measure of the impurity of the air, not that the carbonic acid itself was the real source of uneasiness, or that it was particularly injurious unless in comparatively large amounts; but that it indicated an injurious condition of the atmosphere. Considering in this light the carbonic acid in the soil, it did not appear to be matter of very much consequence whether it did really find its way into houses or not; but it was well known that in the soil, as well as in the air of rooms, the carbonic acid was only a measure of the impurities, and therefore it was most advisable that in every building, if possible, there should be free ventilation under the floors, so that the air entering the house under the floors should not be derived directly from the soil, but should pass freely through the interstices between the soil and the floor of the house. In conclusion, he must say that he had watched the illustrations with great interest, and as an old experimenter must congratulate Mr. Hartley on the success and aptness of his various illustrations. No one who had not been accustomed to such things was aware of the trouble involved in arranging such experiments, and they were therefore much indebted to Mr. Hartley and Mr. Thomson for the care they had taken. They were also indebted to Mr. Hartley for having brought forward in a popular way the valuable results shown in the tables which were not yet generally known, and which, he had no doubt, would now attract attention, and prove very generally useful.

The vote of thanks having been carried unanimously,

Mr. Wills said he was reminded by Mr. Davenport that the ventilation in that room had received much attention, and that, no doubt, was the reason why the air had come so well out of the trial to which Mr. Hartley had subjected it. The air was drawn in, not from the ground, but from the roof, and passed downwards over certain heaters below, and so entered the room. The principle of obtaining air from an elevation as great as possible seemed to be the better plan, and possibly this had some effect upon the result, because, though the audience was not very large, still it was quite sufficient, if the ventilation was not good, to have vitiated the air to a greater extent than had been shown. In conclusion, he begged to tender the thanks of the Section to Dr. Odling for his kindness in presiding, and announced that the next meeting would be held on March 12th, when a paper would be read by Mr. W. Thorpe, on "River Pollution."

AFRICAN SECTION.

A meeting of this Section was held on Tuesday evening last, Colonel Robert Harley, C.B., C.M.G., &c., in the chair.

The paper read was—

THE SOCIAL AND DOMESTIC SLAVERY OF WESTERN AFRICA, AND ITS EVIL INFLUENCE ON COMMERCIAL PROGRESS.

By Thomas J. Hutchinson, F.R.G.S., F.S.A., M.A.I.

Late Her Majesty's Consul at Callao.

The continent of Africa is nearly five thousand miles in length, and four thousand five hundred in

health, at its greatest extremities. It is calculated to have the enormous area of thirteen millions four hundred and thirty thousand square miles. According to M'Queen, it is inhabited by 150 millions of people, "of whom," he said "three-fourths are in a state of slavery, and one-fourth constitutes a despotic governing power." I am disposed to believe this last statement to be only a guess, as well as very short of the mark. Indeed, in that part of the West Coast where I have passed ten years of my life—viz., in and about the Gulf of Guinea—the freemen, or owners of slaves, do not equal in number more than one-twentieth of the slave population.

In a paper which I read in this room* on the 3rd of March last, about the "General Features of West African Trade from Senegal to St. Paul de Loanda," I mentioned what I may here repeat, that the export of slaves on the whole of the West Coast is happily what it was described some years ago by Dr. Livingstone, in regard to Angola, of which he said, "the time of the slave trade may be spoken of in the past tense." For this we may thank her Majesty's squadron on the coast, as well as the partial introduction of legitimate commerce. But the social and domestic slavery is still the grand difficulty, not only as regards the security of our commercial relations, with the introduction of trade, civilisation, and Christianity, into neutral territories, but the efficient working of the Colonial Executive in such parts of Africa as are included amongst her Majesty's dominions. Frankly I confess that I have no remedy to propose for such a state of things. Neither have I a plan to suggest in regard to trading operations, inasmuch as these differ, one locality from another, quite as broadly as do the idioms, dialects, or languages of the various tribes. The chief object of my paper being to bring before you the facts which I have gleaned during my residence on the West Coast; and by thus ventilating the important subject, to lead the way for its practical discussion by the Committee of the African Section of this Society.

On common-sense grounds, I should not think of recommending any friend of mine to embark his capital in a country, or amongst a people where there did not exist a perfect security for realising profit on that capital, without first considering what are the obstacles, if any, to the accomplishment of such an end, as well as the measures should such be available—to obviate these impediments. This principle is especially indispensable for reflection and deliberation before going into the manner of an African commercial and civilising institution, on the plan of the Hudson's Bay Company, as has been suggested by Mr. Sanders, and which I hope it is his intention to bring before this Society.

The primary obstacles then to be considered are the two species of malaria, which exist in most parts of Africa, notably so of both on the West Coast, where no inconsiderable contingency of legitimate commerce has superseded the foreign slave export. These two species of malaria may be defined under the heads of physical and moral—the first relating to the fevers and diseases of the miasmatous districts (which are chiefly on the coast), the second being the social and domestic slavery which prevails throughout the continent. There was much truth expressed in the opinion of Lieutenant Forbes, in his work on Dahomey and the Dahomans, when he said, "I do not look upon Africa as the deadly continent it is the fashion to describe it. Men enter Africa determined to have fevers, and like the phantom's story in the Persian fable of cholera, fear kills them. Less cant on the subject of African diseases would materially assist to stop the slave trade, and render the African enterprise more genial."

This opinion must, however, to some extent be modified. Because the diseases of Western Africa, and its marsh malaria are neither all "cant" nor all "fear." From time immemorial the fatility of the Sierra Leone and Gulf of Guinea neighbourhood has stamped these locations with the titles of the "White man's grave" and the "plague spot of the world."

Even in the early slave-trading periods between Liverpool and the Guinea coast, the sailors had a refrain which ran thus, but for the grammar of which I am not responsible:—

> "Beware, and take care of the Bight of Benin,
> As for one that comes out, there is forty stops in."

Yet by the results of the Niger-Tshadda-Binue expedition of 1854-55 (in which I had the position of Senior Medical Officer), this African malaria has been proved to be perfectly subduable. An account of it was published in my narrative of that exploration, comprising two small volumes (Nos. 91 and 92 of the Travellers' Library) issued by Messrs. Longman and Co., in 1855. Not from any personal vanity, I assure you, but practically to show the results, I may summarise the facts.

When leaving Fernando Po for the deadly Niger, on the 8th of July, 1854, the crew of our little vessel, the steam-ship *Pleiad*, consisted of nine Europeans and fifty-four Africans, the latter including sailors, interpreters, and Krumen. Besides, we had on board three Admiralty gentlemen, and the Rev. Mr. Crowther, a total of sixty-seven souls. It must be borne in mind that in all former expeditions up the Niger, the mortality invariably increased in proportion to the distance from the ocean to which the expedition penetrated. The *Pleiad* pursued the continuous course of the Niger-Tshadda-Binue stream, some 250 miles higher than the furthest point attained in any previous attempt. Yet, despite of this, and of the vessel having been over a hundred days in the rivers, she returned not only with every man of her crew to Fernando Po, but went on to Liverpool, where she arrived without a single mishap by disease or accident to any member of her sixty-seven voyagers.* This proved to a certainty the possibility of preserving health even in the most unhealthy districts of Africa, if sanitary precautions and preventatives to development of malaria are enforced and adopted. My ten years' experience confirms me in the belief, that in few parts of the world have we so much as in Africa a confirmation of the old adage that "prevention is better than cure."

Dividing the indigenous slavery into two classes, the social and the domestic, the first may be said

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* *Journal of the Society of Arts*, No. 1,111, Vol. xxii., March 6th, 1874, page 314.

* I believe the chief cause of success attributable to my having administered quinine wine before entering, and whilst passing through, the swampy districts.

to have its stronghold in the superstition of Ju-Jus and fetishes,* whilst the latter is assimilated to, and affiliated with, the inborn commercial spirit of the natives. It is, however, somewhat difficult to separate them in definite forms, without impinging on the various ramifications that occasionally dovetail into one another. For without the slavery of ownership on the one hand, and perfect subjection on the other, the native trader tells us that he cannot have his *employés* faithfully to discharge their duties in the "barter and traffic system" of the markets. This style of trade principle seems to be a characteristic of the West African, be he freeman or slave, almost as much as the colour of his skin and the crispness of his hair. In one of the colonial books of commercial operations on the Gold Coast for 1857, I find it stated that "Even in fishing at the sea side with hand-nets flung from their canoes, they have the 'barter and traffic' principle in view. The fish caught are brought into the interior, and there exchanged for agricultural produce, such as yams, Indian corn, bananas, plantains, and cassava. These are returned back to the seaport towns, and again bartered for European goods."

The religion of the Africans on the West Coast is most generally that of Fetishism—although not to the extent described by Captain Burton†—"admitting neither God, angel, nor devil." They have belief in a good as well as an evil spirit, the latter of whom is almost invariably to be propitiated for intervention with the former. This is usually attempted through what the distinguished traveller just mentioned speaks of as "natural objects, animate and inanimate, to which certain mysterious influences are attributed."

The Fetishes of the tribes on the West Coast are as varied as their idioms, of which Captain Adams observed "that the tower of Babel might have been built on the shores of Western Africa, as a different language is spoken at every ten or twelve miles." At Akim, interior to Akra, on the Gold Coast, their chief fetish is a large copper pan, called a *Catagury*, which is accredited to have fallen from heaven in remote ages. This is kept from inquisitive eyes, as no one is yet recorded to have seen it, except, of course, the ju-ju, high priest, or fetish dignitary, who levies large sums to keep it polished. The fetish-house (in which it is supposed to be religiously guarded from mortal eye-sight) is ornamented with swords and axes, having golden handles, and hanging to the walls as symbols of authority. Amongst these are drums, likewise bedecked with gold. The despotic power used by the fetish official at Akim may be described as an episode of social slavery, because if a person dies without having conciliated him, he has the privilege of ordering the body to be placed in an upright position inside the dead man's house. Should the corpse retain its perpendicularity, all the property it possessed whilst living is allowed to its family. But if it fall—which the fetish man has knowledge enough of the peculiarity of gravity in a dead person always to secure—the whole estate and effects of the defunct must be handed over to the fetish.

* Fetish represents the worship of material or inanimate things, as stones, weapons, plants, and so forth, apart from idolatry. It is derived from the Portuguese *Fetisso*, a thing enchanted.

† Vide "Transactions" of the Ethnological Society, Vol. I., New Series, page 331: John Murray, Albemarle-street, 1861.

A second illustration of social slavery on parts of the Gold Coast (not within the British Protectorate) is manifested by tribunals of what are called "Pynins," or elders—officials who live on fees derived from suits that are tried before them. These courts are invariably agencies for extortion and oppression. But in the part of Africa of which I am now speaking, the natives show evidences of comfort and independence wherever the British Government has its authorised executive to protect life and property. Up the Rio Bento, or Brass River, the official fetish was a boa-constrictor. Yet the grey and white king-fisher held that post with the family of one of the kings, named Orishima. Thus, if it ever happened that any of these birds flew in sight of his majesty's canoe, and that he was bound on an important journey, the canoe was turned back to the town, and a sacrifice of a goat was made to avert any calamity of which the presence of the fetish winged-messenger was believed to be a warning. In New Kalabar the shark was the fetish, and every seven years, at the mouth of the river, an offering had to be made of an Albino negress, who was thrown into the shark's dominions with much Pagan brutalities.

There is a curious analogy, as well as dissimilarity, between the manners and customs of the tribes about here. Although the New Kalabar residents not only are another people from those of Old Kalabar—a few hundred miles lower down the coast—and speak quite a different language, yet the last-named had the same superstition of sacrificing an Albino child at Parrot Island, forty miles up their stream, which the former did at the mouth of their river. In the one instance it was given to the shark, and in the other to the alligator.* In both cases, the chief urging motive was to sacrifice an Albino, or white child, to the god of the white man, that he might be propitiated to send out more ships. In this explanation I must say that I have no faith.

Interior to New Kalabar there is an ordeal for trial to which criminals are sent, and which is described by the authorities as "the long ju-ju country." It is in the district of Oru, and not far from Aboh, up the river Niger. Although not more than a hundred miles from New Kalabar, it is computed a three months' journey. The Delphic Oracle up here, believed to be a female (who knows everything), calls on the accused, when he approaches a certain bush, asking him if he be guilty or not guilty. When "not guilty" is the plea he is told to go back. The simple people of New Kalabar believe that if the accused be innocent he can return, but, if he be really guilty, that his feet become fastened to the ground. Then water springs up, and rising gradually over his head, in a few minutes he is dead. As soon as this is done the water returns to the source whence it came, drawing with it the body of the victim, but leaving the head over the ground. Many a wealthy trader has been sent up for trial by ordeal to this supposed "long ju-ju country," who has been most probably put out of the way in one of the many creeks, perhaps only a few miles from his own house. And his family are obliged, by fetish ordinance, to believe this fabulous account

* Although there is a place in the Old Kalabar river called Alligator Creek, I believe Cuvier says the animals of this genus here are crocodiles.

of his destiny; for, on its consummation, his property goes to the fetish or ju-ju king at New Kalabar.

Only sixteen to twenty miles beyond New Kalabar, and accessible by intercommunication of rivers, is Bonny, where the iguana was the fetish, I have seen dozens of these reptiles, from five to six feet long, crawling about the streets. They had liberty to enter any house, and help themselves to whatever of good came in their way. It was death to a native to have done any injury to one of them—and a heavy fine for a white man. Within this last few years the iguana is deposed from his high estate, but I do not know if he have a successor.

It may at once be evident what a great impediment to healthy trade must exist in the face of such items of social slavery as these. In the very place I have last referred to, namely Bonny (which is in the consular jurisdiction of Biafra, and the incumbency whereof I held for five years), there was an illustration of it, by the fact that some fetish rows caused the produce of palm-oil, in 1859, to be less by 3,000 tons than it was three years before, in 1856. During the last-named year there were 16,000 tons of palm-oil sent from the River Bonny and New Kalabar (they constitute one market). This, at the then average of £48 per ton in Liverpool, was a tidy business. Yet what a serious matter it is to reflect upon the heavy loss of time and capital that must be endured in such a state of things. Let us imagine King Orishima, for instance, coming to trade with an agent, who is treating for his palm-oil, ivory, or other produce, being turned back, by meeting with a king-fisher fetish during his canoe voyage, and then being obliged to comply with ju-ju practices before he can resume it. All this time your capital is rusting, and the health of your agents or supercargoes is being impaired.

Another phase of social slavery exists in the Old Kalabar river, where unfortunately it is the custom to give credit to the native trader. There, for example, a man sentenced to death by Egbo law, is doomed to have all his property—be it of wives, slaves, or merchandise—let it be British goods or not, divided amongst the ju-ju functionaries or fetish high priests of the order, pretendedly to make and furnish "devil houses," as they are called (which are erected for every great man who dies), but, in reality, to be appropriated to their own private use. This institution of Egbo is a kind of freemasonry as regards its secrecy, but it is, in reality, a brotherhood of kings, chiefs, and freemen, to keep the slave population in awe of its supposed supernatural attributes. There are eleven grades of it. But no slaves are eligible, except that the second or third generation of a slave born within the pale of an Egbo-man's dwelling is liberated by the fact, and, after his parents' death, is allowed to purchase any of the first eight orders. The last three are inaccessible to slaves.

Now, although the principle of giving out goods on credit in African trade may be considered by some persons to have no direct bearing on the subject of social and domestic slavery in regard to commercial progress, still it is a very important feature of our commercial relations. I regret to add, from my experience in Old Kalabar, that it is calculated not so much to foster progress as to annihilate it altogether. On the last night of our meeting, and in the discussion of Mr. Babington's paper, the subject was broached by one of the speakers, I can, therefore, hardly consider it out of place to resume a consideration of it here. During my time out there, the Old Kalabar river was the head-quarters of the "trust system," as it was called. I shall enable you to form your own judgment of it by a few facts. In the year 1856, when I was collecting materials for my report to the Foreign-office about the trade of the Bight of Biafra, I found that the Old Kalabar river, with a produce rarely exceeding three thousand tons of palm-oil in a year, had then shipping in the river equal to a ten thousand tonnage (registered). Thus having as much accommodation of vessels as would bring home the markets of four years. Owing to the frequent official visits I had to make to that river, and the impossibility of settling the disputes that were daily occurring between the native traders and the British supercargoes, and the supercargoes with one another, I felt it my duty to lay before the late Lord Clarendon, who was at the time Secretary of State for Foreign Affairs, a representation of the injuries which the trust system, unregulated by any cycle of certainty, was doing to commercial morality; of the losses in wear and tear of ships, wages of seamen, insurance expenses, and so forth, it was entailing on British merchants; and of the evil influence it was engrafting on the native traders, who saw supercargoes seizing, and often with armed force, puncheons of palm-oil that were being brought to other ships than their own. Moreover, native chiefs were occasionally kept in confinement on board of these ships, not always for their own debts, but occasionally for debts due by others. This last mentioned obligation arises from the fact that, according to Egbo law, responsibility for debts is not a particular, but an universal liability on the district to which a debtor belongs. As, for example, if a debt be due to me by any man in a neighbouring town, I have a liberty, which by a certain kind of palm-oil—in plain words a bribe—I get from Egbo, to distress the goods or capture the person of any other man in the same place, and keep him imprisoned till his neighbour's debts be paid. Of course such a capture must be effected by stratagem, but once I have the party in my power, possession gives me all points of the law; and if he be a fellow of worth I could keep him till every debt due by his townsmen is paid. When he is liberated he proceeds by similar action to recoup himself. Lord Clarendon communicated on the matter of my despatches with the Lords Commissioners of Privy Council for Trade, who instructed the late Sir J. Emerson Tennant to write to the Secretary of the Association of Merchants trading to the West Coast of Africa from Liverpool. That letter being as applicable to the principle on which future trade operations may be most safely carried on, as it was when written eighteen years ago, with your permission I shall read it for you.*

Office of Committee of Privy Council for Trade.
Whitehall, May 28th, 1857.

SIR,—I am directed by the Lords of the Committee of the

* This letter has been published in the author's last work on Africa, "Ten Years Amongst the Ethiopians," issued by Messrs. Hurst and Blackett in 1860.

Privy Council for Trade to invite (through the instrumentality of your Association) the earnest attention of the merchants interested in the trade of the West Coast of Africa to the state of things that exist there at the present moment, and to the danger that, if the trade carried on with the natives be not speedily placed on a more legitimate and sounder footing, the development of the resources of that region, which is now seriously retarded, may be ultimately checked, and a lucrative commerce, susceptible of infinite extension, may eventually decline, or be altogether withdrawn from European enterprise.

Complaints are received by her Britannic Majesty's Secretary of State, by nearly every mail from the African coast, against the arbitrary and unjust proceedings of the British supercargoes towards the native chiefs and traders, of violence to their persons, and the forcible detention of their goods; and there is reason to apprehend that, ruined by their share in these transactions, or disheartened and disgusted by an occupation in which they do not find ultimate advantage, these native dealers are occasionally driven to abandon peaceful and industrious pursuits, and betake themselves again to anarchy and the slave trade.

Without ascribing this discouragement wholly to one cause, my Lords cannot doubt that it is attributable in a great degree to the system of excessive credits, on which at present the barter with the African middle traders is mainly carried on by the representatives of British houses in the Kalabar, Kamaroons, and other rivers of Western Africa.

To so great an extent is this acted upon, that her Majesty's Consul for the Bight of Biafra, writing to the Secretary of State, on the 21st of February last, states it has been represented to him, that at that moment from nine to eleven thousand tons of palm-oil were due by the native traders in one single river, the Old Kalabar, where the annual produce does not exceed one-third the quantity. Thus, in a single district, the entire produce of three prospective years would be absorbed to discharge the obligations of one.

This alone is a serious consideration in the case of an uncivilised people, unable to resist the temptation of excessive credit in the first instance, and afterwards impelled, rather than discharge engagements of such old standing, to convert their available goods to their own immediate profit, to the disregard of their creditors' claims.

But to this dishonest course the natives feel themselves impelled by another consideration, which, however indifensible in itself, is still sufficient in their eyes to justify evasion.

The prices at which European articles are pressed upon them in the first instance are unnecessarily exorbitant, in order to admit of a profit to the British adventurer, who thus entrusts his property to a native about to set off to the interior in search of African produce, with which, after a lapse of one or two years, he may or may not return to discharge his debts. The only security of which the supercargo can avail himself in such circumstances, is to place so high a nominal value on the goods which he advances, as may protect his employers against partial default, and cover not only the risk but the actual cost of shipping long detained in the rivers to await the returns from the speculative investments, with all the incidental charges for interest of money, insurance, depreciation, commission, wages, and outlay on the crews. It is not to be wondered at that the native debtor, aware of the disadvantageous terms on which he had originally contracted his engagements, on returning to the coast, and bringing with him the articles collected during his long circuit in the interior, should hesitate to deliver them to the creditor, and should yield to the bait of better terms offered by a rival European agent.

Such a system of comparatively unlimited credits, by tempting the native into debt, fosters the tendency to dishonesty in him; whilst the supercargo, for the assertion of his own right, finds himself in a condition to resort to force —and force which may appear ostensibly justifiable, under such circumstances, is apt to extend itself to other cases in which justice is less colourable, and the system degenerates into habitual fraud on the one hand, and systematic violence on the other. In such a struggle it must be obvious that legitimate trade cannot long endure; and it has already been represented to her Majesty's Government that civil commotions which frequently agitate the coasts and threaten destruction to European as well as native life and property, are probably encouraged by men rendered desperate by unsuccessful dealings with Europeans, who hope to escape in the confusion; and that such individuals eventually betake themselves to a life of turbulence and slaving.

With a view to apply a check to the further growth of this system, it has been pressed on the Secretary of State for Foreign Affairs, that it will be expedient to bring back the system of trading in the African rivers to a sounder and more legitimate condition, by calling the attention of those interested to the propriety of greatly contracting the present facilities of credit between their supercargoes and the native dealers. The Consul of Biafra suggests, with this view, that, in his opinion, the best plan whereby the merchants of Liverpool embarked in the African trade can extricate themselves from the probability of serious losses, is by instructing their supercargoes (and rendering it incumbent upon them to obey these instructions) not to give more than a certain amount of trust, in proportion to the yearly produce and the amount of tonnage in the rivers, and that they should make it a general rule that, when an amount of oil is brought to a ship for sale, at least one-third of it should be placed to the credit of the old account, and the remainder paid for in goods on delivery.

Mr. Hutchinson is further of opinion, that "to avoid competition between two agents of one house, the best system, as adopted by Messrs. Horsfall, in Brass and Kalabar, Kamaroons, and Bonny, would be by far the best, because common sense should teach that a single vessel on shore would be much more profitable investment than sending out four vessels in charge of two different supercargoes, if from no other reason than the saving of the expense of insurance, of officers and seamen's wages, and of the wear and tear of the ships." These recommendations, emanating from a gentleman of Mr. Hutchinson's experience and opportunities of observation, appear to my Lords eminently worthy of the attention of the merchants interested in the African trade, and their adoption would probably remove one source to which the evils adverted to are very distinctly to be traced.

I have, at the same time, been instructed to intimate that measures will be taken to control the violent conduct so frequently exhibited by supercargoes in the African rivers—that additional powers will be conferred for the purpose, and that her Majesty's Government will rely on the great mercantile houses interested in the development and permanent prosperity of the African trade, to co-operate with them, and by their legitimate authority over their agents in these rivers to put an end to those practices which have hitherto prejudiced lawful commerce, and hereafter, if not checked, to be productive of still more serious evil.—I am, &c.,

(Signed) J. Emerson Tennant.

The Secretary to the Association of Merchants Trading to the West of Africa, Liverpool.

And I repeat here the summary of what I said to the supercargoes of the Old Kalabar river, in connection with that letter, "As long as the system of unlimited trust continues to be followed, as long as recourse is had to native laws, whilst the merchants in the trade send an amount of shipping-tonnage, quadrupling the annual average produce of the district, so long it will not be possible to make commerce in that river what honest trade ought to be everywhere."

This taking prisoner of a trader, or forcibly seizing his palm-oil, was entitled amongst the supercargoes "chopping" the man, or "chopping" his oil. And this "chopping" came to be recognised as a phase of the Egbo business.

Nearly the whole of the tribes of the West Coast have organisations of secret societies, like the Egbo of Old Kalabar. For we find the Mikuka and Bangolo of Kameroons, the Manganga of the Aboh country, up the Niger, and the Mumbo-Jumbo fiddle-de-dee practised in the interior, as described by Mungo Park and Major Laing. They are all of the same character—based on the superstitious faith that the ju-ju man, or fetish priest, has private communication with the spiritual world, more especially with the bad spirits, whose influence and action he is supposed to have power in procuring for his intentions. These, I need scarcely add, are invariably used to keep the slave

majority in subjection to the mastership of their owners.

The second division, or domestic slavery, embraces a wide range. All the women in West Africa are slaves, be they mothers, wives, daughters, or sisters even of kings. They are not only bought and sold, but are completely at the mercy of their owners, be their destiny one of death or of dishonour. It is recorded by M'Queen that "the Krumen," who are the bone and sinew of our sailors as well as workmen on the coast, "never enslave one another." This may probably refer to their not having had anything to do with the export of slaves, but that they cultivate it in their domestic relations appears probable, from the fact that the chief outlay of their earnings down the coast in ships of war and palm-oil vessels up the rivers, is expended when they return to their own country in purchasing wives. They buy them amongst the families of tribes that are around and interior to the Kru districts of Grand Sestros, Cape Palmas, and the country between Liberia and the Assim River. These wives work for them in their declining years, chiefly cultivating rice, yams, and cassava. And a Kruman is considered a very independent gentleman when he can cease to hire himself out as a sailor or workman, and has twenty or thirty wives at his command. Like all the other tribes, the Kruman's wives become the property of his heir at his death, be such heir a son, nephew, or son-in-law, for there is rarely hereditary title in the heirship unless with such grand potentates as the Kings of Dahomey and Ashantee.

This brings me to another phase of the domestic slavery. In the palm-oil rivers of the Bights of Benin and Biafra, as well as at Lagos (and I believe generally on the coast), exists a sort of democratic sliding-scale of this institution. For instance, a boy, who is my property, may be owner of another boy, or several boys, each of whom may be owner of boys in his turn. In some places the line of demarcation between owner and slave is almost rubbed out. A freeman may thus give his daughter as wife to a favourite slave. This has happened, to my knowledge, in Bonny, Brass, or Old Kalabar, though I forget which. And if the latter be a smart fellow in conducting his owner's business of "barter and traffic," he may be left heir to the property on the death of his master. These belongings, as in the case of the Kruman, include not only the father and mother of the slave himself (should they happen to be with the lot), but even the mother, as well as the wives and children of the testator.

The possession of many wives, coming under the head of polygamy, I need scarcely say, exists everywhere on the coast. By M. du Chaillu, as well as by Captain Burton, it is defined to be rather "a political than a domestic or social institution." The latter says:—"A judicious culture of the marriage tie is necessary amongst savages and barbarians, where, unlike Europe, a man's relations and connections are his only friends, besides which a multitude of wives ministers to his pride and influence, state and pleasure."* Although this may be admitted, still such reasoning never enters as bearing on "judicious culture" into the African mind. He steps into the groove of polygamy, as his father did so before him, and because it frequently happens that his chief property is the number of wives left him by his predecessor.

It is but justice to record that in part of tropical Africa, on the East Coast, Dr. Livingstone found a state of affairs very different from much that we have on the West Coast. Amongst one tribe, he tells us it is the custom, when a man marries a woman of a neighbouring village, that he should go to her house to live with his wife, and that the chief occupation of his subsequent matrimonial obligation is to carry home firewood for his mother-in-law. In another district the Doctor found a rule of civil jurisdiction, which you will allow to be rather peculiar to African society. There, whenever a woman assaulted her husband, as, unfortunately, sometimes occurred, she was brought to the palaver-house in the market-place to be tried, and if found guilty, her sentence decreed as punishment that she should carry her husband home on her back. This, however, by the peculiar logic of her sex, became converted into a triumph, for as she went along, women's heads were thrust out at the different doors by which she passed, and joining their voices to those in the procession, there was a continuous and universal cry of "Give it to him again! Give it to him again!" It is quite apparent that if there be any domestic slavery amongst the tribes of whom these two characteristics are recorded, it must be the reverse of what we find on the West Coast.

A curious feature of the "barter and traffic" system is the fact that in many parts of Africa the children of slaves, or even the children of chiefs and kings who may have been killed in war, are used as representative currency; that is to say, are sent to the markets to be exchanged for salt, palm-oil, ivory, and sometimes sold to native traders for goods brought out by English traders.

When I was up the river Niger, in 1854, there came on board the steam-ship *Pleiad* one morning, whilst we were alongside the bank at Ossamaree, two women who wanted to sell their children. One had a little boy, about six years apparently, and a girl, a year or two older. The other owned a boy that seemed about ten years of age. They offered to dispose of them for a bottle of gin each. They pronounced the name of it as nearer to "chin" than we say it; but they pointed to a bottle, and made the motion of tipping off, which could not be mistaken. Ossamaree is little over fifty miles interior to the palm-oil depots of British and American ships at Brass; and I hope you will agree with me it would be better that British enterprise never went to the Coast of Africa, if it do not cease to bring with it this doubtful proof of our civilisation. For I must record my own opinion emphatically, that neither the civilising trader nor the missionary ever can prosper in their labours where they are preceded by the gin bottle and the rum puncheon. Here for a moment I cannot avoid reverting to the discussion at our last meeting, when it was advanced as a justification for our selling powder and rum to the natives, that if British merchants won't do it, other nations, as the French and Germans, will. It was also, to the best of my recollection, stated that, whilst European governments are preparing to sweep the seas with their

* The "Transactions" of Ethnological Society, op. cit. at page 321.

iron-clads, and the science of the age is inventing the quickest mode of destroying hosts in battle array, we should not deprive the Africans of their war materials. I believe both of these arguments to be based on groundless fallacies. If the thing be wrong, its being done by another does not constitute its right for us; and to compare the African's idea of fire-arms to those of modern Europe is like putting a baby on the same parallel with a man. As in everything relating to moral influences, moral reasoning, or moral intelligence, the native African has not yet emerged from the state of childhood.

Up the Nimbe country, of which this same Brass is the capital, there are two defined classes of domestic slaves, the Egbo-bos, or Nigger-niggers, who are employed as pull-a-boys in canoes, as well as to do the most menial work; and the Winna-bos, who are of a higher grade, ranking as adopted children, and having liberty, as soon as they possess the means, to purchace their own freedom.

Of the Egbo and Yoruba tribes of Abbeokutu, several hundreds of slaves have purchased emancipation by their labour. These constitute the class of people by whom the future commercial success and consequent civilisation of Africa will be achieved. Look at the prosperity of Angola, where we find, according to Dr. Livingstone, a population of 600,000 souls, and only five to seven per cent. are slaves.

Amongst the tribes of our Colonial possessions in the Gambia, Sierra Leone, Cape Coast, Akra, and Lagos, we have similar superstitions, social barbarities, and domestic slavery as are found up the palm-oil rivers. In the former they are, to a great extent, kept down by the British authorities. But at Dinkera, Akim, Akropong, and Abokoby, all within the protectorate of the Gold Coast, I know that they have their fetishes, their ordeals, and ceremonies of driving the devil out of town almost exactly as they have it amongst the Efik tribe at Old Kalabar. In the last-named place this expulsion of the evil one is a biennial custom, to purify a town from all devils and bad spirits, who, in the opinion of the Egbo authorities, have taken up their abode since the last ceremonial. At a certain time a number of figures, of the Guy Fawkes style of build, are placed at different corners of streets or appointed places. These are entitled "Nabikems." During the three weeks or a month that these effigies are supposed to be receiving the bad spirits into their substance, all trade and business is sacrificed to the continuous orgies with which the evil ones are adjured to take up their abode in the crude attempts at moulds of living things. For these are fashioned to represent not only men, but tigers, crocodiles, goats, birds, and so forth, as the particular fetish of a family dictates. Till the climax of their being all on a certain evening prescribed by Egbo order, huddled off and pitched into the river, amidst a yelling, beating of drums, firing of guns, ringing of the Egbo bell, and creating a clamour sufficient, no doubt, to drive any devil not only out of the town, but out of his wits. This is prolonged further than the old orthodox ghost time of midnight, "when churchyards yawn and graves give up their dead," until broad daylight. And as no small part of the revelries are on the Bacchanalian side, to them succeed rows, fights, and quarrels, often extending over a week, in the Palaver House. The injury done to trade matters by this state of things is inconceivable.

The superstitions of the "Crabbah," or "Ocrah," still exists on the Gold Coast. By the "Ocrah," or "Crabbah," is meant that a custom is observed amongst the natives of position and wealth to purchase a young slave of their own sex, or sometimes to select one from amongst those previously in the house, and to bestow on him or her the title of "Crabbah," or "Ocrah," the meaning of which is, that the slave thus named is to be looked upon as the soul, spirit, or *Alter et ego* of the master or mistress. These favoured persons wear a chain of gold, or white beads, round the neck, to which is attached a large medallion of gold to denote their rank. They are treated with great indulgence so long as they behave well. In Ashantee, from which, I believe, the custom originally came, the ocrahs of the king and great men were slaughtered on the deaths of their owners, as it was intended they should accompany them into the next world.

When I was leaving Africa, nearly sixteen years ago, domestic slavery prevailed everywhere on the Gold Coast. From Cape Coast Mr. Bannerman wrote, to my inquiries about the subject, that it was not easy to convey to the mind of a stranger precise notions of this institution as it exists amongst them, nor to give clear ideas of the tie existing between master and slave. At Cape Coast there are hundreds of families in which it is quite impossible for even the members to discriminate who amongst them are slaves and who are free. Thirty or forty years' communion from intermarriages obliterate the distinction. A man may be a slave to his own son. For example, I buy a slave, and marry to him my niece. [The line of succession at Cape Coast is usually, but not invariably, from uncle to nephew or niece.] If they have a son, the child on my death becomes possessed of my property, and his own father is one of his slaves. But "slave" is not the proper term for this class of persons, for in very truth they are in general nothing less than members of the family, who have become part of it by purchase instead of by birth. About forty years ago, when the Ashantee invasion of that period had upset the whole country, thousands of families were broken up, and people were sold right and left around the Gold Coast. At the time of which I speak natives of the coast were not accustomed to be sold. The slaves were brought down from the far interior. They were of all ages. Purchasers preferred buying them at the ages of between ten and twenty, for then they could be trained up. Arrived at the sea side, as Elmina, Cape Coast, Accra, and Christianburg, these slaves fetched from thirty to forty dollars a piece. They were all marked in a peculiar manner on the face.

The system of pawning is infinitely more complicated than that of domestic slavery. If a person be pawned to another, an amount of fifty per cent. interest must be paid to the human pawnbroker before the former can be redeemed. Children born whilst the mother is in pawn need to be redeemed at four and a half dollars, or nearly a pound each. If any one in pawn should die, his or her relatives could not take the dead body for the purpose of

burial till they had paid redemption money. To this a compromise was sometimes made by allowing whomsoever buried the body to be security for the debt.

Interior to Lagos the pawning system is likewise carried on. The Reverend Mr. Mann, Church Missionary at Ijaye, in the Yoruba country, informed me in 1859, that the system of pawning the body was largely prevailing, to the disadvantage of morality, industry, and the peace of families. It enabled the head of a family to put his relatives, whose natural watchman he is, into the hands of strangers. He cared little for the pawned relative, who was scarcely better than a slave, and squandered the money thus obtained in idleness, in buying additional wives, and in expensive funeral orgies. But, in the words of the leading journal,* this is "only one side of a story."

The gentleman occupying the post of principal judicial functionary at Cape Coast in 1860 had opinions on the subject of pawning quite opposed to those of the Rev. Mr. Mann. I believe much of this diversity of sentiment may have arisen from the fact of the system which prevails in the Yoruba country being different to that of the Gold Coast. Neither did the judge approve of the Supplementary Slave Trade Suppression Act (6 and 7 Victoria, cap. 98), which places pawns on the same footing as slaves, so far as British subjects are concerned. Of the Act in question he observed†:—

"This enactment, although well intended, I consider to be a mistake, and much to be regretted, for it destroyed, as it seems to me, a most powerful means of the gradual abolition of slavery in those countries, and of introducing in its stead a system of contracts for labour. In principle, pawning, when voluntary, as it is commonly, can be defined nothing worse. If, therefore, instead of being put on the footing of slavery, and so made unlawful for British subjects to deal with, it had been regulated so as to render the terms of the contract equitable, it might have been the means, I think, of gradually superseding slavery altogether, inasmuch as the regular enforcement of such contracts would render pawns more valuable than absolute slaves to persons living under British rule, which, while on the one hand, it checks and restrains the master, can, on the other hand, enforce obedience by the slaves."

The difference of opinion between the Rev. Mr. Mann and the judge arises from the fact that each gentleman founds his arguments on limited, and therefore erroneous, deductions. The judge supposes the majority of persons pawned to put themselves in that condition of their own free will, or "voluntarily," as he says; whereas the clergyman thought only of the pawns put in by their owners, to tend, by the sums raised upon them, to the luxuries and vices of these masters. This is but partial reasoning on each side; yet the subject of domestic slavery, being, as it is, "a natural institution,‡ growing out of the wants and circumstances of society," needs to be considered in the most latitudinarian point of view. The experiences of the judge already quoted seem to me to be based on very sound deductions, for he tells us of domestic slaves who are commonly looked upon and considered members of the family, more particularly in the rural or bush districts, working side by side with their masters, eating from the same dish, and constantly addressing each other as father and son. The master usually provides a wife or husband for his slave, frequently, if it be a female, taking her to wife for himself, or giving her to his son. Indeed, the relations of master and slave are here so much on the patriarchal footing that we read of in the Old Testament, as in concurrence with many other facts to convince me that the systems are derived from a common origin.

"And I have more than once," he continues, "availed myself of the provisions of the Mosaic code in deciding between master and slave, quoting my authority with a short account of its origin. These decisions, as far as I could judge, have been all the more respectfully and cheerfully obeyed, from being found to be based on ancient authority, and a code of laws with which their own is identical."

Far be it from me to advocate in any way a compromise with slavery. But I shall ask you to consider if we desire practically to keep up trading relations with Africa—practically to foster its commercial prosperity—practically to assist in rooting out slavery, so as to enable the bondsmen of the present age to be, as I believe they will be, the chief workers in the development of their country's resources? Because, if so, telling the kings and chiefs—"You must give up slavery; you must abolish pawning, and at once," is not the way to do these things. They will retort, as they have already done, by saying—"By this peremptory action you make slaves of us, the owners of slaves, servants, and persons pawned, on whom we have spent large sums of money. And giving us no time for consideration, you substitute the slavery of the dependents by the slavery of the owners."

Discussing this important point on the simple grounds of practical expediency, the matter is thus truly set forth* in a London paper last week:—"In Africa and the East, slaves, though they may be sometimes exposed to cruel treatment, are by custom, and in accordance with the feelings of both parties, members of the family of the master." There is no more doubt of this than of the idea that "the purchase of a slave, except where it is part of a regular trade, generally resembles the hiring of a servant." It is equally true that in reference to the pawning system, "the practice of treating the persons of debtors as securities for their liabilities, has been suggested by convenience. European morality is better than African; but when the superior race suddenly regulates, in accordance with its own doctrines, relations which had grown up in a different state of society, it is almost certain that great hardships must be inflicted."

No doubt of it. And this is where the great mistake lies with reference to the general idea of slavery in Africa. That humanitarians look upon everything bearing that odious and detestable name—even in the most intimate domestic relations between "members of the same family"—as being the counterpart of the middle passage horrors, and of the bloodhound hunting as it used to be in the Southern States of the American Union. Whilst from there being so broad a difference between the two conditions, the African chief or slave cannot understand any reform that will so break up their relations so long established.

The domestic slavery as it exists can therefore only be rooted out by introducing customs that

* Times (editorial article), February 9th last.
† West African Herald, July 27th, 1870.
‡ "Western Africa, its History, Condition, and Prospects," by Rev. J. Leighton Wilson, sixteen years a missionary in Western Africa; Harper Brothers, New York.

* *Saturday Review* (editorial), February 13th, 1875.

will be incompatible with it—the customs generated by trade, commerce, and industry.

More than a quarter of a century ago, in 1848, the then King of Dahomey asked Mr. Cruikshank, in his mission to that country, "Can I, by signing this treaty, change the sentiments of a whole people? It could not be. A long series of years was necessary to bring about such a change. I myself and my people must be made to feel the advantages of another traffic, in an increase of riches, and of the necessaries and luxuries of life, before they could be weaned from this trade. The expenses of the English Government are great. Would it suddenly give up the principal source of its revenue without some equivalent provision for defraying its expenses? He could not believe so. No more could he reduce himself to beggary."

Although this referred to the foreign slave exports, *totidem verbis*, like arguments, on the very ordinary grounds of economy and practicability, are to-day used by the Gold Coast kings and chiefs. I have also, therefore, to add my conviction of the existing relation between master and bondsman, as well as the system of pawning, being deserving of the most serious consideration, because, standing as they do in the way of progress for legitimate commerce.

Many people in Europe, who imagine Africa to be a land of gold and palm trees, of lions, elephants, and zebras, even those less poetic, and more practical folk, who look to the growing developments of that country's resources in ivory, palm-oil, ground nuts, and a long catalogue of tropical products, would scarcely believe that up to a year ago, as I know to be a fact—and even to this day, as I firmly believe—human sacrifices and cannibalism are carried on in parts of Western Africa where British commerce has been progressing since long before the abolition of the export slave trade by Act of Parliament in 1819.

I have not mentioned these facts of ju-jus, fetishes, human sacrifices, and cannibalism for the purpose of casting reproach or obloquy on the Africans of the present time. Indeed it would ill become me to do that, knowing the lack of education, which is an inevitable results of their position in the social scale; and knowing—as I am sorry to confess, I do likewise—of what I read in the daily papers about the things which are done with the clogs down Lancashire way, and with the poker even in our great district of London.

But as healthy commerce cannot co-exist with slavery of any kind, and as this latter may be said to be identified with the superstitions and innumerable barbarities of the native African, we must try to substitute extension of trade and profitable employment into the country, whilst it should be remembered that what is applicable to the East Coast is not adaptable to the West. I believe the rescuing of Africa from the Laocoon of ignorance and superstition shall be effected by the liberation of her slaves. But I do not believe this can be done by a treaty, however stringent. It must be effected by helping the slaves to emancipate themselves through industry and commerce, as has been done—teste Dr. Livingstone, at Angola—as has been done, teste Rev. Mr. Crowther, in the Yoruba country, interior to Lagos—and, as I know, is being done every day amongst the palm oil rivers of the Bight of Biafra.

Seventeen years ago I wrote in my "Impressions of Western Africa:"*—"The social and domestic slavery being a growth of centuries cannot be eradicated in a day, either by Act of Parliament or treaty, or by any single plan, however feasible or excellent. As much as our age can do will be to clip its wings and extract its claws, leaving to an educated spirit of emancipation, that must be racy of the African soil, to effect its final overthrow. The most civilised nations of which the world's history gives us record, have not grown to manhood in a single epoch. Hence Africa—helpless as she is—for in human progress she is but an infant—must have a fostering hand to aid her upwards, and show her people how to make something of their country and themselves. There are four reasons why Great Britain should be foremost in this work:—

1. Because of the Christian character of its Government and its people.

2. Because it owes no small restitution to Africa for having during so many years legitimised the slave trade.

3. Because, I believe, the people of Africa taken *in globo*, have more reliance upon, and confidence in, our Government and people than they have in any other.

4. Because the actual existing traffic of exports and imports between Great Britain and Africa exceed those used and gained by any other nation in the world.

Commercial operations up the Niger, as well as on the West Coast rivers, will need, for some time to come, to be protected by the moral force of a man of war. The trade we should pursue ought to be "a commerce founded on a spirit of equity, and joined with conscientiousness, that will induce the native African to believe there is a reality in our Christian professions." But whatever organisation it may assume, on the West Coast at least, it needs to be carried out with the ideas of Sir Bartle Frere, that it is necessary to let the natives know "who were to be the masters there, and whose ideas were to be the dominant ones." Whilst not by preachment, but in practice, we should help the African to discover the truth of that axiom uttered by Burke, the illustrious author of the sublime and beautiful, that "to deal not in the labour of men but in men themselves is to devour the root, instead of enjoying the fruit of human diligence."

DISCUSSION.

Mr. Swanzy, in proposing a vote of thanks to Mr. Hutchinson, said there were some points on which he differed from him, although on many he agreed. In a paper read in that room more than two years ago, by Mr. Pope Hennessy, he said he hoped to see the African trade carried on entirely by African capital, and the sentiment was loudly applauded. He was therefore rather surprised to hear what was said by Mr. Hutchinson the other evening against the system of credit, because the whole of the trade had been almost entirely carried on by that means, and it was only in that way that native traders could be encouraged to develop the resources of the country. Many years ago, when he commenced trading there, it was almost entirely done on credit, and it answered pretty well on the whole; the natives then made larger purchases than was often the

* Published by Messrs. Longman in 1858, page 263.

case now. Mr. Consul Hutchinson had no doubt spoken more with respect to the state of things on the rivers, where the credit system was carried to a greater excess than on the Gold Coast; and it was certainly a great evil to give too much credit, which was only a temptation to dishonesty. It must not be supposed that English merchants were not ready to buy small quantities of produce at any time, but they could not always have European agents at every little place, and therefore they were obliged to depend, in a great measure, on native traders. A great deal had been said on the subject of domestic slavery and the proclamation of the Governor of the Gold Coast, by which, at one fell swoop, the whole social system of the people was to be upset. He was glad to find the view taken in the paper was rather deprecatory of too sweeping measures being taken on this difficult question. How were the magistrates to distinguish between a man's wife and his slave? In his time there was a certain recognised form of marriage, which consisted in the payment of a sum of money, so that the woman was at the same time a wife and a slave. How were such cases to be dealt with? With regard to the statement that had been made, that four times the amount of tonnage was sent out which was required to bring home the produce, he thought there must be some mistake, because it was both contrary to ordinary common sense and to his own experience. The climate had been spoken rather favourably of, he was afraid too much so, for he did not think the malaria of that part of the world was at all understood as yet, though, no doubt, an improvement had been effected since the introduction of quinine, and many lives had been saved. In his time, the favourite remedy was bleeding and cupping, and he had been several times cut in the temples with an old razor, a gourd being afterwards applied to act as a cupping glass. It had been said that the Africans were children, and so they were, but their infancy had lasted a long time, for they were pictured on Egyptian monuments of exactly the same type as at the present day, and were represented in inscriptions as ignorant, dull, and stupid. This showed, he believed, the impossibility of altering by a proclamation a social system which had existed for thousands of years. He quite agreed that the steps taken by the Government were in the right direction, but they must not be carried out with too much precipitation. In many parts the name applied by the slave to his master was synonymous with father, and the relationship which existed was often really quite of a family character. He did not think many of these domestic slaves would avail themselves of the advantages of the proclamation, but would remain with their masters if they were kind to them; but in the meantime, it would be well to consider if some plan could be adopted for utilising the labour of the slaves, by some system of apprenticeship or otherwise, before perfect freedom was bestowed upon them.

Sir John Glover said that during all the time he had spent on the coast of Africa, for nine and a-half years of which he was administering the Government of Lagos, he had been practically working out the question of the manumission of the slaves. He could not admit of any sophistry being introduced with regard to the differences between domestic and actual slavery. He was sure the time had arrived, and he said so when on the coast, when the system of slavery which had been in force up to a recent period, would become a thing of the past. It was quite a mistake to suppose that there was no ill-treatment of domestic slaves. Slavery, from its very institution, was a wrong, and neither the commerce of England nor the prosperity of certain merchants connected with the coast of Africa, would, he was sure, be allowed to continue such a soil to remain any longer on the British flag. It was quite a mistake to suppose that the slave would not gratefully accept the freedom which was offered him; and there was one answer to be given to all who were opposed to the sweeping proclamation which had been issued, viz., that free labour was going to produce from hundreds, nay, almost thousands of square miles of virgin forest, a return which slave owners had never been able to obtain. The slave only laboured to provide the means of subsistence for the family to which he was attached, but when he knew that what he worked for was his own, the results would be far different, and land as yet untouched would be brought into cultivation.

Surgeon-Major Rowe, C.M.G., said he had had occasion during his residence of 13 years on the coast, to pay a good deal of attention to the question of slavery, and he was quite confident that there as elsewhere free labour would be much more productive than that of slaves. The negro was quite willing to work for wages; he worked hard, and worked successfully, and he believed that in the end the commerce of England would be immensely benefited by the change. For the moment, possibly, some little disturbance of commercial relations might ensue, because such a change could hardly be expected to take place without, but he was quite sure that the emancipated slaves would produce much more than was now available for commerce on the Gold Coast. And probably a scheme would be carried out which would compensate the present slaveholders, by giving them some interest in the land which they had already partly tilled by slave labour, and which would recoup them any loss they might appear temporarily to suffer by being deprived of the forced labour of their slaves. Some disturbance might also result in our relations with the tribes in the interior, because it was scarcely likely that people whose very existence was bound up in the system of slavery, would at once feel very friendly towards a nation which entirely disapproved of it; but they would soon find it to their interest to be friendly, and when they found there was no other way of obtaining certain products necessary to their existence, but by carrying them through the English protectorate, they would find it to their interest to keep on good terms with us. All this was matter of arrangement and of time. The proclamation was not intended to meet every emergency, it merely established a general principle which would have to be carefully marked out in detail, and he had no doubt of the result being highly satisfactory, not only to the people themselves, but to British commerce generally.

Mr. Swanzy explained that he perfectly agreed with the principle of the proclamation, and with the necessity of abolishing slavery; he only deprecated too sudden a change in the state of society. His experience, however, and he believed that of everyone who had tried to cultivate land in Western Africa, was that it was impossible to obtain steady continuous labour. As he had stated on a former occasion, some members of his family, who had attempted to establish a coffee plantation, when it was declared that the pawn system was too nearly allied to that of slavery to be permitted, had been obliged to abandon it; and, in fact, an enumeration of the articles produced there would show that nothing was obtained which required the outlay of capital or labour beforehand. The negro would only work in such a way that he received the produce immediately; but if any means could be suggested by which this state of things could be altered and the amount of produce increased, British merchants certainly would not be interested to oppose it. One branch of trade which had greatly increased within the last few years was that in palm kernels, and he thought it quite possible that this would be stimulated by the women and children, whose occupation it was to crack the nuts and extract the kernels, receiving individually the results of their labour.

Dr. Mann desired to draw attention to one practical point arising out of the discussion, viz., that the term domestic slavery was, to a large extent, a misnomer. His acquaintance with Africa was confined to its Eastern border, over a large portion of which slavery existed in its blackest form, and was one of the greatest curses. In and around Natal, however, it was entirely unknown,

even amongst the wild native tribes, though what had been rather too loosely termed domestic slavery existed universally. Throughout that region the women were purchased, being generally worth about ten cows apiece; and having been purchased in that way, the woman became the absolute property of her husband. The men as they grew old and wealthy, purchased many wives, and these were kept in that state of subjection which was called domestic slavery. But there was one important fact to be borne in mind. Amongst all these tribes it was the custom, that when a woman had borne her husband three female children, she was free, if she chose, to go back to her own family, because the three daughters were considered a fair equivalent for the original outlay. But over the whole of the large district with which he was acquainted he had never once known that privilege to be exercised, and Mr. Shepstone, whose experience was much greater than his own, had never known an instance either; showing what a wide difference existed between this state of things and that which was properly called by that villainous word slavery. He did not put this forward as a recommendation of the system of buying wives and keeping them in this abject condition; on the contrary, he considered it a great evil; but still it was a minor evil, engrained in the habits of the people, which would be removed only by long and careful rule of a superior kind; and it called for very different treatment to the other and grosser evil, properly designated slavery. The only way in which it would be extinguished would be by the gradual introduction of better habits of life, as practised by more civilised nations, where woman rose to her natural dignity, and was not so depressed in the social scale. In all these eastern tribes he had found the women presenting the features of a distinct caste, being lower in organisation, and inferior in physical beauty and in mental power to the men, which he had no doubt was due to their degraded and subservient condition. In conclusion, he desired to draw attention to the remarkable fact, that the whole of Central Africa was peopled by barbarous races, which, contrary to the general experience of such tribes, were rapidly increasing in numbers. In Natal, during the time he had known it, the native population had increased from about 120,000 to more than 300,000, a very different state of things to that which existed in Australia and North and South America, where barbarous races were always found to melt away before the white man. This was a great fact underlying all our commercial, political, and missionary relations with the continent of Africa; and unless some means were found for turning this vigorous life into better channels, the evils now existing must necessarily become intensified, simply by the numerical increase of these barbarous tribes. He was, however, convinced from experience that such means could be found, and he believed that was the end which all men who turned their minds to this great country must keep steadily in view when working, as they did, not only for the present, but for the future.

Mr. Trelawny Saunders said he hoped that at last the attractions which Africa presented to European intelligence were being appreciated. Those attractions consisted in her teeming population and in her enormous productive power, which must, sooner or later, have an effect upon the industry and capital of England. But if English capital and enterprise were to be thrown with vigour into the African continent, the question whether we were to go there under the flag of our own principles or prepared to bend to the habits of the inferior races we found there was of great importance. For his part he hoped that whenever the attention of England was addressed to the commerce of the interior they would be equally in earnest in their determination to go there, acting on the same principles which guided their conduct in other parts of the world. On the one hand we were asked by African merchants who had been content to hang about the coast, and who could not be persuaded to go a day's journey into the interior, to sacrifice our principles, and to abandon the stand we had hitherto made against slavery, that we might make ourselves acceptable to these poor, benighted Africans; but in his view the only proper course was to go in as masters of the situation, and with a resolution turn to account, for their benefit and our own, the great natural advantages which the country possessed, and with a full determination to maintain at the same time the political, social, and religious principles which we have carried with us all over the world.

Dr. Mury said this question of slavery was one on which it was very easy to excite the feelings and passions of any English audience, but he had greatly admired the calm and reasonable manner in which it had been treated in the paper. It appeared to him there were three principal points to be considered. 1. Slavery. 2. Trade. 3. What ought to be the action of the English Government? With regard to slavery, there were two phases of it, wholesale slavery or slave-dealing, and domestic slavery; and with regard to the first, it would be only necessary for those who, like himself, had travelled much in Africa, to draw upon their experience, to paint such a picture as would harrow the feelings of an audience almost beyond endurance; and with regard to this crying evil England had but one course, to put it down with a strong hand wherever she came in contact with it. It was, however, not so easy a thing to put it down as it was to talk about it, especially when it was remembered that both the countries and populations of different parts of Africa varied immensely. The existence of the milder form of domestic slavery also created great difficulties. The credit system, which had been referred to, he did not think could be altogether abolished, as it seemed the only way of developing native commerce; but both for the purposes of trade, and also for the abolition of slavery, he believed one of the most effectual measures would be the introduction of English settlers into the district north of the Gaboon, where the country was healthy, and where a very superior race of people were to be met with. Constant communication would then be kept up with the coast, and the gradual improvement of the intermediate tribes would follow as the natural consequence.

The Chairman said:—The very deep interest which I have taken in this question for many years, makes me feel highly honoured by the position which I have been requested to occupy here to-night. I do not know that it is any breach of confidence to say, that I took the earliest possible opportunity of addressing the Secretary of State for the Colonies on the subject in a paper which was official, embodying certain recommendations. I say this, not to draw attention to anything which I may have done, but to give the best guarantee that I go with Mr. Hutchinson on the question that commerce cannot co-exist with slavery of any kind, and that I fully endorse, by my own personal experience and convictions, the policy of her Majesty's Government and the efforts of those who endeavour in a wise spirit to carry it out. Upon the termination of the Ashantee war, I felt that the best legacy I could leave to West Africa was the conviction which I expressed, that slavery in all its forms, social and domestic, must be at once finally extinguished. When in this Society we speak of commerce, we do not all speak as commercial men, although not losing sight of its advantages. It is not from any personal advantage you may hope to gain that you take up this subject in this philosophical Society. You come forward as men interested in the progress and happiness of the human race at large, and this branch of it in particular, but you cannot help seeing that commerce and reciprocity between nation and nation must, in fact, be the pioneer of all civilisation. I speak as one interested in the highest development of our dependencies; but I cannot shut my eyes to the fact, that no teaching of Christianity, pure and simple, can ever touch the mischief at work in semi-

barbarous populations, whilst it has to meet the antagonism of slavery. Christianity itself can lend but little support, and can receive but little, except on the conditions of freedom. You cannot get at the people except by a system of trade which must, first and foremost, be open and unselfish; and no system of trade can flourish where one portion of a population binds and hampers the working of the rest. I hold that while advanced civilisation is beyond the reach of semi-barbarous tribes you can obtain influence amongst them by no other means than by just trade; and even trade cannot be successful in this desirable result unless the producers and consumers are free. Indeed, the only point of contact between a nation like England and a people like the Ashantees is reciprocity of commercial advantages, and the only justification of invasion and subjugation of these or any other aborigines lies in the claims of justice and truth, and fair dealing. It seems a low ground to take, but it is not low; it is, in fact, the basis of all that is highest and best, so essential is commerce to the progress of Africa, and internal freedom and commerce are obvious correlatives. Trade stands to morals as matter to mind, and as the physical constitution of a man stands to his mental and spiritual welfare. It is the *corpus sanum* in which the *mens sana* of the community has to live and work. If the first law of healthy morals is to do to your neighbour all you could wish your neighbour to do to you, the nearer relations which subsist the more scope for its development. Establish relations of commerce upon recognised laws of right, regarding the native vendors and purchasers of your goods as placed all of them upon an absolute equality, and they will soon begin to see what equal law and justice mean. Trade, in fact, is the pioneer of civilisation and Christianity. But if the African peoples were to feel that the Imperial nation countenanced the possession of men, in order to obtain increased profits, commerce would fail in the object I have endeavoured to point out, and only engender principles of rebellion, which would lead to its inevitable failure and destruction. The possession of men as chattels is not to be mixed up with the possession of the goods obtainable by those very men's labours, and it is obviously impossible, at any rate for Englishmen, to countenance it on the Gold Coast now that we have assumed a more definite protectorate there. It is, in fact, not a protectorate if we do not protect the best interests of the poorest and weakest against those of the wealthier natives; so that the abolition of slavery was rightly the first act, and that which lay on the very threshold of intercourse with an advanced commercial nation like ours upon the close of the Ashantee war. It is the recognition of the fairness and equality of English law in commercial and other relations, reaching down to all classes of the community, which alone can penetrate and leaven the dark masses of those ignorant and benighted populations. It would be idle, and not altogether complimentary to pass over without notice the fact that at least a considerable number of those who are interested in West Africa are interested purely from the desire to advance Christianity. Looking at the question before us from their point of view, it is clear that the abolition of slavery will not only render the promotion of their principles more easy at the onset, by sweeping away the chief obstacle to progress, by opening wide the doors of sympathy, and by securing a ready ear for the arguments of the great truths which plant them on the human level. I may add, from a personal knowledge of the condition of the Negro, both in Africa and in Cuba, that I consider domestic slavery in Africa more crushing and demoralising in its effects than the same system pursued in Cuba. The difference is, that in Cuba the slave is trained to habits of industry and usefulness, is better treated, attains a higher degree of intelligence, and in time becomes of more value to himself and the community. On the other hand, in Africa, the negro as a domestic slave is comparatively worthless, because his energies are left almost wholly unproductive. Whatever palliations may be alleged where blacks are the slaves of a race superior in other respects than in strength, there certainly are none in such a case as that with which we have to deal in West Africa. I fear slavery has somewhat spoiled the picture drawn by Goldsmith of the happy savage:—

> The naked negro, panting at the Line,
> Boasts of his golden sands and palmy wine,
> Basks in the glare, or stems the tepid wave,
> And thanks his gods for all the goods they gave.
> Such is the patriot's boast, where'er he roam,
> His first best country ever is at home.

It is to give Goldsmith's negro a true home, and elevate his idea of home, that we sweep off the curse of his home by giving him commerce as a basis of freedom, and insisting on freedom as a basis of commerce.

The vote of thanks was passed unanimously, and the proceedings then terminated.

ELEVENTH ORDINARY MEETING.

Wednesday, February 24th, 1875; Captain Sir JOHN HERON MAXWELL, Bart., R.N., in the chair.

The following candidates were proposed for election as members of the Society:—

Atkinson, George, 66, Aldersgate-street, E.C.
Austin, Henry Felix, 125, Bermondsey-street, S.E.
Blood, William, East street, Crowland.
Bly, J. Henry, Great Yarmouth.
Buist, A. J., Broughty Ferry.
Caldicott, J., 24, Wood-street, E.C.
Caldicott, T. P., 24, Wood-street, E.C.
Hunt, John, Hope Works, Communication-row, Birmingham.
Leney, Charles F., Phœnix Brewery, Wateringbury, near Maidstone.
McPherson, James, Savannah, Georgia, U.S. America.
Mawle, J., Banbury.
Sandford, F. Vavasour, M.D., Hammam-chambers, 76, Jermyn-street, S.W.
Saunders, James Ebenezer, F.R.I.B.A., 9, Finsbury-circus, E.C.
Scott, Sir John, K.C.M.G., 21, Kensington-park-gardens, W.
Wood, Christopher, Bunscall, Chorley.

The following candidates were balloted for and duly elected members of the Society:—

Ashworth, Taylor, J.P., Sunny Bank House, Shelton, Stoke-on-Trent.
Benskin, John P., The Cannon Brewery, Watford.
Drummond, Dugald, North British Railway Company, Cowlairs, Glasgow.
Glydon, William, Spring-hill Metal Mills, Birmingham.
Greener, Thomas, Benton-lodge, Darlington.
Harris, Underwood P., Surrey-villa, Tufnell-park, N.
Hough, Captain George, 2½, Ingram-court, Fenchurch-street, E.C.
Lamb, James, John Dalton-street, Manchester.
McNiel, Henry, 39, Market-street, Manchester.
Mason, David King (Consul for Siam), 5, Great Winchester-street-buildings, E.C.
Munro, George McKay, London, Brighton, and South Coast Railway, Brighton.
Nicholson, John, 59, Wells-st., and Vicar-lane, Bradford.
Player, J. Hort, Phosphorus and Chemical Works, Oldbury, near Birmingham.
Robinson, Thomas William Usherwood, Houghton-le-Spring, Durham.
Stockinger, Franz, Austrian Consulate, 29, St. Swithin's-lane, E.C.
Swanton, William, London Salvage Corps, 65, Watling-street, E.C.

Walmsley, Thomas, Brooklyn, Bolton-le-Moors.
Warwick, John Francis, 5, Castle-gate, Newark-on-Trent.
Williams, Francis, Messrs. D. F. Taylor and Co., Newhall Works, George-street, Birmingham.
Wright, Howard, Phœnix-lodge, Chapel Allerton, near Leeds.
Yarde, Giles, 60, Lamb's Conduit-street, W.C.

The adjourned discussion on Capt. Bedford Pim's paper on "The Mercantile Marine," was resumed on Wednesday evening, February 24th, Capt. Sir John Heron Maxwell, Bart., R.N., again occupying the chair.

The Chairman, in opening the discussion, said the two main points which had been kept in view were the ships of the mercantile navy and the seamen who manned them. He would not state his own views until the close of the discussion at the ensuing meeting, but he could not disguise from himself that there was a scarcity of sailors, and in this view he was supported by Admiral Sir J. Milne.

Mr. E. N. Hudson wished to make a few remarks on a matter which he thought had been only cursorily glanced at, and that in the speech of Mr. Norwood, the subject of the advance note given to seamen before entering upon their voyages. He said—The advance note is but little understood by persons outside the shipping community, and it has been charged with being the parent of manifold mischiefs, not only to the mariner, but to the ship-owner, and by a natural reflection to the whole commerce of the country. This idea is perfectly erroneous. The nature and incidents of the advance note, and the purposes it is intended to, and does, subserve, are not generally understood. It is assumed by those who are not at all, or but partially acquainted with it, to be the source and origin of many and great evils to the sailor, to lead to dissipation and extravagance on his part, to be a fruitful source of injury to the ship-owner, and a tax and incubus upon the maritime commerce of the country. No conclusion could be more false than this. The advance note given to seamen is not only a just and equitable arrangement between owners and seamen, but is the only means by which crews can be secured for ships sailing from the ports of this country. An advance note is an obligation entered into by the captain of a ship before starting on a voyage, by which he engages on his owner's behalf that three day's after his ship leaves—say the Downs—if the seaman has joined the ship, and is duly earning his wages to pay to his order a month's pay, which we may take for an A.B. to be £3 10s. Now for what purpose is this given? It is to enable the seaman to procure the outfit necessary for him to enter upon the voyage, to pay any indebtedness he may have, and to leave the port of his departure with the feeling that he had discharged his debts and leaves his home as an honest man. The kit and effects of a seaman cannot be detained by a boarding-house keeper for a debt due to him; a sailor having entered himself on board a ship and requiring his effects, can apply to a magistrate and a peremptory order will be made to deliver them up, leaving the man who had trusted him without any remedy except the sueing him whenever he should return. How different is this to the position of any other class. If I go to an hotel and contract a debt for board and lodging, my luggage and effects are in the hands of the landlord, who has a lien upon them for my debt, and cannot be compelled to part with them until that debt is discharged. To the honour of the seaman I cannot remember any instance in which such a privilege has been claimed. With the most scrupulous honesty, however, if the advance note is abolished, as it is sought to be by the Bill now before Parliament, it must result that the sailor cannot fulfil the engagement he has entered into, and must proceed upon his voyage a defaulting and disgraced debtor. Is this desirable, and are we, while admitting his many failings and weaknesses, prepared to add this ignominy to his charge? But if we are, how will it then stand with him? There seems to be an impression amongst those who would legislate without knowing, or perhaps caring anything about the matter, that they would remedy all the evils to which the seaman is liable by simply abolishing this particular document. Still, faith is the parent of credit, and without this security for fulfilling his engagements the sailor could not obtain credit for any of his requirements when on shore. It may be asked, "Why should he resort to credit? Does he not come home with a pocket full of money? Should he not then take care not to incur debt? Should he not, as a first step, provide himself with the necessary outfit for a new voyage? Should he not then place the remainder of the money he may possess in a savings bank or other place of secure custody, and, long before it is exhausted, should he not obtain a new employ, and go again to sea, as an independent and honourable member of society?" Undoubtedly he should do this. We all should do many things we do not do. Remember the peculiar and trying circumstances of the sailor's life. For months of his existence he is imprisoned in a ship with poor food, miserable accommodation, no society except of those as uninstructed as himself, subject to various and constant perils, and holding his life in his hand from moment to moment, happy, if he make a port, that at least for the time he has escaped destruction, but longing for a little relaxation from his toil, a little respite from danger, a little indemnity for all the privations he has endured; without education, with no acquaintance with the refinements of life, with no domestic ties to bind him, with no kind or judicious friend to counsel or direct him; with every inducement held out to him to enjoy his recovered liberty in pleasures, as he understands them, that we cannot comprehend and much condemn; with harpies and profligates of both sexes waiting at the very door at which he is discharged from a terrible restraint, and offering to his lip the cup of pleasure, low, sordid, and sensual, if you will, but still complying with his idea of what constitutes enjoyment; can you wonder that he is not a paragon of goodness, or that he does not exemplify in its highest type and expression the ideal of human virtue; that he does not prudently set aside some portion of his hard-earned wages for a future need; that he will drain the cup of indulgence to the dregs, or that until his means are exhausted he does not seek fresh employment and again, while risking existence, incur the certain privations of life on board? I by no means intend to, nor could I with any truth, assert that advance notes are free from objection, or that it would not be infinitely better if sailors did not, by resorting to them, anticipate their future earnings. The question is, however, can they be entirely dispensed with? With confidence I say "No." Advances in some shape or other must be made to the mariner before he is capable of going to sea in a condition of efficiency for the performance of his duties. The advance note is condemned to extinction for its assumed vicious operation, but singularly the evidence taken before the Parliamentary Commission is of the most meagre and inconclusive description, and not a vestige of proof or a shred of argument supported by fact has been adduced to justify the conclusion arrived at. Not only then is the note to be summarily abolished, but the master or owner is, by the operation of clause six of the proposed measure, prohibited from making any advance in any shape whatever of unearned wages, that clause stating distinctly that no such money or other advance in respect of wages not actually earned shall be deducted from the seaman in paying him off. It happens but too frequently that a man is landed at a port a destitute castaway, without a stitch of clothing except what he stands upright in

without a farthing in his pocket. Suppose he can at the instant procure a ship, and that the sufferings he has endured have not rendered him for the time physically incapable of duty, how is he, if this Bill become law, to take a berth and go to sea? Again if, as is most probable, no immediate employment offer, how is he to live? Under the existing system, with all its blemishes, he has a refuge readily offered him by the keeper of the boarding house, who knows that the man will receive an advance of pay out of which he will be satisfied for the necessaries he has supplied him with. It is said that the advance note is an injury to the ship-owner. Sedulously endeavouring to find an instance in which it can be so, I have discovered a blot and will place it before you frankly and fairly. I now read you an advance note:—

ADVANCE NOTE.

£ London, 187

THREE DAYS after the Ship
leaves pay to the Order of
(provided he sails in the said Ship and is duly earning his wages according to his agreement) the sum of
Pounds Shillings, being Months' advance of Wages.
To Master.
Payable at

The Seaman must write his name on the back hereof; by this act he will understand he is conveying to another the value of the Note. If he cannot write, his mark must be attested by a witness not the discounter or recipient.

N.B.—The Seaman must join the Ship at the time appointed, or a substitute will be engaged.
Ship lying in Time to join

The payment of this document is, you observe, entirely contingent upon the seaman not only going on board, say in the port of London, but proceeding to the Downs, and being on board and earning wages three days after the ship leaves that place. Now comes the blot I have adverted to. It may be easily conceived that a ship has passed through the Downs, the note has been paid according to its tenour, and the vessel has afterwards, say on the fourth day, had to put back into a channel port through accident. The seaman, of course, knows that his advance note has been collected, and it is possible that he may refuse duty and be willing to undergo imprisonment with hard labour for twelve weeks; but I put it to you, is it likely that this would be a frequent occurrence? At a large meeting of seamen held on Saturday last, to adopt a petition to Parliament, which was presented by the honourable member for the Tower Hamlets on Monday last, the greatest enthusiasm was shown in favour of the retention of the note, and the strongest determination expressed to insist upon it before shipment. Strikes and trades unions are now causing a great deal of uneasiness in the minds of capitalists, and indeed of the entire public, and I feel reason to apprehend that if this Bill should be passed in its present shape, the whole maritime commerce of this country will be paralysed, its trade directed to foreign bottoms, the supplies of food borne over sea be greatly diminished, and a general dislocation of our industrial machinery be at least temporarily accomplished. Upon the whole, after a good deal of reflection, I have come to the conclusion that advances in some shape or other must continue to be made, and I believe the evils complained of may be removed, the contingency I have described be excluded from calculation, and a valid document free from defect be substituted for the present illegal advance note; and I for one shall hail with satisfaction a change which will be alike for the benefit of hand and owner. On the special matter on which I have ventured to address you I have done. As to the general question before the Society, I have briefly to say, I leave the seaworthiness of ships and all that constitutes it to the better instructed minds of gentlemen who, fully possessed of the technical aspects of marine architecture, have so ably expounded and enforced their views; and if they appear sometimes to be at issue, I believe, out of their varying opinions, we shall at last reach a safe and practical unity. With respect to the seaman, however, who is the object of my most ardent interest, I implore you to give the circumstances of his condition ashore your earnest attention, ameliorate as far as is possible the privations to which he is exposed at sea, treat him as a dependant, and on the whole a deserving brother man. Take care that the ships in which he does such useful, such noble, and such indispensable service to you and his country, shall be well found in all that is really essential to his comfort and safety, and to the dignity of our common nature.

Mr. Temple said it was hardly necessary to deal in any detail with Captain Bedford Pim's paper, as it had already been so ably answered by previous speakers. In response, however, to a request from the Chairman, he had brought with him two scales of provisions, one that in accordance with which they victualled their crews at present, and the other one which they attempted to introduce four years ago, and which he considered the better of the two, but they found the sailors, who were generally somewhat conservative in character, objected to it on account of several articles being introduced to which they were unaccustomed. These scales he would hand to the Chairman, and they might be published if thought desirable. He might add that his firm did a large business in provisioning ships, and substantially the first scale was that generally adopted in long voyage ships. Passing on to a few remarks on the Board of Trade report as to the loss of his firm's ship the *Cospatrick*, the main gist of it appeared to be that there should be in all emigrant ships a hardwood bulkhead to separate the crews; but it was added that in iron ships this was not necessary, because the collision bulkhead served that purpose. With reference to that, he must say he regretted that amongst the nautical assessors there was not included a Government emigration officer, because he would have been aware that the charter-party, under which they conveyed Government emigrants, compelled them to carry an amount of coals which in an iron ship could not go into the collision bulkhead, so that, as a matter of fact, a portion was always carried in the fore-hold. It was the practice of his firm to use this collision bulkhead as the boatswain's locker, and considering that many of the boatswain's stores were of an inflammable nature, he thought this plan much preferable to using it as a coal-hole. And their reason for not using it for the latter purpose was, that in their ships they had the valves used in connection with the distilling apparatus, so that in the event of any accident happening the water should not get into the ship itself. This, however, necessitated leaving the place comparatively easy of access. If the ingenuity of shipwrights could devise a bulkhead which would prevent the access of the crew into the main-hold, it might also invent some kind of iron hatch, which, if properly locked, would be equally effective. One other point which came out seemed worthy of notice. It seemed assumed by the Board of Trade in the instructions given to their counsel, that the owners, the crew, and the passengers of the ship were almost certain to have done wrong, but they seemed to lose sight of the fact that the vessel contained nearly 1,000 tons of general cargo; or to assume that the shippers of the cargo were perfectly innocent, without admitting the possibility that the contents of the packages differed in any respect from the declaration made at the Customs. Now, as a ship-owner, he should have been very glad if the shippers of the cargo had been summoned and compelled to produce their invoices, so that it might have been clearly ascertained that the ship contained nothing beyond what was reported to the owners. It was obvious that many hollow articles were capable of holding other goods inside. The law with regard to passenger ships was so strict that many articles were positively forbidden, and sometimes for months together there was not a ship on the berth open for such goods, and the consequence was that they were

often sent surreptitiously. Therefore, he thought any further legislation, such as was called for in some quarters, limiting the discretion of owners, would do more harm than good. He had previously lost two ships by fire, the cause of which was in each case shown to be spontaneous combustion—in the one case arising from compressed hay, and in the other from New Zealand flax. He much regretted, therefore, that, as in two cases out of three the fire had been traced to spontaneous combustion, there had not been an opportunity afforded in the third of ascertaining what was the real nature of the cargo on board. Then what ought to be done for the future? One of the principle things was a large increase of boat accommodation; and it was proposed that the Act of Parliament should limit the number of emigrants to the amount of boat accommodation. But it was quite erroneous to suppose that that was material to the ship-owner. It was simply a matter of price—at least speaking as regards the long sea voyage to the Australian colonies—it was, he knew, nothing as to other voyages—but broadly on a voyage to New Zealand the difference of carrying two hundred instead of four hundred emigrants would be something less than £2 per head. But he would venture also to ask, would the effect of limiting the number of emigrants in this way be beneficial to the emigrant, and would life be thereby saved in the event of an accident? He rather doubted it, for it was impossible to be certain that some of the boats might not be lost in a gale, as had been the case with one of the life boats which was washed ashore from the *Tintern Abbey* before that ship really left the Channel. He held in his hand a letter from the captain of the ship *Samuel Plimsoll*, which was dispatched from Plymouth with 331 statute adults—he did not know how many souls—in which the captain gave an account of the loss of four of her boats, she having six on board when she left; so it would be seen that although they might limit the number of emigrants to the boat accommodation, it might not result in a greater safety to life. Then there was a recommendation of the Board of Trade surveyors that the boats should be always carried keel down, and although in reading the report of the *Cospatrick* inquiry, it might be imagined that it was the other way in her case, the fact given in evidence was that there was only one keel uppermost. His opinion was that when a ship shipped a sea, if the boats were keel down, the water would fill them, and there would be a greater chance of the boats splitting up and being lost. His opinion was that if they wanted to secure the greater safety of emigrants they would best secure that by making the ship herself safe, and not simply the boats or rafts. Then, as regarded the extinction of fire, the Act required that each ship should carry a fire-engine which should have the capacity of throwing not less that fifty gallons of water per minute. That was all the Act required. But on board the *Cospatrick* they had another fire-engine on the forecastle, and yet they could not prevent the fire. He had asked some hydraulic engineers if they could not devise some species of engine on the principle of their centrifugal pump, which would be more efficient, not only in the case of a leak, but also be more powerful as a fire-engine, and he was happy to say that they had made a pump which would throw a very much greater quantity of water, and that to a far greater height, and in future all their ships would be fitted with it. Of course, after the loss of the *Cospatrick*, their firm was deluged with applications and suggestions from inventors for the safety of life at sea, which, though it would be possible for a public body like the Society of Arts to discuss, yet it was utterly impossible for private individuals to go into. But out of all that were brought to their notice there was only one of practical utility that he had gone into, and that was a smoke respirator, which he had seen in operation at Westminster, and which acted very efficiently; for it was clear that if by any means they were enabled to go into the densest smoke they could get nearer the fire, and so might better put it out in its earlier stages. The next matter he would refer to was that regarding the regulations for the ship. They had drawn up a set of regulations which he believed would very efficiently meet the wants on this head, and though he would not trouble the meeting by reading the whole of them, he would venture to hand in a copy of them, and only specially refer to one. In their ships they intended to make it imperative that all the regulations should be strictly carried out. There were regulations as to lowering the boats, as to the fire-engines and hose being prepared and got out every night, as to the provisions and the water being left in the boats and being changed every week, and more particularly as to an efficient fire brigade on board composed of the crew and of the male emigrants who should become members of it. It was stated in the House of Commons last night that it was impossible to enforce this last condition, as nothing could bind the emigrants to do this. But he believed it was quite possible to carry out this particular clause of the regulations, and if necessary it might be embodied in the articles, at all events they meant to try the experiment.

Mr. Frederick Wood thought the discussion had become very desultory, and of little profit, for they had wandered into so very many questions. They had before them the question of measurement, the survey of ships, the prevention of overloading, the condition of seamen, the provisions they had to eat, the pay they received, the treatment they met with, and a variety of other topics had been started to-night, such as the prevention of fire, and the question of the advance note. On some of these questions he did not intend to touch because he was not competent to give an opinion; but on the question of tonnage he felt he was, and though he had read the letter of M. de Lesseps, he thought there was but little in it, for he would naturally approve of any system of measurement which would increase the tonnage, and consequently the cost of a ship going through the Suez Canal. As to the observations which had been made, that these were not matters that ought to be made the subject of legislative interference, he would reply that they never thought of leaving the question of the fencing in of machinery, or the arrangement of mines, to be dealt with between master and men, or the construction of a building to the whim of a purchaser and builder, but made them the subject of legislative enactment; and he did not see why they should not make the safety of life at sea a subject of legislation. But the laws that had been passed on the subject were amply sufficient for the purpose, and though they might not always have the effect of binding an unscrupulous owner, yet such instances were very rare, and the present law went quite far enough if the British ship-owner was to compete with the foreigner, for if the law were too tightly drawn, it would be like running a race in fetters, and they could not possibly win. On the question of the pay and condition of seamen he could speak with some confidence, having been connected with five mercantile marine offices. Their condition had been one of gradual but steady improvement, and as to their pay, he fully corroborated what had been said by Mr. Norwood. It was infinitely superior to men working on shore, and had been gradually increasing, and was now 15s. a month more than before. It was not due to any trades union, or anything of that kind, but the real reason of its improvement had been the opening of the Suez Canal and the great increase of British shipping, especially since the commencement of the telegraph cable service, which was an entirely new employment, and a much better paid one. The increase was permanent, and had never been so high before except in war time. As to the provisions, they had always the power of calling for a survey, and on most respectable ships he knew more was issued than was in the ship's articles. On the question of accommodation

he had had complaints, but there was a vast improvement in this respect, since the owner had been allowed to deduct it from the registered tonnage, for he had now no interest in doing otherwise than providing for the welfare of the seamen. He had shipped in a given time for one office 1,769 crews—not men, but separate and distinct crews—and of all these he had but one complaint of accommodation, and that complaint was a just one. The men were generally satisfied before the ship went away. It had been said that these things were not discovered till after the ship had started, but he had made particular inquiry at Gravesend as to this, and had heard no complaints there. On the next topic which had been much discussed—that of the deterioration of seamen—he held a very different view from many of the speakers. The deterioration of our seamen had been the cuckoo-cry of all ages, and went so far back as the time of Homer, who complained 3000 years ago of the deterioration of sailors, and he must say he never knew a veteran, with perhaps one or two honourable exceptions, who did not say that the service was going to their ghostly enemy. He had no doubt it was so always. There might sometimes be a difficulty in getting good men, but it was not often the case, as any one might see who would go to the offices of the Mercantile Marine at Tower-hill. Of course they might also see a few loafers, but only a few. Let them be equally just to sailors as to ship-owners. More was expected of a sailor now than forty years ago, and it must not be forgotten that there was a great deal of difference between the strength of a crew old style and new style. The next point raised was the exclusion of foreigners. What was a foreigner? Mr. Norwood had said they were one in nine, but the petition which had been brought before them said they were one in four. How could this be? A foreigner, according to the jurists, was one who owned no allegiance to our flag; but the sailors who drew up that petition put in Lascars, West Indians, Heligolanders, and Maltese, whereas these were not foreigners. The Peninsular and Oriental were the chief offenders in this matter. They had manned their ships chiefly by Lascars, which arose, as a gentleman had explained to him, from absolute necessity, when their own men refused to go to sea. It was purely a matter of self-defence that they adopted the system of having Lascars. There had been a scarcity of men, commencing some years back, but that had been met by the admirable institution of training ships, such as the *Worcester*, the *Warsprite*, and others. As regards some of Captain Toynbee's suggestions, he was exceedingly sorry to differ from that gentleman. They had been described as good. He would take the liberty of saying they were "goody;" and no plan such as Captain Toynbee suggested would work, and if it were subsidised by Government to the extent of one half even, it would never pay. As to the renewal of the navigation laws, that would come when they re-enacted the corn laws, and when the good ship Britannia reversed her engines and began to make backway. On the question of a certificate and examination, he would remind them that three examinations were required for a captain's certificate, and to submit the men to any such system would be simply to revive the old register ticket, which had long since gone by. There were some able men who never could pass such an examination, such as the men who came from fishing smacks, and yet they were most thoroughly efficient and useful in that branch. As to what had been said about the Mercantile Marine Office, he believed it was a most useful office, where a seaman could go and have all his grievances, real and unreal, settled. It could be made an engine of oppression and mockery, but generally now it was not so. Formerly it was filled with retired ship-owners, and the sailors were not satisfied that in some questions referred for arbitration that their arbitrators were unbiassed, and of course confidence was lost. But that was not so now. In conclusion, he could say that the condition of seamen was steadily improving. They might smile at their ignorance on such questions as political economy and so forth, but they did not utter the facts. They ought to regard as much the prosperity of a seaman as the welfare of a ship-owner. They were bound together, and if the ship-owner was to be crushed the seaman must fall with him, and then must fall our glorious navy.

Mr. M. Dipnall said it was admitted that the subject of the mercantile marine was not a shipowners' question, nor an underwriters, nor a seaman's only, but of travellers and emigrants, and in these days of Cook's excursion tickets, he might even say excursionists. It was to the subject of human life rather than the protection of property that he would therefore address himself. On the question of tonnage he knew nothing, but on the question of construction he would say that ships built ten or eleven times the length of their width could not be normally safe. That opinion had been given by Sir William Fairbairn close upon the loss of the *Atlantic*. The model on the table was seven times the length of the width, and they could see how narrow it apparently was, and if they stretched that the length of three widths more they would see how narrow she would be. The *Atlantic* was 420 feet in length, that is to say, if she stood on her stern her fore-foot would reach the cross of St. Paul's, and she would be twice the height of the Monument. If a ship of that length were made of iron, strong enough to be perfectly rigid in a beam sea, or fore and aft sea, she would still be such a depth of immersion at starting that she could not have a cargo carrying capacity to make her pay. Constructors had a good deal to consider in regard to the length of ships. Steamers were the chief sinners in this respect, and not sailing vessels; but on the question of the deep load line, sailing vessels he thought to be rather the sinners than the steamers. It was true that steamers often started with a deep load line, but they lightened as they went. A gentleman from Lloyd's had stated at the last meeting that marine insurance was to some extent the cause of disasters no doubt, and that if in every case a person was his own underwriter he would take care of his ships. And he went on with some further remarks that legislation would be the best thing for underwriters, as it would then be so lucrative a business he supposed everybody would be going into it. He then proceeded to say that he could adduce scores of policies which were marked "warranted not to be shipped in ——— and ———'s ships," or "——— and ——— Co's. ——— limited ships." They knew them and they could take care of them, and they were perfectly able to look after these men, he said. Now he (Mr. Dipnall) would ask if there were such persons, why was not information given whereby such ships should not be permitted to go to sea at all. This was a most serious question. The real principle of marine insurance should be that of an equitable society, where it was everybody's interest to look after the interest of the others and see that they were honest. It was here confessed that a large number of ships were known to gentlemen which could not be insured.

Mr. Young said he did not say ships, but ship-owners.

Mr. Dipnall was obliged for the correction, but it landed them in the same position he thought, for ship-owners must have ships.

Mr. Young observed that it could not be discovered till after the ship was lost and the damage done.

Mr. Dipnall said it still left the matter very serious. Much had been said during the discussion regarding the loss of British ships, and that it was not so large comparatively. He would venture to remind them that with 22,000 sailing vessels and 22,500 steamers, the marine disasters of 1862 were, that 2,682 ships were totally lost, and that of these 1,310, or nearly one-half, were British. There were 240 steamers lost, and

of that number 142 were British, making a total of 1,452 British ships alone in one year. That represented a loss of life and property at sea perfectly appalling. He had read the report of the Commission, and he could only say that much of what was suggested would become simply a question of freight and price, and they knew that it would come out of the consumers pocket, and therefore, although it had been said this was only a ship-owner's question, with which they ought not to interfere, to his mind it was prominently a public question. Then he would have the status of the commander much improved, and make it necessary that they should have a University degree. He then described the condition of sèveral vessels which had been sent to sea in an unseaworthy state, one of which was making three or four inches of water when she left the Clyde. For that case the captain had his certificate suspended for six months because the ship was not saved; but he thought it should have been for attempting to take a ship to sea in the condition she was. Only an improved education and status would enable commanders to act with judgment and independence in such matters with ship-owners. He then referred to the case of the *De La Warr*, which met with an accident three or four days after she left Liverpool, owing to having been lengthened without her steam power being increased proportionately; to the *Agincourt* and the cause of her loss; and to the Peninsular and Oriental ship *Rangoon*, which had struck on a rock at Point de Galle. It was perfectly awful the loss of life and property which ensued from these calamities. He would suggest, as the main point to be kept in view by the committee, the raising the standard of education amongst naval commanders; because the position of the captain of a large ocean-going passenger ship was really one of tremendous responsibility. He was the lawgiver and magistrate for all on board, and something should be done to improve his education and social status, so that in case of any emergency he would be able to rely on his orders being implicitly obeyed and carried out by everybody. In fact, he could not imagine a more responsible position. He was glad to see that in the examinations at the Greenwich Naval University something had been done for merchant captains, because a limited number were to be admitted as students, and the courses of lectures were to be open to officers of all grades. Still, he felt that the mercantile navy crept in rather through a door left a little ajar, instead of marching in boldly through one which was thrown wide open, as he should like to see it, feeling convinced that only good would result from captains in the Royal Navy and in the merchant service meeting together, and learning from each other the results of their varied experience. He saw in the *Times* that the revenues of Greenwich Hospital, which were very large, were about to be applied to excellent purposes; and the establishment of this naval college was certainly a point of great value; but he should like to see it thrown open fully to the whole mercantile navy; and he hoped the time would come when no man would be allowed to command a large passenger ship who had not taken a degree at that or some similar college. He found that out of its great income, £4,000 per annum was to be allocated for pensions in the merchant service, and they also had the advantage of the hospital. The latter, however, was not exactly a boon given to the merchant service, since the *Dreadnought* hospital ship was open to all the world; and the £4,000 a-year was not so very much, considering that for a century the whole merchant service contributed to the funds of the hospital, receiving nothing in return.

The Rev. J. Scarth said he had been engaged for some years in a work which brought him in contact with nearly all the sailors in the port of London, and he would suggest one or two practical points to be kept in view before attempting any further legislation. One was that you could never get a really good mercantile navy until the same plan was adopted as in her Majesty's service, of apprenticing boys from training ships to the vessels which they joined. Captains generally complained of the boys they had on board, and too often they were sent adrift on reaching their point of destination; but this could not be done if they were apprenticed. With regard to sailors on shore, if there were any legislation on this subject at all, boarding masters and runners of all kinds should be registered. Very frequently before getting alongside a ship, he could tell in what state he should find the men, simply because he knew of the sympathy and care shown by the owners, captain, and officers. If owners would only follow the good example set by some of their class he was convinced that merchant seamen would soon grow into a set of men as good as any in the Royal Navy. He could quite bear out what had been said by Mr. Wood and others that the character of the men had not deteriorated, though their *physique* might; from ten years' experience he could say that the character of the men was gradually and steadily improving, whilst that of the officers had changed entirely. They were now a splendid set of men, deeply interested in the sailors under their command, and for the most part taking an interest in their spiritual as well as in their temporal welfare. It would be a great thing if owners would enable their masters to pay off their men and send them home immediately on arrival, but he could not say that sailors were in the habit of complaining, either of their owners, their accommodation, or their provisions.

Mr. Biddle said that though now connected with the press, he sailed out of the port of London in 1860 as an apprentice, and since that time, until a few years ago, he had served in the British and American mercantile navy, so that he was able to speak from practical experience. He apprehended they were not met to take sides one way or another, neither to advocate sailors at the expense of owners or *vice versa*, but to consider what could be done by wise legislation to improve the condition of matters. He did not advocate further interference by the Board of Trade, but such legislation as had been pointed at by Captain Pim. The Board of Trade had been at it ever since 1854. Act after Act, and clause after clause had been passed, the last issued being an immense Blue Book, which no one could understand. He thought there need be no more risk in travelling by sea than by land, because ships might be constructed which would set at defiance the utmost violence of the winds and waves, as had been proved in the case of light-ships and many others. Mr. Plimsoll had been accused of exaggeration, but the fact was he had not told half the truth. For instance, he had sailed from London in a ship with 26[illegible] emigrants on board, and the captain would not allow the pumps to be touched until they got clear of the Channel, and then there were 3 ft. 6 in. of water in the hold. There was no doubt losses at sea could be prevented by legislative interference to a very great extent, but such interference would probably end in throwing our trade into the hands of foreigners.

Mr. Graves said the flag under which they were [illegible] was, he imagined, described by the motto which he used to hear as a boy before he ran away and went to sea, *salus populi suprema lex*. He had heard it suggested more than once that if certain alterations were made in the law, British owners and masters would put their ships under foreign flags; but the fact was they could not do so without being naturalised abroad, and submitting to all the internal polity and regulations of the country which they selected, and he did not think they would be very anxious to do that. If, for instance, they chose Germany, they would be called upon to serve either in the Landwehr or the Royal Navy, and this he apprehended would prove an insuperable objection. He knew the character of British seamen, and though he was not going to foul his own nest, he must admit that at the present moment there was something rotten

the state of Denmark. This was shown by the report of the Judge of the Court at Shanghai a year ago, in which he wound up by saying that his office had become the most unthankful which anyone could hold under the Foreign Office; and not very long ago, when he reached New Orleans, with a thoroughly well-affected crew, they all came aft, wished him civilly good-bye, and walked off. After referring to the difficulty of getting landsmen in Liverpool, and the necessity for taking foreigners, though this was a thing he disliked on principle, he said there had been great complications lately between the home authorities and those of the colonies with regard to the custom of engaging men for the run out only to Bombay, Calcutta, Singapore, and Hong Kong, and discharging them on their arrival. The masters could not keep the men on board because their contract had expired, but the local authorities would not allow them to be put on shore because they had not sufficient money coming to them to provide for their accommodation in the Sailor's Home. A long correspondence had taken place on this subject, and he remembered great difficulties having occurred at Hong Kong about it, the result being that about three hundred men had to be taken off in a man of war. He found in the Shipping Act Amendment Bill a provision that sleeping on watch was to be made a misdemeanour, to be entered against the culprit in the captain's log, and followed by punishment on arrival at home; but he considered such a regulation absurd. He would defy any man to go to sleep during his watch in a ship under his command, because if the captain and officers worked in unison together such a thing would be out of the question. The officer of the watch would not stand on the quarter-deck or the bridge and shout, but would walk round and talk to the men, arouse their intelligence, and try to elevate them. A captain ought to act as a father to his ship's company, not score up all their faults in his log and drag them off to a magistrate at reaching port. The great thing was to elevate the position of the master, and educate him; and this was all the more necessary because it was evident that England was about to run a race with one of the greatest Powers which was ever seen in the world—a Saxon Power, of kindred race to herself, and one whose practice it was to educate all her people, and to do so on first principles. This was the great thing wanting in education for the navy, to lay down a solid foundation in those principles of spherical geometry on which the whole science of navigation was based. This had not been properly attended to, and great evil had resulted. With regard to advance notes, there was a column in shipping articles in which the advance was entered, and when the account was made up by the [illegible] or the shipping officer, that was reckoned as so much to be deducted from the balance due to the sailor. But it might happen that when he got home, the person to whom he had paid the advance note on leaving would inform him that it had never been paid, the broker's answer being that he had no funds, and poor Jack's only remedy would be by civil action against the owner. He contended that the Board of Trade, by allowing that column in the articles, legalised the advance note, and made itself responsible for enforcing its payment. Recurring again to the subject of education and compulsory examinations for a master's certificate, he complained that foreigners were allowed to pass such examinations without having served the stipulated time on board an English ship. This was a great hardship on English [illegible]; and in the words of an article in the *Nautical [illegible]* for 1861, "To grant a foreigner a certificate [illegible] through a sham sale, he has put his ship [illegible] a British flag, is suicidal. You put an instrument [illegible] his hands which, should any rupture take [illegible] between his country and ours, makes him an [illegible] and a spy at his pleasure." He had [illegible] overtures during his life to forsake [illegible], but he could never consent to be a renegade, nor did he see why a foreigner was to be admitted to share in his birthright. He considered an English ship to be an integral part of the country, and that it was indecent and improper for her to be commanded by a foreigner; though it was quite possible for this to be the case even though the man in question did not know a word of English.

The discussion was here adjourned to Wednesday evening next, March 3rd, at 8 o'clock.

MISCELLANEOUS.

THE NEW PATENT BILL.

The following is an abstract of the provisions of the new Patent Bill, given in *Engineering* last week:—

Clauses 1 to 4 are preliminary and definitive.

Clause 5 defines the constitution of the Patent Commission, which includes, as at present, the Lord Chancellor, the Master of the Rolls, and the law officers of England, Ireland, and Scotland, with five new Commissioners, who are to be unpaid, and are to be appointed by Royal Warrant. Two are to be nominated by the Board of Trade.

Clause 6 provides for the appointment of examiners, not less than two, and not more than four in number, to be chosen by the Lord Chancellor, who shall state in writing that they are "specially qualified for the office by legal or scientific knowledge."

Clause 7 refers to the appointment of referees, who "shall be persons specially qualified for the duty by knowledge of manufactures, art, or science." They are to be chosen jointly by the Board of Trade and the Commissioners every two years, and are to be "distributed in panels according to their several qualifications."

Clauses 8 to 10 define the mode of making applications for patents. The applicant is to file a full specification of his invention, and any person having an interest in opposing the grant may do so. "The use and publication of the invention by the applicant, during a period of six months from the date of the application, shall not prejudice the grant of a patent for it (which protection from the consequences of use and publication is in this Act referred to as provisional protection)." The application shall, "on the expiration of the prescribed time," be referred to an examiner and a referee.

Clause 11. "The examiner and referee or referees shall consider the application and relative documents, and shall report to the Commissioners thereon, and especially with reference to the following questions:—

(*a.*) Whether the invention is a proper subject for a patent within the Statute of Monopolies.

(*b.*) Whether the specification is sufficient.

(*c.*) Whether the invention is new, as far as they can judge thereof from an examination of former specifications and other documents and publications in the Patent-office.

(*d.*) Whether the invention is in the nature, wholly or mainly, of a combination of known machinery, substances, or processes.

(*e.*) Whether, regard being had to the last-mentioned consideration, or to the consideration that the invention is not of great importance or utility, or for any other reason, it is expedient that the duration of the patent to be granted for it (if any) be limited to seven years; or

(*f.*) Whether, by reason of the frivolous character of the invention, or any other reason, it is not worthy of a patent."

Clause 12. The application, accompanied by the report of the examiner and referee, which is always to go with the specification, is to be transmitted to the law officer, who will give his opinion. The application and opinions will then be made public.

Clauses 13 to 16. Notice to proceed having been given by the applicant the patent and a warrant for sealing will be prepared and submitted to the Lord Chancellor. If the law officers' report is adverse, the applicant may, nevertheless, petition the Lord Chancellor for the grant and sealing of a patent, but "any person" may petition against the sealing, and the patent will not be sealed "unless a request for the sealing thereof is made within three months of the date of the warrant, and within the period of provisional protection." The sealing must take place within seven days before the provisional protection and not sooner, and every patent shall be dated the day of the application.

Clause 17. Patents to extend to the Unted Kingdom, but may in certain cases also include the Colonies.

Clause 18. Powers are reserved to the Lord Chancellor to extend the period of provisional protection, and the period during which the patent may be used.

Clause 19 relates to foreign inventions and to applicants resident abroad or to aliens wherever resident. The provisions are as follow:—

"(1). A patent shall not be granted on the application, unless the applicant declares himself to be the first and true inventor, and no patent shall be granted in respect of a communication from abroad.

"(2). A patent shall not be granted after the expiration of a foreign patent for the invention, and, if so granted, shall be void.

"(3). If at the time of the application there is a foreign patent for the invention in force, a patent shall not be granted unless the foreign patentee is the applicant, and his application is made within six months after the date of the foreign patent, or of the earliest foreign patent (if there are more than one).

(4). A notice of every foreign patent for the invention existing at the date of the warrant for the patent shall appear by indorsement or otherwise on the patent.

(5). The patent shall cease on the ceasing of the foreign patent (if any), or of such one of the foreign patents (if more than one) as first ceases."

Clause 20 regulates the use of inventions patented here by foreign vessels in British waters.

Clause 21 enables the patentee to amend his specification. If leave is sought to amend after the reference to the examiner it is to be treated in all respects as an original application. No amendment will be allowed which would extend the patent beyond the original claims. Parties may amend after the patent is sealed.

Clause 22 provides that a patent may be revoked on petition to the Lord Chancellor, the proceeding by *scire facias* being abolished.

Clauses 23 to 26 regulate the granting of licenses and provide for the registering of license deeds and assignments at the Patent-office, and do not materially differ from the regulations now in force.

Clause 27. Within two years of the date of a patent it may be revoked, unless it has been put in practice within the United Kingdom, or unless "the patentee fails to grant licenses to proper persons requiring the same, on terms which the Lord Chancellor deems reasonable."

Clause 28 empowers the Lord Chancellor to allow extensions of patents which have only been granted in the first instance for seven years, but the whole term of the patent is in no case to exceed fourteen years from the date of the original application.

Clause 29 saves the rights of inventors who exhibit at any exhibition held by the Commissioners of 1851, or at any other exhibition which shall be certified by the Board of Trade as "likely to promote British art or industry, and to be beneficial to the mercantile or industrious classes." Application for a patent must, however, be made within six months of the opening of such exhibition.

Clauses 30 to 33 deal with cases of fraud, and provide that a patent granted to the first inventor shall be invalidated by an application in fraud of him. A falsification of entries in the register of assignments or licenses is a misdemeanour. Any person who fraudulently places the name of a patentee on any article is liable to a penalty of £50, but no person is in any case liable to a penalty for placing the word "patent" on anything made. It is a misdemeanour to file or caused to be filed a false declaration at the Patent-office.

Clause 34. "A patent shall have to all intents the like effect as against her Majesty the Queen, her heirs and successors, as it has as against a subject. But the officers or commissioners administering any department of the service of the Crown may, by themselves, their agents, contractors, or others, use the invention for the service of the Crown, on terms to be agreed on between those officers or commissioners and the patentee, or, in default of such agreement, settled by the Treasury."

Clauses 35 to 43 relate to procedure, and are mainly of a technical character. The Lord Chancellor is empowered to delegate his authority to a judge of the High Court, and any petition may be dismissed on the ground of the petitioner having no interest in the matter. No appeals are allowed from the Lord Chancellor's decisions, but he may at his discretion grant a re-hearing. Full particulars of objections are to be delivered, and the Lord Chancellor can grant orders "for an injunction, inspection, or account." The assistance of experts may be obtained when thought fit.

Clauses 44 to 46 relate to the official seal of the Commissioners, and the providing of proper buildings by the Treasury.

Clauses 47 regulates the duties of the examiners.

Clause 48 consists of fourteen sections empowering the Commissioners to make general rules for printing, publishing, selling, distributing, and indexing their publications, for the establishment of a museum or collection of models of inventions, and for regulating the fees of referees and experts.

Clauses 51 and 52 direct that the payment of fees be made by stamps.

Clauses 53 to 56 refer to procedure for infringement and revocation in Ireland and Scotland.

Clauses 57 and 58 are transitory, and merely facilitate the introduction of the new enactments.

Clauses 59 to 61 save the rights of the Lord Chancellor and of the Crown.

The schedule gives the list of fees, which are generally the same as at present, the only material alteration being a reduction of £5 in the cost of a patent for the first three years.

In a report upon the attempted naturalisation of various plants at Nismes, in the South of France, furnished by M. Maumenet to the *Bulletin de la Société d'Acclimatation*, it is stated that the Japan wax tree (*Rhus succedanea*) has lasted through six seasons, though it has been cut to the ground by the frost more than once. The *Laurus camphora*, after giving hopes, has proved too tender. *Andropogon squarrosus*, an exceedingly fragrant grass, has withstood the most severe seasons. All attempts to naturalise the *Eucalyptus globulus*, however, have failed.

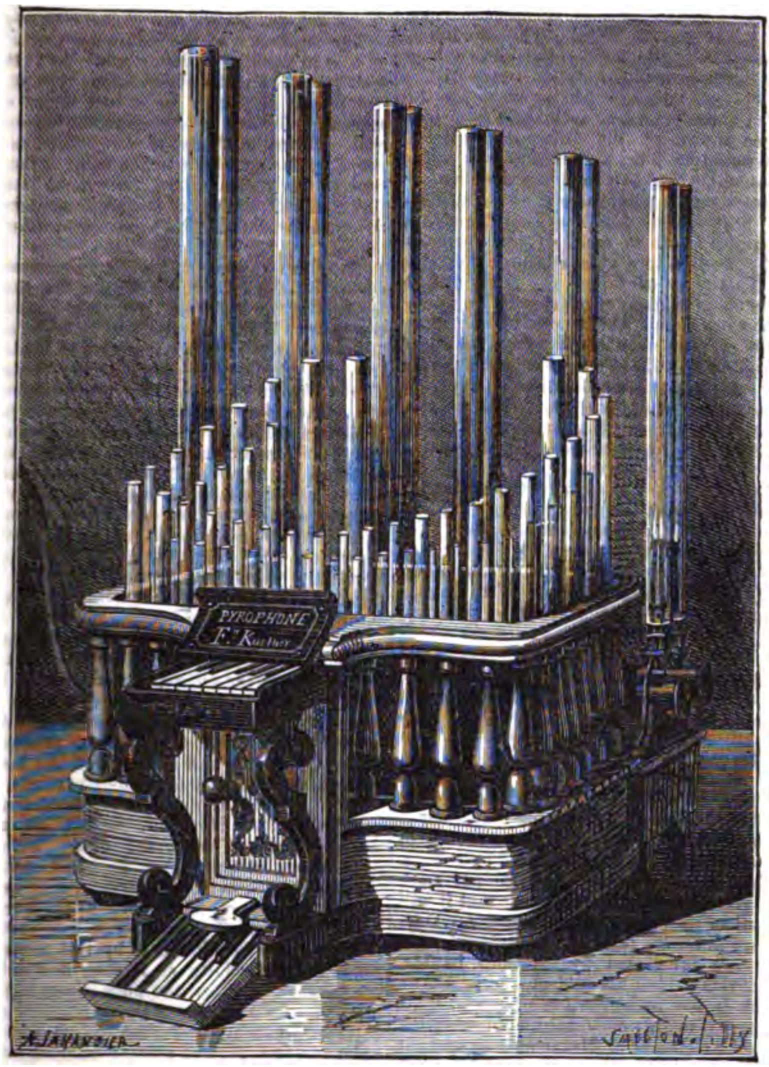
A cast-iron lighthouse for the islands of Dag[illegible] in the Baltic, has been made in Paris and sent out to [illegible] on account of the Russian Government. The shell is entirely of cast-iron 2¾ in. in thickness. It is 47 metres in height from the base to the summit of the lantern, and measures 12 metres diameter at the bottom, and 7 metres [illegible] the gallery above.

The production of coal in Belgium in 18[illegible] amounted to 15,778,401 tons. Of this production 4,171,8[illegible] tons were exported. Of the 4,171,872 tons of Belgian coal exported in 1873, 4,014,118 tons went to France. The exports of coal from Belgium appear to have somewhat declined in the first half of 1874.

According to Bottger nickel is better adapted than any other metal for galvanising iron, and it resists the action of oxidation much better than gold. The latter metal is very porous when it is in a thin layer; nickel, on the contrary, forms a thoroughly impermeable coating.

THE PYROPHONE.

The accompanying illustration represents the Pyrophone of M. Kastner, which was the subject of a paper read last week by M. Dunant. The instrument exhibited at the meeting was of the same character, but had not as many tubes as that shown in the engraving.



M. KASTNER'S PYROPHONE.

INTERNATIONAL EXHIBITION OF APPARATUS FOR SAVING LIFE AT BRUSSELS.

The *Indépendance Belge* gives the following particulars respecting the International Exhibition of Apparatus for Saving Life and Hygienic Appliances that is intended to be held at Brussels next year. This exhibition will be divided into ten classes, as follows:—

Class I.—Saving life from fire, sub-divided into five sections, viz.:—1. Apparatus and means for saving life on land and at sea. 2. Instruments and appliances for giving alarm of fire. 3. Appliances used for saving life. 4. Apparatus, instruments, and substances used for extinguishing fire. 5. Means of transport for men and material.

Class II.—Apparatus and implements of every description for saving life at sea and preventing danger from drowning.

Class III.—Appliances for preventing accidents on roads, railways, tramways, &c.

Class IV.—Appliances for relieving wounded in time of war.

Class V.—Hygiene and public health.

Class VI.—Hygiene and means for preserving health in various industries.

Class VII.—Hygiene as applied to domestic and private life.

Class VIII.—Medicine, surgery, and pharmacy in their relation to the previous named classes.

Class IX.—Institutions having for their object the bettering of the condition of the working classes.

Class X.—Hygiene in its application to agriculture.

During 1874 a single fruit firm in New York imported the large number of 67,250 bunches of bananas.

VIENNA EXHIBITION REPORTS.

(Continued from page 263).

The report following that of Dr. Russell, noticed in the article on the present subject is, by Lieutenant T. H. Anstey, R.E., on "The Art of War." The amount of exhibits under this heading seems to have shown how great an advance has been made of recent years in the implements of war. Lieutenant Anstey has, for the most part, confined himself to a description of the various classes of weapons shown by the different countries, through which it would be difficult to follow him without exceeding reasonable limits in the present notice.

Next to this comes an elaborate report of the utilisation of peat and peat lands. Mr. Paget considers that the problem of adapting peat to metallurgical purposes has been solved by Austria, to a great extent, before any other country. This state of things is chiefly due to the fact that Austria is in many parts rich in iron ores, but has no coal to work them. On the other hand, there are immense tracts of peat available for fuel, and these are being more and more utilised as wood grows dearer and more scarce. A Government Commission reported on the subject not long since, and the effect of this condition of things naturally was that the Vienna Exhibition was specially rich in specimens illustrative of recent progress in the peat industry.

The various exhibits were classified by the reports as follows:—(1) National formation and growth. (2) Extraction or winning. (3) Mixing and condensation. (4) Drying. (5) Carbonisation or charring. (6) Products of distillation. (7) Applications as fuel. (8) Reclamation of peat lands. (9) Sundry applications. With regard to the formation and growth, the principal practical remark is as to the very considerable variations which are found in peats from different localities. As to the method for extraction, it appears that hand labour is principally employed throughout Germany. There are, however, several machines which are extensively employed, and the principal of these are described with illustrations by Mr. Paget. The methods of masticating, compressing, and moulding peat are of course numerous, and the various machines for the purpose receive due notice. The methods of drying peat are all air-drying, and it is well known that here lies the great difficulty of its preparation. Peat as cut contains 75 to 90 per cent. of water, and this has to be reduced to 25 per cent. When dry its hygroscopic qualities are such that it will take up 20 per cent. of its weight in wet weather. Drying frames of very different forms are employed, and several of them are illustrated by diagrams in Mr. Paget's account of this part of his subject.

The next point is the carbonisation of peat. This portion of the report is mainly occupied by a description of Lettmann's peat-charring kiln. Next comes an account of the products of the distillation of peat. This class was, Mr. Paget states, very meagrely represented at Vienna. There were some cases of the various products —paraffine, naphthaline, benzoine, photogene, asphalte, naphtha, oxalic acid, carbolic acid, &c. In some cases gas has been distilled for use in factories near peat beds, but the difficulties in the way have naturally prevented any such considerable use of this material. Several attempts have been made to utilise the Austrian supplies of peat as a fuel for manufacturing purposes. It was employed in blast furnaces, for generating steam, for puddling iron, &c., to judge from Mr. Paget's report, with some amount of success.

As to the reclamation of peat lands, the chief instances are given by Holland, and by some parts of Germany, Hanover and Oldenburg especially. In the first-named country peat has been gathered for three hundred years. There a rotation of crops is practised, which produces excellent results. Tobacco, the most exhaustive of all crops, is grown very successfully. In Hanover, the bog, after being drained, is cut up, burnt over its surface, and laid down in buckwheat for six years. By this time the soil is exhausted, and it is planted with birch, pine, and fir. Under the heading of "Sundry applications of peat," a few uses of it are treated, not mentioned under the previous headings, such as railway carriage briquettes, thatching, pasteboard and paper, manure, &c.

The conclusion of the report deals with the utilisation of peat in the United Kingdom. As to this, the general result of Mr. Paget's observations appears to be that peat *per se* can only pay as a fuel under certain circumstances, and when it does not come into competition with coal. However, there are many districts where the removal of the peat adds to the value of the soil below, and here, if the reclamation of new land was taken in conjunction with the use of the superincumbent peat as fuel, the question would, Mr. Paget urges, wear a very different aspect.

The third volume of the Reports commences with the report by Sir M. Digby Wyatt, on the characteristic features of the building. In this an account is given of the various buildings which have been used for exhibitions since the original structure in Hyde-park. Speaking with considerable praise of the Vienna building, Sir Digby Wyatt yet sees much remaining to be improved. He doubts if we have yet attained the best form of exhibition building, or whether it may not have to be sought in modifications of several of the already attempted schemes. It is suggested that the best type might very probably be found in some of our largest railway stations. The description of building required is one "with no internal walls, but with a roof supported on light, cheap columns, with the light coming vertically down from near the apex of the roof in our climate, or from vertical windows, easily shaded by blinds or venetians in hotter countries."

Professor Archer's two reports on pottery and porcelain and on glass are the next in order. As to the comparative merits of the different countries in the first-named class, he considered that there was little doubt as to the pre-eminence of British manufactures. Austria is placed second, in many respects running us close; then follows France. Prussia and Austria had the best show of terra-cotta, but in all the other departments England came first. In glass the exhibition was unrivalled by any previous one. Standing, so to speak, in the very centre of the Continental glass industry, it would have been strange had it been otherwise. Here neither France nor Great Britain was well represented. Venice, Bohemia, Hungary, and Bavaria did their utmost. That our manufacturers did not come forward more readily is alluded to by the reporter as a matter for regret, especially as it caused a deficiency in that description of glass, the pure crystal-glass, on the production of which our makers particularly pride themselves. In plain sheet-glass Belgium was specially conspicuous, and showed considerable superiority over ourselves and other competing countries.

(To be continued.)

According to *Nature*, the Ramie, or China grass plant (*Bœhmeria nivea*) seems to thrive in Cayenne, specimens having been shown at a recent exhibition in that colony and compared with plants grown in France. The Cayenne plants, which were grown on comparatively poor soil, without manure, and with little or no attention, were double in size and height to those grown in France. Three successive shoots were produced in one year.

The increase in the cultivation of beetroot in Europe for the manufacture of sugar is said to be causing great loss to the cane-sugar planters in Cuba. Should the European manufacture and consumption of beet-sugar go on increasing as it has done during the past four years, serious changes are anticipated in the cane-sugar productions all over the West Indies.

THE LOAN COLLECTION OF SCIENTIFIC INSTRUMENTS.

We do not think we are going too far in assuming that the unusually influential meeting held at South Kensington last Saturday may be regarded as the first and very emphatic step in a most important work.

The presence at a meeting of this kind of two such influential members of her Majesty's Government as the Duke of Richmond and Lord Sandon may, we think, be taken as significant that the present Government is willing to do what it can for the advancement of science and of scientific education, and in order to do this, is seeking to learn what its duties are in the matter. The tone of the reply of the two above-named Ministers to the King's College deputation last week is quite in accordance with this view.

The meeting was altogether a remarkable one, consisting as it did of two of her Majesty's Ministers, together with many of the most eminent men of science in the country; and their unamimity in favour of the proposal is a proof of its high importance, and we hope a guarantee of its success.

With regard to the proposal itself, the wonder is that no steps have, long ere now, been taken to organise a museum for the illustration of the physical, chemical, and mechanical sciences. One of the recommendations contained in the fourth report of the Commission on Scientific Instruction and the Advancement of Science proposes the formation of a collection of physical and mechanical instruments, and submits for consideration whether it may not be expedient that this collection, the collection of the Patent Museum, and that of the Scientific and Educational Department of the South Kensington Museum, should be united and placed under the custody of a Minister of State. In our article on this report (*Nature*, vol. ix., p. 397) we went so fully into the subject that it is unnecessary to dwell again upon it now. Why the particular departments mentioned above should be left out in the cold it would be difficult to give a reason for; probably, as we before suggested, it has been simply from want of thought; and now that so many eminent men of science have met together, under the auspices of two members of her Majesty's Government, we may hope that the great gaps in our system of Museums will not remain long unfilled up. Natural history, including geology, zoology, botany, not to mention nearly every practical application of science, such as mining, &c., have in London at least, resources for the practical study of their history and methods; and we are exceedingly glad that this is the case. Greatly on this account, we believe, is it that these sciences are so popular, and that so much more is known about their results among the people at large than about the various departments of the physical sciences. If a student of any of the above sciences wants to pursue an investigation on any point connected with their history, their methods, or their results, he has magnificent scope for doing, both in London and other large towns throughout the country. But the unfortunate student of any department of the Physical Sciences—Electricity, Magnetism, Heat, Light, Chemistry—if he wants to study historically or to investigate any point connected with his subject, has nothing for it but to buy his apparatus, borrow it from a friend, or perhaps only look at it in a shop window.

A collection which exemplifies the history of the progress of any science may be made both interesting and instructive; and of all the sciences none can be more aptly and fully illustrated in this respect than the Physical Sciences. How interesting, even to the uninitiated, was the recent exhibition of a historical series of musical instruments at South Kensington; but how much greater would be the interest that would attach to, and how much higher the instruction to be derived from, a collection of apparatus that would exhibit the progress in the single department of Optics, say from Newton down to Cornu and Fizeau, embracing as it might very well do all the work that has been done in recent years by means of the prism. So in the department of Heat in all its branches, how intensely interesting and instructive a collection might be made. The mere mention of other subjects—Electricity, Magnetism, Acoustics, &c.—suggests possibilities of magnificent collections which might be formed, if only the public spirit of fortunate possessors could be properly roused; and on this latter point there need, we think, be no fear.

One condition, we think, ought to be insisted on—the collection which it is proposed to form should be almost entirely confined to the region of scientific research and instruction, and should include as little as possible of the practical applications of science, which, indeed, have hitherto had almost wholly their own way in our exhibitions and museums. It should be distinctly understood and acted upon, that the collection which it is hoped will be opened at South Kensington in a few months is meant to illustrate the history and methods of abstract scientific research of the true nature of which the public know really nothing, and of teaching. Our friends the engineers and other practical men, we are sure, will see the fairness of our demand, and they are so powerful, and have hitherto been so largely represented, that they can well afford to be generous in this matter.

While one great value of the collection about to be formed will no doubt be from a historical point of view, it cannot but serve also an important educational purpose. It will let the public see how multifarious are the ways of science, will show them that it is no mere child's play, and tend to impress them more and more with the great importance of scientific education as a means of culture and mental training. When the claims of scientific research upon Government are advocated, those who are familiar with such a collection will know what is spoken of, and for what purpose the public money is wanted.

We hope, and indeed believe, that the experiment about to be tried at South Kensington is simply the first step towards something more permanent and much more extensive—in short, the fulfilment of the second part of the recommendation of the Commission quoted above. We believe that if such a collection is once formed, if it be properly organised and arranged and made perfectly intelligible to the public, both as to its theoretical principles and practical bearings, it will in time lead to a scheme as comprehensive, as complete, and as invaluable as the French Conservatoire des Arts et Métiers, to which we have frequently referred as a model which our Government would do well to copy. The unsatisfactory state of our museums, their want of system, and incompleteness, we have often insisted upon. We think we are now on the road towards mending this latter defect; other defects can only be remedied by the adoption of the Commission's recommendation, to unite the principal collections under one responsible Minister of State. It would without doubt be greatly to the advantage both of the science and the industry of the country to have collected and arranged in one establishment, supported by Government, all the apparatus and illustrations of all the processes connected with every department of science, pure and applied, abstract and practical, instead of the heterogeneous and imperfect collections at present scattered in various buildings under different systems of management.—*Nature.*

It has been determined that the Industrial Exhibition, announced to be opened at Blois on May 1st of the present year, will not be confined to French products alone, as was originally proposed. It is now intended to invite English exhibitors to join. For all further information application should be made to le Président du Comité de l'Industrie, Rue Porte-Bastille, 1, Blois (Loir-et-Cher).

THE INTERNAL TRADE OF INDIA.

The report upon the moral and material progress of India gives an account of the land traffic through the passes of the Himalayas, which lead from Sind and the Punjab to the lofty plateaux of Afghanistan, Turkistan, and Tibet. The trade of the Lohani merchants, who are the channels of communication between India and Central Asia, is a very old one. Only militant merchants of this description could ever have made a profit out of a commerce which had to traverse different mountain ranges, through tribes of savage robbers, and the countries between them seamed with the customs lines of greedy, short-sighted chiefs. But the "Povindahs," as they are called, band themselves together in caravans to resist exactions that would render their trade impossible. They defied the robbers here, compounded with them there, avoided or slipped past in the night some customs post of a weaker chief, whose pursuing emissaries they could defy, and bribed officials at others to shut their eyes to the value of the richer bales. And so, sorely harrassed at every step, losing men, horses, camels, bales of merchandise here and there on their way, bribing, cajoling, bullying, defying, and fighting, twice every year did the caravans of these hardy traders seeking their precarious gains battle their desperate way through the desert of Bokhara, the defiles of the Paropamisus, the Ghilji plateau, and the passes of the Sulaimun range, across the Indus to the Punjab. The Povindahs number some 12,000 fighting men, with 60,000 camels, and their trade with the Gomul pass is worth £60,000, in spite of the serious disadvantages with which they have to contend. Every year they lose a hundred or more men, and at least 2 per cent. of the camels, besides some hundred loads, at the hands of Waziri and Sulaiman Khyl tribes.

In the Eastern Himalayas there are trade routes from India to Tibet and Nepal, by Sikkim, and by the country of the Tawany Bhutias. The prohibition of trade between India and Tibet is solely due to orders from Pekin. The local officers in Tibet would, it is said, gladly facilitate a direct trade, and even now there is considerable traffic through Sikkim, carried on by Tibetan, Lepcha, and Bhutea merchants. The Tibetans are evidently a commercial people, and it is stated that every person in authority, including even the chief lamas of the monasteries, keeps an agent, and carries on trade on his own account. Besides this, a large number of Mussulman traders from Kashmir are located in the capital. The inhospitable nature of the country, which produces few articles that are required by the rest of the world, makes bullion an important article of export, and there is no doubt that, with a more careful exploitation of the mines of gold and silver which abound in Tibet, commercial transactions would assume larger proportions. The commerce of Tibet with China is carried on almost entirely along the great road between Tatsiamlu and Lhassa. The Chinese import into Tibet cotton fabrics, thread, porcelain, and Yunan ponies, and receive from Tibet silver, salt, blankets, and other woollen goods, furs, drugs, and musk. The inhabitants of the mountainous country of Szechuen clothe themselves to a great extent in Tibetan blankets. Tibetan musk is much esteemed in China, and there is a great demand for it, but it reaches the sea-coast in a very adulterated state; the best musk is said to be that produced in the Mishmi country, and this trade, at least, ought to come into our own hands. Salt is abundant in Tibet, and is produced by solar evaporation in shallow pits. Tibet supplies parts of Szechuen, the whole of Yunan, and all the wild tribes along the Lutsekiang, and in the north of Burma.

As the largest portion of the products of India is consumed in the country, the internal trade is even more important than that with foreign countries, and the condition of the people may to some extent be shown by the
character of the traffic between province and provin
The materials, however, for such an examination
very incomplete. In the Punjab the value of the
ternal trade in 1872-73 was £5,024,000. There wa
considerable increase in the value of the silk and sh
manufactures, the whole trade of the Punjab be
estimated at £5,351,000. From the hand looms co
valuable white and coloured cotton cloths, and th
floor-cloths with coloured stripes. The woollen ma
factures are from the exquisitely soft fleeces of Ram
and Kirman, from country sheep wool, and goat
camel hair. The silk manufactures also form an import
branch of industry. In the Bombay Presidency there
extensive silk manufactures, all by hand-loom weavi
and all consumed at home, the raw silk coming chie
from China and the Persian Gulf. The exhibitions
Lahor, Rurki, and Calcutta, in 1864, at Nagpur, in 18
and at Madras and other places in India, have been v
useful in stimulating manufactures and making desig
mutually acquainted with the products of the diffe
parts of a vast empire. The commencement of Europ
influence of the best kind in Indian manufactorie
beginning to be clearly perceptible. An advanc
being made in every department, but schools of de
are much needed, and one at Lahore has been determi
on. If the once famous manufactures of Bengal, the
stuffs and the muslins have nearly disappeared, it
only been to change their seats, but not to be destroy
These industries not only still exist, but they are gr
ing in importance, and in some respects are likely
hold their own against the imports from Europe.

The numerous fairs held all over India, generally
occasions of pilgrimages to shrines, are most u
stimulants to trade, and as extending the knowledge
increasing the wants of the people. At the great D
fairs 50,000 persons assemble, some of them coming f
distances of 500 miles; and at the last great solar ec
in 1861, 200,000 persons assembled at Haneswar,
Ambala, from distances extending 1,000 miles;
there are 127 other fairs in the Punjab, at which
assemblies number 10,000 and upwards. In the Bom
Presidency the *jattras*, or fairs, are held in all parts
the country, and in Sind, where they are held in hon
of Moslem saints, the fairs are very numerous. T
custom of assembling at shrines, and of taking
opportunity of the occasion to display merchandi
prevails in all parts of India, and is of immense advant
to the commerce of the country.

CARRARA MARBLE.

The working of the quarries of Carrara dates b
from a very remote period. Under the Roman sw
these marbles were known and highly appreciated,
their reputation was such that they soon replaced
Grecian marbles of Paros and Pentelicus. The gr
portion of the monuments of Rome, and especially
Trajan columns, were constructed with marble fr
Carrara.

At the present day, this same stone gives rise to
important trade; and the little town of Carrara poss
no less than 720 quarries, of which 450 are now in
work. The most ancient and the best known, those
the Grand Canal, of Poggio, Dorizio, and of Palva
still exist. The first named of these is that which
at the present day yields the largest blocks as well
the purest marble.

The working of these different quarries furnished,
years ago, 50,000 tons, representing a value of four mill
francs. In 1873, 97,940 tons were quarried, the valu
which reached the amount of nine million francs.

The marbles included under the name of Carrara
of several kinds and different qualities. The princi
quarries belonging to this town, and which bear
names of Riccanaglia, Colonnata, Piastrone, and Mug
produce the most celebrated marbles. They are clas

s:—Statuary marble of first quality, veined marble, bigio marble, and clear white marble. All the sculptors of the Renaissance period employed rst quality of these marbles for their *chefs-d'œuvre.* veined marble, more especially used in churches, ars, tombs, &c., is less esteemed. The clear white constitutes the commonest variety, and gives to the most extensive trade; it is furnished to sculptors and architects in considerable quanti- This again is divided into different qualities, g the names of the quarries whence it is extracted. town of Carrara, the most active centre of this of industry, possesses on the river Carrione forty- w-mills, and in the town itself, or its immediate y, there are 115 establishments where the marble into blocks, polished, and sculptured. More then workmen, without counting their wives and en, are employed in the different operations of ying or polishing; the extraction generally takes "open-cast," as the quarries nearly always exist side of a mountain.

 to these men, who are not mere labourers, come ry important class, and one becoming less and umerous, of skilled workmen, sculptors, orna- , &c. The former earn from 2 to 4 francs a-day, latter a much larger sum.

 polished or worked marbles are sold in Italy; the portion, however, is exported to England, France, ny, Russia, Holland, Belgium, and often even to nd Australia. The provinces of North America r some years past imported considerable quantities. thstanding the distance and the customs dues, the marbles have become quite the rage in America, ery month blocks are sent out cut, numbered, and d for large constructions. The loading of these sses, for which a heavy freight is demanded, lace either at Avenza or at Leghorn.

 consignments to France, which may be reckoned t 15,000 tons, are generally put on board Italian bound for Marseilles, Nice, Bordeaux, and

 trade in all the Carrara marbles is in the hands n firms. Some English and American merchants rted two very important establishments in the ut the Italian houses are the most numerous and ve.

mall town of Massa has during the last few years an important part in the marble trade; it possesses quarries in full activity, supplying 16,000 tons, ich represent a value of 1,500,000 francs. Serravezza, the province of Lucca, also possesses some rich rries.

The town which is best known is that of Albissima, ich furnished all the marble employed by Michael gelo in the immense works which were entrusted to by Popes Julius II. and Leo X. This quarry is still ked, and yields very fine statuary marble. The ntity it exports is estimated at 20,000 tons.

Other beds of marble are met with at different places Tuscany, at Pietra Santa, and in the Apennines, but no other spot does the working attain the importance the celebrity enjoyed by the marble of Carrara.

Herr Fuscher has discovered a method for making ordinary drawing paper transparent during time that a tracing is being made, and afterwards storing its original appearance. The process consists in dissolving a certain quantity of castor oil in two or three volumes of pure spirits of wine, according to the thickness of paper, and of applying this solution by means of a sponge. The spirit evaporates at the end of a few minutes, and the paper is ready for use. The drawing may be made in pencil or Indian ink. Its original opacity is afterwards restored to the paper by plunging it in pure spirits of wine, which may be kept for dissolving the oil on future occasions.

ESPARTO GROWING IN ALGERIA.

The alpha fibre, or esparto grass, one of the most important productions of Algeria, covers enormous spaces in the high plateaux in the three provinces. Several companies have been formed for the purchase and exportation of this fibre, which is becoming more and more sought for in proportion to the increasing scarcity of rags, for the manufacture of paper. The Algerian autherities are quite alive to the necessity of encouraging all such commercial enterprises as tend to develop this important branch of commerce. A statement has lately appeared containing accurate information as to the localities where the plant is produced, and the approximate quantities obtainable in each district. As this cannot fail to be of interest to the manufacturers of paper in England, Consul-General Playfair gives a *résumé* of this document, which may be easily understood by a reference to any ordinary map of Algeria.

Province of Algiers.—The northern limit of the surface covered with alpha in this province is formed by a line passing through Ain Federel, Chabonmia Ain Oussera, El-Birin, and Tonbia. The southern limits of its production in this direction extends beyond Laghouat, the whole comprising an area of 2,500,000 acres, of which at least one-half is north of Djelfa. The high road from Algiers to Laghouat cuts this district into two nearly equal parts; the most important points on this route and the most suitable for depots are—Boghari, distant from Algiers 127 kilometres; Boughzoul, 188; Ain Oussera, 222; Djelfa, 325; Laghouat, 437. Mule paths lead east and west of these points, which would admit of the alpha being brought by beasts of burden to the main road, and then conveyed by carts to the nearest railway station. Before, however, the alpha in the province of Algiers can be brought to the sea at a remunerative rate, it would be necessary to construct a railway from Affraville to Boghari, and even to Boughzoul.

Province of Oran.—The circles of Sebdon and Daia are almost entirely covered with alpha of the best quality, extending from St. Kelos, north of Sebdon, to beyond the Chotts as far as the mountains of Ksour. The alpha in this district might be collected at Kemcen, and thence sent to the sea by a railway from that city to Rachgoun, or what would be preferable, a railway direct from Rachgoun to Sebdon, following the course of the river Tafna; such a railway would monopolise the traffic of the important market of Maghnia, the mines of Garonban and Naziar, as well as the mineral wealth which is known to exist in the country of the Beni Snous. It is difficult to estimate the quantity of alpha obtainable in the district of Sebdon, the quantity is almost boundless. In the circle of Daia it covers a space of about 900,000 acres, in the sub-division of Mascara there is an immense field for the exploration of alpha, as also in the Bach Aghalick of Foenda in the circle of Saida, and throughout the whole country traversed by the strategic route from Daia to Tiaret; this part of the country will be opened out to traffic by the new railway about to be commenced from Saida to Arzew.

Province of Constantine.—In the sub-division of Setif the circle of Bon Saada contains about 170,000 acres of alpha, but the means of communication are wanting, and the force of transport to Aumale would be excessive. This district cannot be profitably worked without a railway to Algiers, passing by M'sila, with a branch as far as Bon Saada. In the sub-division of Batua this substance covers about 250,000 acres, which might be collected on the main route between Constantine and Biskra, and thence conveyed by coast to the former city. In the neighbourhood of Tebessa and Ain Beida there are about 150,000 acres, the produce of which will be easily and cheaply conveyed to Bone, should the projected railway between these places be carried out. From the above remarks it will be seen that there is practically no limit to the supply of alpha procurable from Algeria;

all that is required is the establishment of railway communication, and the government of the colony is prepared to sanction the construction of lines either by French or foreign capitalists on the most liberal terms.

CORRESPONDENCE.

THE WEST COAST OF AFRICA.

Sir,—I attended the meeting at which a paper was read by Mr. Babington on the "West Coast of Africa." Having returned from the Coast a month previous, after visiting most of the places mentioned in his paper, including the rivers Brass, Bonny, and Niger, the latter of which I ascended some hundreds of miles, I was anxious to gather, if possible, further useful information respecting these very interesting regions, but I must confess that my expectations, and those of my friends who accompanied me, were sadly disappointed. It was the old tale over again—a voyage from Liverpool to the various stations on the West Coast of Africa, many passages in Mr. Babington's paper being identical with those of lectures and writings on the same subject.

In Mr. Babington's account of his visits to the various places, and his statements and opinions of the trade and general condition of the people, social, moral, or religious, he failed to give any reliable statistics or authorities in support of the same. Before I return to the Niger I hope to be able to furnish a paper of my views on this all-important subject, at which time I will fully refer to the various opinions offered by Mr. Babington, and follow him step by step from Liverpool to Bonny. I, however, very much fear my being able to be so fortunate as he was in making a passage from Liverpool to Madeira in four days, a thing never before heard of except in the case of her Majesty's steam-yacht, *Victoria and Albert*, when it conveyed her Majesty the Empress of Austria in four days and six hours. I feel, however, compelled to reply to his reference to Liberia at once.

Mr. Babington, after referring generally to Liberia, and making most erroneous statements in reference to the constitution, trade, and politics of the country, then refers to the Liberian 7 per cent. loan, and has the temerity to state that the whole of the revenue of the Republic is not sufficient to pay the interest upon the same, which is 7 per cent., not 6 per cent., as stated by Mr. Babington. I have now before me the report of the Secretary of the Treasury for the Republic, for the fiscal year ending September 30th, 1873, published by order of the Legislature, and verified by the president and officers of the various departments of the Government. The following are the figures:—

Receipts, 209,890 dols. 90¾ cents., equal to about £45,750, whilst the expenditure for the same year amounts to 180,913 dols., equal to about £39,360, thus showing a balance in favour of the Treasury of 28,977 dols., equal to about £4,390, enough to provide interest at 7 per cent. on between £69,000 and £70,000 of the loan.

I find from the same source, included in the Treasury receipts for the same year, that upwards of 75,000 dols. was received in payment of import and export duties, or nearly £16,000; and in the same year 280,000 gallons of palm-oil was exported from one port alone, viz., Monravia, equal to about 800 tons.

I think, sir, Mr. Babington would have given greater satisfaction to his audience, done greater service to the cause of African civilisation and development, and much more credit to himself, had he bestowed less attention in collecting the hackneyed notions of theoretical and sentimental writers on this subject, and given to your new and important "African Section" some reliable data in support of his arguments.

I write these few lines chiefly to maintain that if the "African Section" of your valuable Society is to be made of general benefit to those watching our A[illegible] affairs in England, more of fact and less of theo[illegible] be necessary to impress the minds and enlist the s[illegible] thies of the audiences who attend the meetings. [illegible] is much to be done in the work of African develo[illegible] and civilisation, and it will require many men [illegible] much work for many years in Africa, and many [illegible] hearts to support them at home before the debas[illegible] rupt, lawless, and cruel accumulation of evils [illegible] defaced by the light of that mother of freedom, wh[illegible] I am proud to be—Legitimate Commerce.—I am, [illegible]

David Chinery, [illegible]

THE IMPRACTICABILITY OF ADAPTING [illegible] ROMAN CHARACTER TO THE ALPHA[illegible] OF INDIA.

Sir,—I wish to offer the following additional r[illegible] on the impracticability and danger of adapting the [illegible] character to the alphabets of India:—

1. There are more sounds in the Indian alphabe[illegible] can be rendered by the Roman character, and it [illegible] merely lead to confusion to invent additional cha[illegible] for the Roman alphabet, or to invest its existing c[illegible] ters with additional values.

2. There is no chance of the Roman character[illegible] accepted by the masses in India, who revere the [illegible] Arabic and the Sanskrit characters, because th[illegible] identified with their religion, and because all their [illegible] —indicative of intellectual and moral life—are d[illegible] from these sources. Arabic, Persian, and Sansk[illegible] also the keys to all that is valuable in an ext[illegible] Oriental literature, without which the whole n[illegible] existence of the peoples of India has no me[illegible] Romanisation is a well-meant and laborious atte[illegible] pouring water into a sieve.

3. Modern Greek, Russian, and German have c[illegible] ters that spring from the same source, yet they ar[illegible] differently, nor can anyone, by merely knowing [illegible] alphabets, read their languages correctly. For forty [illegible] strenuous attempts have been made to write Ger[illegible] the Roman character, yet its Gothic form still ke[illegible] hold on the newspapers, letters, &c., of the present [illegible]

4. There are, comparatively speaking, as many [illegible] bets in Europe—which is generally Christian in [illegible] and Roman in laws—as there are in India. Beside[illegible] alphabets above mentioned, there are the alphab[illegible] the Armenians at Constantinople, the Hebrew, T[illegible] dical and running hand of the Jews, two Geo[illegible] alphabets, the Cyrillic in Serbia, the Arabic charact[illegible] the Turks, &c., nor can a man read correctly I[illegible] Hungarian, Polish, or Wendic because he know[illegible] Roman character, or even Danish or Icelandic, [illegible] because he knows the German character. Nor hav[illegible] Irish altogether abandoned their alphabet in antiq[illegible] publications. Nations cling to their alphabets, with [illegible] they have identified themselves. Why do we not [illegible] our reforms by writing Thucydides in the same ch[illegible] ters as Tacitus? Would not trouble be saved by wr[illegible] Ancient Greek in Latin?

5. Romanisation, could it ever be successful, wou[illegible] the death of the vernaculars. Could anything be [illegible] deplorable than the specimen of pigeon-English [illegible] ferred to by Sir Charles Trevelyan, "Office *jane ha[illegible] hai*,"—"It is time to go to office"—when the verna[illegible] had equally expressive words? No, the vernac[illegible] must be developed from within by their indigenou[illegible] foreign sources—as Sir George Campbell has [illegible] them—and by the juxta-position, not the super-pos[illegible] of English.

6. Romanisation, which has hitherto been a [illegible] plete failure in India, as Mr. Long as shown, sh[illegible] strictly be limited to a scientific and uni[illegible] system of transliteration of Indian names for th[illegible] of Europeans. Much would be gained by Go[illegible] ment adopting a really correct system, but d[illegible] tions from it would constantly occur, as must [illegible]

...ers have no accurate knowledge of the exact value of sounds in consequence of the false notions which they have imbibed in early childhood through the spelling of English.

7. The Roman character might also be taught with advantage in the elementary schools side by side the character of the vernacular of the district, as it would somewhat lessen for natives the difficulty of learning English, but to substitute a foreign and poor alphabet for any of the rich indigenous ones would retard the development of the vernaculars, and thus impede future indigenous and lasting civilisation of India.

8. As little as the words "gratitude" and "egotistical" can be called foreign words in English, because they are derived from Latin and Greek respectively, so little can Arabic, Persian, or Sanskrit words be eliminated from any of the vernaculars, on the ground of their being foreign words, without throwing them back to that stage of savage primitiveness which is without a religious, social, or moral organisation.

9. The test of the alphabet proposed by His Excellency the Persian Ambassador for all the languages which use the Perso-Arabic character (whose sub-divisions vary less from one another than the German does from the Roman) is, that it shall at once be read by any Mahommedan, who does not know the new alphabet. This is true reform, whilst the copious and accurate Sanskrit character might perform the same office for its derivative alphabets. Let us, however, begin in India by insisting that every one should write his own alphabet clearly, and that our officers shall learn the native alphabets in their district thoroughly.

10. That Germans and others have transliterated Oriental texts into the Roman character, is simply because, as a rule, European printing-offices are not already provided with Oriental types. Besides, we shall never admit it as a principle in governing Oriental races, that our own convenience is to be the guide in the reforms which we press on their attention. As a matter of fact, the Oriental character can be printed or lithographed far more cheaply and elegantly than a book in the Roman character. We should develop our printing appliances for the benefit of India, not curtail its benefits because our European printers find a difficulty in dealing with Eastern alphabets.

11. If natives go to Government schools it is because they either wish to stand well with the authorities, or because they desire to study English as a means of employment in Government offices. They do not want to study the vernacular at Government schools, because they believe it to be a waste of their time, as they think they have already learnt it, incidentally through their religious languages, at their own religious schools. By "vernacular" I mean the language spoken by a native; and as the natives of India vary as much among one another as the nations of Europe, so also their vernacular varies; but nearly all the vernaculars, if spoken by Mahammedans, derive their vitality from Arabic and Persian, and, if spoken by Hindus, from Sanskrit. There is really no need for them to study their own vernacular when they know its source, but the capability of the vernaculars, Urdu and Hindi, when developed by that source, has been proved by the fact that students, who were only acquainted with Arabic and Sanskrit, have recently passed the first examination in arts of the Punjab University College in science through the medium of Urdu and Hindi.—I am, &c.,

G. W. Leitner,
Principal, Government College, Lahore.

OUR MERCANTILE MARINE.

12, Upper Westbourne-terrace,
February 28th, 1875.

Sir,—I am very much surprised and annoyed to find that my paper, read at the Society of Arts on the 16th inst., has been so altered before appearing in the Society's Journal that it makes me express opinions which are quite contrary to the whole of my sea experience. All allusions to religion have been taken out, and some other person's opinions replace them. All who know anything of seamen are aware that education alone does not insure their being able or useful. One of the worst A.B.'s that I can call to mind was able to read Greek and Latin. The most objectionable men, who go by the name of "sea lawyers," are very generally the best educated. But whether I am right or wrong, it is not fair to saddle me with another person's opinions, so I shall feel obliged by your giving this letter and the following alterations a place in the next number of the *Journal*:—

Page 267, col. 2, line 8 from the bottom, instead of "education," read "religion."

Page 267, col. 2, line 7 from the bottom, instead of "cut off from all sources of enjoyment," read "without hearing the name of God, except in an oath."

Page 267, col. 2, line 4 from the bottom, instead of "mental welfare," read "religious culture."

Page 269, col. 2, line 15, instead of "can very generally make it a holiday," read "can generally have divine service."

Page 269, col. 2, line 35, instead of "and seeing what has already been done, can we doubt that we will soon complete the work we have begun," read "and seeing what Christianity has already done, can we doubt that by its means the good work will be completed."

Page 269, col. 2, at the end of my paper, put a comma after "circumstances," and add, "and that it was not sensuality, but selfishness and covetousness which murdered the Prince of Life."—I am, &c.,

Henry Toynbee.

P. Le Neve Foster, Secretary,
Society of Arts, John-street, Adelphi.

[The report of Captain Toynbee's remarks was revised in the usual manner, and an attempt made to tone down in a slight degree the somewhat excessive vigour of religious opinion enunciated therein. The obvious reason for this was simply the rule of the Society, which precludes the discussion of religious or political topics. As, however, Captain Toynbee considers himself to have been misrepresented, his letter is inserted above as received. It only remains to express regret that any misconception should have arisen as to the complete impartiality of any report appearing in this *Journal*.—Ed.]

GENERAL NOTES.

The Bessemer Steamer.—The *Central News* states that the machinery devised by Mr. Bessemer for the steamer for Channel service, which bears his name, has just been tried at Hull with great success. As the ship was not at sea, the reverse test of rolling the cabin within the ship was adopted by Mr. Bessemer's representatives, and the power of the apparatus to put the ponderous saloon in motion alternately in opposite directions with the necessary rapidity was fully established. The *Bessemer* is expected to leave Hull for the Thames in about a week's time, and shortly afterwards will proceed upon her service between Dover and Calais, under the auspices of the London, Chatham and Dover Company, in the event of the officers of that company being in every respect satisfied with her.

California Silk.—It is stated that the attempt to make silk husbandry a feature in the industries of California has shown that while sudden changes of temperature in Europe destroy the worms and lead to imperfect cocoons, not a worm has been lost from this cause in California; that the mulberry flourishes; that careful housing and regulation of the temperature avert climatic troubles, and that in the foot hills even these guards are unnecessary. Proper labour is also available at fair rates, and the Eastern demand for cocoons has given a stimulus to the business. So far as attempts have been made, and results reached, it looks as though Califonia had succeeded better than should have been expected. It is proved that the State can secure the cocoons, proved that the temperature does not cause any loss of worms, that the silk is strong and lustrous, and that profit is made from the Eastern demand for manufacture.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Victorian Year Book for the year 1873, by H. H. Hayter. Presented by the Agent General for Victoria.

The Settlements on the Gold Coast and the Ashantee War, by J. G. Lovell. Presented by the Author.

Jacob's Rod; a translation from the French of a work A.D. 1693, on the Art of Finding Springs, &c. Translated by Thomas Welton.

Report of the Proceedings at the Dinner of the Cobden Club, July 11th, 1874.

Convention de Genève; un Souvenir de Solferino, par Henry Dunant. Presented by the Author.

La Guerre et l'Humanité au XIXe Siècle, par Leonce de Cazenove. Presented by Henry Dunant.

Proceedings of the Literary and Philosophical Society of Liverpool. Vol. 18. Presented by the Society.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 3.—Adjourned Meeting for Captain BEDFORD PIM's Reply to Discussion on his Paper on "The Mercantile Marine of Great Britain." Sir J. HERON MAXWELL, M.P., will preside.

MARCH 10.—"The Art of Illustration as applied to the Printing Press," by HENRY BLACKBURN, Esq.

MARCH 17.—"Food Adulteration and the Legislative Enactments Relating Thereto." By WENTWORTH LASCELLES SCOTT, Esq.

AFRICAN SECTION.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 9.—"Livingstone's Discoveries in Connection with the Resources of East Africa," by the Rev. HORACE WALLER. Sir T. FOWELL BUXTON will preside.

MARCH 30.—"Civilisation and Progress on the Gold Coast of Africa, as affected by European Contact with the Native Inhabitants." By ANDREW SWANZY, Esq.

CHEMICAL SECTION.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

March 12.—"River Pollution, with Special Reference to the Work of the late Commission," by W. THORP, Esq., B.Sc. Lond., F.C.S. U. J. KAY-SHUTTLEWORTH, Esq., M.P., will preside.

APRIL 16.—"Recent Advances in Photographic Science," by J. SPILLER, Esq., President of the Photographic Society. WARREN DE LA RUE, Esq., D.C.L., F.R.S., will preside.

MAY 7.—"Alum Shale and its Application," by SYDNEY RICH, Esq.

CANTOR LECTURES.

The Second Course of Cantor Lectures is by the Rev. ARTHUR RIGG, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

The remaining Lectures of the Course will be delivered as follows:—

LECTURE IV.—MONDAY, 1ST MARCH, 1875.

Picks, Axes, Adzes, Chisels.

LECTURE V.—MONDAY, 8TH MARCH, 1875.

Planes, Knives, Shears, Saws.

LECTURE VI.—MONDAY, 15TH MARCH, 1875.

Saws and Dove-tailing Tools.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Rev. Arthur Rigg, "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft." (Lecture IV.)
Farmers' Club, Salisbury-square, E.C., 5½ p.m. Mr. James Howard, "Freedom of Contract."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. J. W. Wilson, "The Construction of Modern Piers."
Royal United Service Institution, Whitehall-yard, 8½ p.m. Sir John Coode, "The Military and Refuge Harbours on our own and on neighbouring coasts, and on such as it may seem desirable for this country to construct."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. E. Ryde, "The Rating of Country Mansions." After the reading of the paper (the discussion on which will be postponed until the next meeting) Mr. J. E. Bonny will call attention to the provisions of the Home Secretary's Bill for facilitating the Improvements of the Dwellings of the Working Classes in Large Towns.
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Mr. S. R. Pattison, "The Chronology of Recent Geology."
London Institution, Finsbury-circus, E.C., 5 p.m. (Travers Course I.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8 p.m. Annual Meeting.
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Dr. George Ross, "The Bill for facilitating the Improvement of the Dwellings of the Working Classes in Large Towns."

TUES. ...Royal Institution, Albemarle-street, W., 3 p.m. Mr. A. H. Garrod, "Animal Locomotion, on Land, in Air, and in Water."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion upon the papers by Messrs. Findlay, Cudworth, and J. T. Harrison, "On the Working, Sorting Sidings, and Statistics of Railways."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.

WED. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Reply of Capt. Bedford Pim to discussion on his paper.
Microscopical, King's College, W.C., 8 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THURS. ...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. Professor Dyer, "Note on the Seeds in Cycads."
Chemical, Burlington House, W., 8 p.m. 1. Messrs. Braham and J. W. Gatehouse, "The Dissociation of Nitric Acid." 2. Dr. Thudicum, "Some Constituents of the Brain." 3. Mr. C. Kingzett, "Calcic Hypochlorite from Bleaching Powder." 4. Mr. Noel Hartley, "A Simple Method of Determining Iron."
London Institution, Finsbury-circus, E.C., 7 p.m.
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. Ferdinand Praeger, "Poetry and Music."
Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "Electricity."
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

FRI. ...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Lord Rayleigh, "The Dissipation of Energy."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. Professor Rieu, "Persian."
Archæological Institution, 16, New Burlington-street, W., 4 p.m.

SAT. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor W. K. Clifford, "The General Features of the History of Science."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,163. VOL. XXIII.

FRIDAY, MARCH 5, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HALL-MARKING OF JEWELLERY.—PRIZE FOR ESSAYS.

1. It having been brought to the knowledge of the Council of the Society of Arts that what is termed "Hall-marking" of Jewellery and articles of Gold and Silver is inadequate to secure to the public that protection in the quality of the materials for which it is intended, and also fails to meet the requirements of the trade, they accepted the offer of one of the members of the Society, Mr. Edwin W. Streeter, to place £25 at their disposal, to be awarded as a prize for an Essay treating on this subject, with suggestions for an improved system.

2. Seventeen Essays were sent in for competition, but as none of them were of a sufficiently comprehensive character to justify the Committee in selecting any one for the prize, they recommended the Council, with the assent of Mr. Streeter, to renew the offer. Mr. Streeter having given his assent to this course, the Council now renew the offer of the prize.

3. It is suggested to competitors that the Essays should treat on—

(a.) The history of hall-marking in this country showing, with some degree of detail,

(b.) The processes adopted and now in use.

(c.) The merits and demerits of the present system, and how far it meets the wants of the public on the one hand, and satisfies the manufacturer on the other.

(d.) If any system is desirable, what should it be, and by whom or under what authority should it be carried out?

(e.) The systems in use in foreign countries, and how far they meet the wants both of the public and the manufacturer.

4. The Essays must be sent in not later than the 1st of June, 1875, marked with a motto or cypher only, accompanied by a sealed letter, with the corresponding motto or cypher marked outside, giving within the name and address of the writer of the Essay.

5. The Council shall have the right of publishing the prize Essay in the *Journal*, and they reserve the right of withholding the prize altogether, or of awarding a lesser sum, if the judges shall so recommend.

(By order)

P. LE NEVE FOSTER,
Secretary.

1st March, 1875.

INSTITUTIONS.

The following institution has been received into Union since the last announcement:—

Broughty Ferry Young Men's Christian Association.

TECHNOLOGICAL EXAMINATIONS, 1875.—NOTICE TO INSTITUTIONS.

Candidates intending to sit at these examinations should make early application to the Secretary of the Society of Arts, Adelphi, London, for forms for making a return of age, address, &c., as these particulars must be forwarded to the Society not later than the 31st instant.

TWELFTH ORDINARY MEETING.

Wednesday, March 3rd, 1875; Captain Sir JOHN HERON MAXWELL, Bart., R.N., in the chair.

The following candidates were proposed for election as members of the Society:—

Akroyd, Mrs. W., 2, St. Alban's-villas, Highgate-road, N.W.
Curtis, Frederick, 48, Baker-street, W.
Goodwin, George, 62, Cornwall-road, Bayswater, W.
Höglund, Fabian, 39, Drottninggaten, Stockholm.
Porter, Thomas, The Cottage, Dulwich-wood-park, S.E.
Riley, Edward, F.C.S., 14A, Finsbury-square, E.C.
Satrustegui, Senor Don Joaquin M. de, 21, Billiter-street, E.C.
Whitfield, John, F.C.S., Scarborough.
Wilmot, John Fletcher, Thames-street, Windsor.
Wright, W. Cort, F.C.S., 46, Morley-street, Manchester.

The following candidates were balloted for and duly elected members of the Society:—

Batcheler, John, jun., Dagnall, Hemel Hempstead, Herts.
Evans, William Herbert, Tintern-house, Primrose-hill-road, N.W.
Gilbert, Mason William W., 43, Rathbone-place, W.
Hartley, Joseph, Ormskirk, near Liverpool.
Hewett, Edward, Elvetham-mount, St. Leonards-on-Sea.
Hewitt, Richard, F.R.G.S., 3, Princes-square, Hyde-park, W., and the Green, Esher, Surrey.
Hooper, William, 113, Victoria-street, S.W.
Houghton, James, 41, Rodney-street, Liverpool, and 4, York-buildings, Dale-street, Liverpool.
Lloyd, John, Kingsbury-brewery, St. Albans.
Pargeter, Philip, Red-house Glass-works, Stourbridge.
Ross, Lewis Buttle, Southend-laboratory, Driffield.
Smith, Edward, F.C.S., Strand, Torquay.
Spencer, Thomas, 32, Euston-square, N.W.
Thatcher, John H., Brook-mills, Oldham.
Ventura, Signor M., 49, Coleman-street, E.C.

The discussion, adjourned from Wednesday, February 24th, on Capt. Bedford Pim's paper on "The Mercantile Marine of Great Britain," was resumed by—

Captain Sharpe, R.N., who said—I propose to read a few extracts from a letter on tonnage admeasurement, which I have just addressed to Sir Charles Adderley. The tonnage question was very ably brought before us by the gallant and learned member for Gravesend, although it has scarcely been alluded to during the late discussions; but before reading these extracts, I venture to make a few remarks on one or two points which have been brought before us. Every one, I feel sure, must have been painfully impressed (as I was) at observing some of the most eminent and respected members of the shipping interest rise, one after the other, to assure us that they neither starved their crews, nor were guilty of the malpractices complained of. I feel confident that no one in this room ever supposed them to be the persons complained of; but when the honourable member for Hull informs us that there are more than half a million of ship-owners, it is manifest that a very small percentage will afford a very large number of persons who will bring discredit on the whole body, and must be looked after, for only one in a hundred will supply 5,000 delinquents; and such is human nature, that in all probability every walk of life would furnish an equal percentage; I doubt if even the lawyers could show more favourable returns. With respect to an increase of British seamen, I scarcely know a subject of more urgent importance at the present moment. The very safety of the country is involved in the question. The deep-sea fishery, as one of the very best nurseries in the world, should be encouraged, but to a largely increased entry of boys we must mainly depend for our future supply. The coast line of the United Kingdom where seafaring habits are acquired is, however, of limited extent, and is now quite incapable of meeting the demand for sailors. We must consequently look to the inland counties, and if other counties will do what we have so successfully accomplished in Middlesex, I firmly believe our present difficulties will in a few years cease. We have now at Feltham an admirable establishment for 800 boys, sent there for comparatively venial offences, such as having no friends, throwing stones, playing at pitch and toss in a public thoroughfare, and other similar offences. These boys are instructed in their duties by means of a brig which has been built and rigged in the grounds, and after undergoing a certain course of education and discipline, these boys very quickly find employment and turn out well; and if every county was compelled to support similar schools the increased supply would soon meet the demand. The boys should be duly apprenticed, and as it would effect a great saving to the counties, a premium of £10 per head should be paid to the ship-owner. With respect to the present liability of ship-owners, it would be unfair and unwise to increase it, unless ship-owners registering under the Limited Liability Act (as far as penalties are concerned) were placed in the same position as those who do not register. For my own part, I would limit the liability of the ship-owner to such an insurance on the particular vessel as would cover the present £8 and £15 per ton liabilities; and as regards provisions, why not adopt the scale of the Royal Navy, which would be fair both to the owner and consumer? With respect to the question of tonnage admeasurement, it will be a subject of great regret if the present Session be allowed to pass without an effort being made to pass such a measure as will be accepted by foreign governments as an international system of tonnage, but to have any prospect of permanent success, the law must be correct in principle, exceedingly simple in details, and yet sufficiently comprehensive for the various requirements of different nations. Any law, for instance, that required special provisions to be made for vessels of different forms, or for vessels employed in different trades, would fail in meeting these requirements, only court evasion, and terminate in failure. A law in fact is required that would be capable of universal application to every class and form of vessel. The country has now before it a considerable body of evidence, collected during the last Session of Parliament by the Committee on the Merchant Ships (measurement of tonnage) Bill, which will materially assist in the settlement of these questions, and show the unfortunate state of evasion and disorder in which the subject is involved. The Bill which was brought before the late Tonnage Committee differed but little from the present law, the principle embodied in both of them (viz., the measurement of the internal cubical contents of the vessel) being the same; the deductions for the register tonnage formed in fact the chief subject of evasion, the discordant views in respect to which seemed so difficult of adjustment and so utterly irreconcilable, either with abstract justice or with the various interests concerned, that it was even suggested that all the deductions in dispute should be swept away, and that the so-called "gross tonnage" (*i.e.*, the sum in cubic feet of all the internal measurements of the vessel up to the highest deck, with the measurements of all the covered-in spaces above such deck, divided by the arbitrary factor of 100) should be adopted as the readiest solution of the apparently insurmountable difficulties with which the question was surrounded. The proposal, however, met with little support, which is not to be regretted, as it would equally with the Bill have been quite unsuited for an international system of tonnage, and would have pressed most unequally on different interests, as I will presently show. It has been again and again urged by those interested in the success of the measure, that the main object of the present tonnage law was to make every part of a vessel that could be made available for cargo contribute to the tonnage dues, and provided every part of a vessel included in the tonnage admeasurement could be filled with every kind of cargo without reference to its weight, one of the chief objections would be removed; but there are natural laws which interfere and render it impossible to do so and keep the vessel afloat. Weight, and weight alone, is the all-important element in a floating body, and if all the spaces, as measured under the present Act and by the proposed Bill, were filled with weighty goods, such as metals, bricks, stone, coal, and water, and even with many goods lighter than water, the vessel would sink. When goods of this description have to be carried, a considerable part of the vessel which has been measured for tonnage must always remain unoccupied. A vessel laden with iron has, for example, a comparatively empty hold, and for anyone to assert that the unoccupied spaces in a vessel thus laden should be taxed, as being then available for cargo, is evidently a mistake. But there are many other cargoes differing in weight, according to their specific gravity, and which by their mere weight will prevent the whole of the cubical contents of a vessel, as now measured, being fully occupied. The advocates of internal cubature have evidently overlooked the impossibility of making use of all the spaces now measured and taxed whenever a vessel has to be laden with goods of a certain specific gravity; and internal cubature, as affording a correct principle for tonnage, is an entire failure. We have now the anomaly of the Legislature by one Act directing the measurement for taxation of every space available for goods, without in the least considering the prohibitions which weight imposes, and then should the unfortunate ship-owner so fill these taxed and presumedly licensed spaces as to immerse his vessel too deeply, it by another Act empowers the Board of Trade to interfere and punish him. The same vessel may on one voyage entirely occupy the whole

her measured spaces with light goods (such as German toys and other light merchandise), and on the next trip with a heavier cargo be compelled to leave them partly unfilled; and yet in both cases her owner has to pay per 100 feet of the whole registered space. This, I venture to assert, is wrong in principle and manifestly unfair, as it presses unduly on the vessel carrying heavy goods, besides opening a wide door for evasion. The space occupied by goods must naturally be secondary to the weight of the goods, the weight being the only true index of a vessel's capacity; 100 tons may immerse a vessel to her fullest extent, but whether the 100 tons is of lead or of feathers, the immersion must be precisely the same, and cannot be exceeded, and yet the space occupied by the lead will be very much smaller than that filled by the feathers. But should these illustrations fail in showing the maze of difficulty in which we become involved by the mere measurement of internal dimensions, the painful disclosures which have appeared before the Tonnage Committee would alone conclusively prove how variously and adversely different interests are affected by these singular measurements and exemptions. We have evidence that some trades would be absolutely ruined by being brought strictly under such a law as the one proposed; hence evasion (as before) will reign supreme; and yet this is the law which England, with all her great mercantile experience, has been proposing to foreign nations as the best law she is capable of producing. There is, I may state, a singular concurrence of opinion among our best authorities in favour of the weight of the lading (as shown by the displacement of the vessel) as supplying the only exact means of ascertaining the carrying powers of a ship, and for comparing one vessel with another; the same weight, whatever be its size or material, causing everything that floats to displace a quantity of water of equal weight with itself. We have, therefore, at our command a well-known and infallible standard advocated by some of the best authorities on these subjects, and who have defined the burthen of a ship as equal to the weight of the water displaced between the light and load lines, the cubical contents between which lines, when measured in feet and divided by 35, supply the weight of a lading which will immerse a vessel to her load-line, and show the extent of her carrying powers and true tonnage. The load displacement (either absolute or modified, as I will presently show), is in fact the only reliable basis for such a law, and in further confirmation of its value as an absolutely correct measure of relative size between vessel and vessel, the Committee on Designs, at page 18 of their Report, recommend for the Royal Navy "that the mass of a ship be described by displacement." But it might be objected that if the entire displacement were adopted in the merchant service, it would produce an amount in figures somewhat larger than would properly harmonise with the tonnages obtained under previous tonnage laws, or with the statistical returns of the Board of Trade; these objections can, however, be easily removed, by reducing the amount of the load displacement by one-fourth (or some other proportion) as an equivalent for the omission of a calculated displacement at the light-line; by which means the light displacement would always bear a fixed relation to the load, and the necessity for ascertaining the position of the light-line would be avoided, and cleverly designed changes in the coal supply for reducing the tonnage would be prevented, and a stop put to the interminable disputes as to the proper weight and dimensions to be assigned to the propelling power, and the adjustment of the claims of sailing and steam-ships (another question of difficulty and hardship) would equally be disposed of. In other words, no chicanery could then have any effect in reducing the amount of the tonnage through the agency of the light displacement. The load displacement reduced by a fixed quantity as described, would give the weight of the loading when the ship was brought to her load-line (the weight, in fact, of the heaviest cargo she could carry in safety); but then an important and interesting question arises, as to whether it be right to levy taxes on a vessel, as if she always had a full lading on board, or whether it would not be fairer to all concerned to retain the displacement as a standard of comparison between vessel and vessel, and to employ the displacement at the moment when required for the purpose of tonnage dues. But whether a vessel be taxed on her load displacement, minus her light (or some fixed quantity in lieu of her light), or on the displacement for the time being (as shown by the draught of water), we have an identity of principle and two exact standards of comparison, either being fully capable of supplying a reliable basis for an international tonnage law. The rules for ascertaining the displacement for tonnage are remarkably simple, and are in strong contrast to the present system of internal measurement with all its disputed exemptions. After the load-line has been fixed, either by the ship-owner or Legislature, the displacement (or cubical contents) below this line can be ascertained in the usual way from the drawing of the vessel, and when brought into feet and divided by 35 for tons (with a fixed proportion substituted for the light displacement), the tonnage would be arrived at; or, should the drawings not be available, let the area in square feet of the plane of the load-line be ascertained, and the area in square feet of another plane parallel to and at one foot below it; add the two areas together, and divide by 2 for the number of square feet, and then again by 35, and we have the number of tons of water displaced by the solid described; continue this operation foot by foot, and the sum of the whole will be the tonnage of the vessel. By adding together the foot tonnages up to any particular draught of water the tonnage corresponding to that draught will be immediately obtained, and a table giving the tonnages at every foot could be formed and entered on the ship's register. The horizontal curves of the ship's side would be taken by a simple instrument, and when transferred to paper the areas could be taken out by inspection; the system of measuring tonnage by displacement, while being absolutely correct, can be worked out without the least necessity for any science in the agents employed. This system has therefore both correctness and simplicity to recommend it, two essentials which are indispensable in an international system of tonnage. And if the Government will look to the general interests of the community rather than to the special interests of individuals, and will vigorously undertake the subject of tonnage, without respect to class interests, I am convinced that all difficulties will quickly disappear, and a measure befitting the mercantile position of England be produced which will be a credit to the country, and will meet with a general acquiescence from foreign powers. Allow me, before sitting down, to tender my thanks to the Society of Arts, and to the gallant member for Gravesend for the valuable discussion which has taken place. Whether we do or do not agree with all the honourable member's views, the country is equally indebted to him for initiating it.

Mr. H. Liggins said he would not say anything more on the subject of tonnage, which had just been referred to, except this, that he had had the honour for many years —though not at the present time—to be official measurer to the largest yacht club in the world, and therefore it came within his knowledge that all the yacht clubs in England and the United States had for many years been endeavouring to discover some system of tonnage measurement adapted to racing purposes, but in vain. He therefore did not think there was any chance of Parliament during the present Session passing an Act which would settle this most difficult question. If there was one question more difficult than another, it was that of tonnage, and he was quite amazed at some of Mr. Sharpe's remarks. Many evenings might be employed in the discussion by gentlemen who understood

the subject of this question, and it would be therefore impossible to enter upon it at that moment profitably. The main object of the discussion, he apprehended, was to improve the quality of English ships, and of a small class of ship-owners. As he had owned ships trading from London to the West Indies for the last three years, he knew something of the subject, and was able to state that, as a rule, ship-owners were honourable, upright men. He should never fear to face either Mr. Plimsoll or Board of Trade or Lloyd's surveyor. He could say with some pride that his father and himself had owned ships trading to the West Indies at all seasons of the year, during forty years, and had never had an accident from a preventible cause. True, one ship had once to cut away her mast to save herself from wreck on the Mouse Sand, in one of the most terrible hurricanes that ever visited the coast; but she was the only ship within sight which was not totally wrecked. It was plain, therefore, that ships might be kept in a state of efficiency to cross the Atlantic in all seasons of the year, but his ships were not ten times their beam in length. They were of the old school, but at the same time they could do their 12 or 14 knots an hour, for he had gone, under favourable circumstances, 30 miles in two consecutive hours. Mr. Currie, when speaking of long ships, said they were built of iron, and that the strength of iron girders, as shown by Sir William Fairbairn in his work on the subject, should be borne in mind. They all knew that, and that it was impossible to build wooden ships of the length of some of the ocean-going iron steamers. But who was there who had been to sea, and had had any experience of severe weather, who did not believe that these long iron vessels did not go down because they were weak in construction; they went to the bottom and drowned everybody on board, because their form was such that they could never cope with the rough waves they had to encounter. He defied any man, however skilful, to save those ships in many of the gales which occurred off the coast. You could hardly take up a newspaper without reading of the loss of some well-known favourite ship; there was one reported in that day's *Times*, one of the Cape mail boats, kept up in the highest state of efficiency, and commanded by men of the highest eminence. The remark had been made that the country was going to the dogs, and that sailors, ships, and trade were going to the dogs too. However that might be, he knew that when he first crossed the Atlantic in his father's ship 39 years ago, every sailor was English, efficient, and capable of steering the vessel. But in later days, when he sailed in his own ships, he found that if there was a man on board who could steer he was a foreigner, and he found his captains always preferred Swedes, Norwegians, and Danes, because they were more steady and respectable, and more sailor-like in their habits. He had often been asked by his captain to steer, because there was not a man on board whom he could trust to do so. It was an undoubted fact, therefore, that there was a great deterioration in the character of English sailors, and it was only on board of yachts that you could find really first-class sailors. Any captain of a merchant ship would say that his crew were the scum of the earth, and nearly useless for practical purposes. As to the remedy, they must begin at the beginning; and, having been often in the lowest slums of London in search of sailors, he would say that the first effort should be to improve their dwellings inland. It was impossible to improve the condition of a working man if he were driven from his wretched home to an almost equally degraded public house. There was no class so utterly helpless as the poor sailor. His calling was one in which he could well enjoy his duties, but directly he landed he was set upon by a shark called a "crimp," who carried him off to the first public house; poor Jack in ten minutes was in a state of hopeless drunkenness, and in that state he was kept by the crimp until his wages were all gone, when he was sent to sea again, the ship often being selected by the crimp himself. This introduced the question of advance notes, which he admitted were wrong in principle, but he feared necessary in practice, or sailors would scarcely be clothed at all when starting on a voyage. The improvement of sailors' dwellings he thought could only be effected by Government inspection, and as this was already carried out in his own parish of Kensington and elsewhere, he saw no reason why it should not be extended to houses occupied by seamen. In conclusion, he would only say that he believed Mr. Plimsoll and Captain Bedford Pim had done an immense service to their country as well as to the shipowning class. He begged leave to quote the words of Lord Hampton, then Sir John Packington, two years ago at the Institute of Naval Architects, which he considered were equally applicable to the gallant member for Greenwich as to Mr. Plimsoll—"Let us do all honour to the merit, and I do think it a great merit of Mr. Plimsoll in thus having given his attention to this most interesting and important subject. I do not shrink from saying, that in my opinion Mr. Plimsoll is entitled to the gratitude of the whole country for the spirit, energy, and vigour with which he has carried his motion into Parliament."

The Rev. R. J. Simpson (Rector of St. Clement Danes) after referring to the great national importance of the discussion, to which he had listened with much pleasure, said he feared there had been a little of the old logical fallacy in it of arguing from particulars to generalities, one side speaking of good ship-owners, and the other of bad, as if they were to be the criterion for the whole class. Public attention had now been aroused, and though he should have been glad if this of itself had been sufficient to cure the evils complained of, he feared legislation would be necessary, but he hoped it would be temperate in character, and not bear the appearance of being in any particular interest; it should be a law simply for the good of the community, a law "not made for the righteous man, but for evil doers, and for the praise of them that do well." The point he wished to impress upon the meeting was the importance of multiplying training ships to as large an extent as possible. Not only as a member of Mr. Plimsoll's committee, but as one who had taken a deep interest in a training ship on the Thames, he had seen the admirable practical results which had followed. It appeared to him this was the kernel of the nut. They were told that sailors had deteriorated in quality, and were wanting in quantity, and it was impossible to avoid a blush of shame on hearing such statements as had just been made with regard to the superiority of foreign sailors. Why was this? Not because they were made of better material, or were naturally better sailors, but because the *morale* of the English sailor was inferior. Therefore what was wanted was to improve their *morale*, and if they began by making good, honest English lads of boys who were now in danger of being trained up to be inmates of workhouses and gaols—for prevention was better than cure—they would go far to supply the want complained of. Out of 15,000 boys who had passed through the *Chichester* in seven years only 123 had been refused their certificates, which showed there was no danger of failure in this direction. He hoped therefore that training ships would be established, not at one or two places only, as used as receptacles for criminals, but at every large port where boys of good Anglo-Saxon spirit would be proud of becoming by their means English sailors. Therefore, however much gentlemen might differ on some points which had been mentioned, he hoped all would be unanimous in voting for the establishment of training ships in every great port of Great Britain, in which the lads of the neighbouring towns could find a place, not merely of refuge, but of honourable employment. In that way they would supply the country with good seamen, and prevent may a body and soul being lost to the country and to heaven.

Captain Pim then read the following reply:—

I wish, at the outset, to express my warm thanks to the meeting for the flattering reception my paper has received, due of course to the vast national importance of the subject of which it treats. The opinions it has elicited from experts, during four nights' discussion, are of the utmost value, without them, indeed, the paper would have been comparatively worthless. I think I may now fairly hope that the question of the "State and Condition of the Mercantile Marine of the United Kingdom," thanks to the Society of Arts, has been so placed before the public, that no one can well plead ignorance about it, and that certain facts have been so clearly brought out as to render it an easy task to proceed with legislation on a sound, safe, and, above all, judicious basis.

It will be remembered that I divided my subject into two parts, viz., "Sailors" and "Ships," and under those two heads in the broadest sense, the paper has been discussed. As a matter of interest, I may mention that no less than twenty-six gentlemen have taken part in the discussion, besides two important letters which have been written on the subject, one from Mons. de Lesseps, the other from Mr. James A. Smith, which have been printed. Those gentlemen who have taken a practical interest in our proceedings may be classified as follows:—

Ship-owners	7
Ship-broker	1
Underwriter	1
Naval architects	3
Masters	3
One seaman and one apprentice	2
Mathematician	1
Yachtsman and R.N.A. volunteer	1
Medical examiner of seamen	1
Representatives of education and marine training	3
Merchant	1
Maritime Bank manager	1
Shipping master	1
Total	26
Letters	2
Chairman	1
Total opinions	29

In addition to which this discussion has given rise to the formation of a committee, on which experts and practical men connected with every branch of the mercantile marine will be asked to serve. The deliberations and action of this committee I confidently believe will prove of the greatest value in bringing about the legislation we all desire.

Before proceeding further, I wish to be distinctly understood as in no way reflecting in my paper on the good ship-owner, or ship-owning companies; how indeed could I do so, for I perfectly well know, that were it not for their savour, the shipping interest of this country would long since have lost its saltness; were it not for their healthy presence and example, the present deplorable condition of our mercantile marine would be past reform; there are, however, ship-owners and ship-owners. We have still, thank God, good men and true amongst us, whose bounden duty it is to bring their practical experience to bear upon legislation, with the determination to root out the bad from their numbers, and not rest for a moment until the slur which Mr. Plimsoll has cast upon their class has been effectually removed. It was with the view of invoking the aid of these men that I prepared the paper I have read to you. There is no blinking the question; this must be done without flinching, or the good and bad will fall together; for there is no denying the fact that the true British seaman is disappearing with frightful rapidity. Such being the case, and my avowed object being to ventilate this most momentous question as a practical man, and by that means get at the opinions of other practical men, I must confess that I was somewhat taken aback by the warmth infused into the discussion by certain gentlemen who seemed to think I was attacking their particular interests, when in reality no such thought ever entered my head. Perhaps I had better at once take the opportunity of dealing in this part of my reply with these gentlemen, as it partakes somewhat of a personal matter, so that the thread of what I have to say on the discussion, pure and simple, of my paper, may be uninterrupted.

My desire that Lord Campbell's Act should be extended to ship-owners (I still entertain this opinion, although only the bad owners need fear its effect) seems to have irritated some gentlemen very much, for what reason I cannot imagine, as I am told that the two of them who are ship-owners, Mr. Currie and Mr. Duncan, are the very *élite* of their class; while the third, a ship-broker, Mr. Glover, is, I hear, a most estimable gentleman. Why then did he, forgetful I fear of that Christian love and charity which, no doubt, ordinarily distinguishes him, "ask the honourable Council of the Society of Arts if it was right that the pages of their *Journal* should be defaced by such a misrepresentation" as I had made. This, I think, you will agree with me was scarcely kind from a gentleman of his great influence. Then, again, his wrath was great at my daring proposition that the mercantile marine of this country was worthy, for many and substantial reasons, of having a responsible head—a Minister of State, for instance—to take off the pressure from the unfortunate President of the Board of Trade, whose multifarious duties are enough to drive him distracted. He was very strong indeed against such an idea, and somewhat unintelligibly, if not sarcastically, I think, said:—"He would ask, had they not already got one in Mr. Farrer and another in Mr. Gray." The latter gentleman, who was present, must have felt much gratified at being joined with Mr. Farrer as one of the two new heads, suddenly appearing in the place of my poor responsible one, decapitated so remorselessly by Mr. Glover from that Hydra—the Board of Trade. But my iniquities seemed to have reached their climax in my expressed hope that "the incubus of the Board of Trade interference had reached its limit." I can only say that I do hope most sincerely that the Board of Trade interference has reached its limit, and that Mr. Gray will be in future restrained from running about the country making curious speeches and blowing hot and cold within the short space of two years, as follows:—

A report on "The Supply of British Seamen," signed by Thomas Gray and Mr. R. G. C.

Hamilton was submitted to Parliament in 1872. In this report it is stated that—

"Our practical conclusions therefore are, that for the purposes of our Mercantile Marine no case is made out for the interference of Government to increase the number or improve the quality of seamen serving on board British merchant ships, and *that nothing need be done* for undertaking the special education of persons going to sea as merchant seamen with a view to making them fit for the Royal Navy Reserve, until it has been first shown that there are not among our merchant seamen and fishermen at the present time an adequate number sufficiently good for the purpose."

And at the same time it was pointed out by the Liberal Press—

"That the conclusions arrived at by the officials of the Board of Trade must remove from the minds of the public any fear that might be entertained respecting the quality and supply of seamen for the Mercantile Marine."

Two years after we find the same official who signed the above report attending a meeting of ship-owners at Liverpool, and stating that—

"There is undoubtedly in the Mercantile Marine an immense waste through the unshipworthiness of seamen. Men were shipped who were utterly unfit to go to sea from their physical condition."

And again—

"The question of the supply of seamen to the Mercantile Marine was not a small one, and must be taken up from a comprehensive point of view."

In fact, the losses both of life and property, which this country has almost daily to deplore, arise now, in this gentleman's opinion, not from the unseaworthiness of ships, but the unseaworthiness of seamen. The *Morning Advertiser* is lost in wonder at the part now taken by the Board of Trade and Mr. Gray, and I also am surprised that the Government of this great maritime empire should allow such mighty interests to be tampered with, and that they should permit so "indefatigable" (!) an individual to go about the country blowing hot and cold almost in the same breath.

Mr. Gray, I am told, is a most conscientious gentleman. I do not question this, but I should like to see him kept strictly in his place, and confined to the duty of his office, where, I doubt not, he might be made a useful public servant.

Mr. Currie followed in much the same strain, dragging into the discussion my Central American experience, hinted at by a previous speaker. This was the unkindest cut of all, for although I am naturally proud of my connection with Central America, quite as proud as he can be of the shipping business he has made, yet I must confess that pride is associated with the feeling that I at all events have not yet made a good business—as he has—out of the time, labour, and money spent during the best years of my life in efforts to develop through Nicaragua and Honduras the much desired transit. Surely Mr. Currie, from his strong position, with no loss of ships, life, or property to throw a damper on his career, might have let me try and forget, at least during a discussion on the merchant marine, my disappointments, my losses, and the sufferings endured, cheerfully, I hope, but still, humanly speaking, without result, so far as the hobby of my life is concerned. It put me in mind of the old story, "No case, abuse the plaintiff's attorney." No doubt, on reflection, Mr. Currie will feel that the course he took was not a generous one, but I freely forgive him. Both Mr. Currie and Mr. Glover tried to make capital about the melting away process, which they stated I had asserted to be the case with our commerce, in support of which a portion of my paper was quoted, which was considered applicable; but I submit that the entire passage must be taken, or the drift of my observation will necessarily be misunderstood. As I stated at the time, that man must be a fool who asserts that our commerce is melting away. What I really said was as follows:—

Now, under what aspect and in what form does this great matter really present itself to us? To such an inquiry the answer is as simple and plain as it is both startling and lamentable. Since the repeal of the Navigation Laws in 1849, just one quarter of a century ago, the marine carrying trade of this vast commerce has been gradually melting away from our flag, and falling into the hands of other nations. Indeed, at the period of the commencement of the great Civil war in the United States in April, 1861, matters looked dark indeed for us, our transatlantic kinsman having then absorbed a very large proportion of the maritime carrying trade of the world. At that time the tonnage of American shipping was about equal to our own. One effect of the American Civil War, however, was to throw the United States completely into the background in respect to their merchant shipping. And yet, notwithstanding the approximate extinction of that once-formidable rivalry, at the present moment a very large proportion of our own commerce is carried in foreign bottoms. Had it not been for the American Civil War, it would be difficult indeed to say to what condition our merchant service before the time now present might have been reduced; so that in this case, at all events, we have an illustration of no common magnitude of the saying, "It is an ill-wind that blows good to nobody."

With regard to Mr. Duncan, the third gentleman to whom I have referred, an eminent shipowner, as I am informed, who, by-the-bye, spoke with reluctance, and only after being called upon by his friends, he also could not stand the idea of enforcing Lord Campbell's Act on the ship-owner, "why, in one day (said he), Mr. M'Iver, it was stated, had sold 28 vessels because an Act was passed extending Lord Campbell's Act to ship-owners, although he was bound to say that a gentleman, who said he had not much to lose, bought them all at £3 per ton!" Mr. Duncan then stated that "he was quite sure that Captain Pim would not knowingly traduce ship-owners, but he had evidently gone into this subject without making sufficient inquiries, and had been led to make statements that were not well founded." He then remarked, with touching pathos, that "one of the charges which had cut him to the quick, was that seamen were not properly fed; he did not care what was said about their being hard-worked, because that they took their chance of, but he should feel very much hurt if any man in his employ came home and said he had not had enough to eat, and he felt that this charge was not true generally." Of course it is not true "in general." I never said it was; the seamen would necessarily famish if it was; though my experience goes to show that vile provisions—meaning not enough to eat—are only too frequent on board ship. Mr. Duncan seemed then to have got into his head that I was against small ships. Why, I do not know. He went on to say that "that there was many a master navigating a small coaster (which Captain Pim possibly would n

like even to go on board of), who brought up a family in respectability out of her earnings, and with two or three men under him who were doing the same, and why should they not do so?" I say why, indeed? These are the very men who should be encouraged to the utmost; but I must inform Mr. Duncan that I have seen as rough work as any one, not even excepting himself, and that I should rather enjoy than otherwise paying his coaster a visit.

Mr. Duncan then, with charming simplicity, told the meeting that he had known numerous instances where, from a sea breaking on board, the sugar had been spoiled, and the men had been paid for it. I should like to know where the sugar was stowed in those ships.

Doubtless, in all these *numerous* instances, it was not the sugar alone that was spoilt—for a little chink is said to admit a great deal of light. From this I suppose it may be honestly affirmed that in numerous instances the sugar and other stores are stowed where they should not be, and that due care is not exercised in the construction of hatchways, companions, and skylights, so as to admit of their being secured against the invading sea. In fact, the grossest carelessness in a certain class of ships is known to prevail; and it is notorious that the very space necessary for the storage of provisions is given so grudgingly, that at the last they are stowed—not quite, but nearly—anyhow and anywhere. No doubt this experience of Mr. Duncan is not very recent.

But I will not pursue this subject any further, for personal matters are neither instructive nor entertaining as a rule, and I have said enough I think to vindicate myself, while the *animus* displayed takes away from the value of what would otherwise have been listened to by me with the utmost respect.

I now turn to a foeman worthy of my steel—Mr. Norwood. I have seldom listened to a more able speech than his, or one delivered in a more gentlemanly manner. I demur, however, to his facts, except in so far as they apply to himself. On inquiry amongst seamen I find he is a most popular owner, for when, preparatory to the great meeting of sailors last year at Limehouse, Mr. Plimsoll in the chair—at which I was present—a procession of seamen marched about the East-end, when abreast of the office connected with Mr. Norwood's business, they loudly cheered that gentleman, while other owners' offices were treated to groans.

Mr. Norwood has told us that there are 500,000 shipowners in this country, half a million of ship-owners! This statement was questioned, at the time it was uttered by the meeting; but in truth, Mr. Norwood was not far wrong, for probably there is an average of twenty owners for every British ship; but this fact only renders it the more imperative that so large a class should be looked after, lest more good owners should follow the lead of the bad in yielding to the temptations which the repeal of the Navigation Laws, empirical tonnage laws, and the extraordinary legislative enactments which hedge about the shipping interests, dangle like the forbidden fruit before their eyes. But let me put this matter before you in a practical shape. I should like anyone in this meeting to name to me a class or profession in this country, or indeed in any other country under the sun, of whom five per cent. at least are not *mauvais sujets;* I will not except even clergymen, whether Churchmen or Dissenters. Now then, if this be true, as true it is, no doubt, though understated, where do we find ourselves landed? Five per cent. of the 500,000 ship-owners is 25,000. Well, let us say, 25,000 indifferent ship-owners in our midst at least, and heaven knows how many more. Surely it is time to be up and stirring.

In replying to the objections raised by the various speakers, I shall adhere to the plan followed in the paper itself, and deal first with the sailors, and then with the ships.

Sailors.

I have laid it down that the British sailor is "ill used;" and I am sorry, very sorry to say that no evidence whatever has been brought forward to refute this statement; the fact is incontrovertible. Indeed, with the exception of Mr. Duncan, no one seems to have cared to argue the point; Mr. Duncan, even, did not go beyond asserting that "knuckle-dusters" were not used by the officers on British ships. And for my part, although, according to Mr. Duncan's own showing, knuckle-dusters do not seem to be unknown, I freely admit that knocking a man down with a hand-spike, and then kicking him for falling, is rather the exception than the rule, though by no means an uncommon exception, as is well known. What I maintain is this, that no one pecuniarily interested in him cares to understand Jack, to study his idiosyncracies, to really attend to his welfare, mentally, physically, and spiritually; on the contrary, that he is systematically neglected, that there is little or no effort to elevate his character, and no attempt is made to rescue him from the appalling state of heathenism into which we all know he has fallen. If this is not ill-usage, and what is more, undeserved, selfish, aggravated ill-usage, I do not know what is. There is a clause in the Naval Discipline Act to this effect:—"The public worship of Almighty God shall be reverently and devoutly performed on board the respective ships." Now I have often performed this duty on board the vessels I have commanded, when there was no chaplain (on board a gunboat, for instance, on a voyage to China under difficulties, as may be imagined), and I have found great benefit therefrom, and experienced the wisdom of the regulation, even from an essentially worldly point of view. Now, why, I ask, do not ship-owners, other than owners of mail, passenger, and emigrant ships, order their captains to perform divine service on board their ships every Sunday, weather permitting; they may take my word for it they would gain by enforcing such a regulation in every sense; and I venture to think that the improvement in the moral, and therefore in the physical condition of the merchant sailor would very shortly be most marked, if the man was only taught the reverence due to God's holy name, instead of taking it in vain a thousand times a day in the shape of oaths and execrations. I would appeal to my friend Captain Toynbee in support of what I say, and I take this public opportunity of thanking him for his admirable remarks on this subject. Again, with regard to books, a child of five could count up the owners who supply even a modicum of

reading for their men. Yes, indeed, the sailor is "ill used."

Now, in regard to my assertion that the sailor is "inadequately paid." I was very much amused with the buoyant and triumphant manner in which my honourable friend Mr. Norwood disposed of this question, by reading to us the current rate of wages obtained only the day previously, signed by the Registrar-General of Shipping. At first sight, an average of £3 15s. per month and found does not seem at all bad for an A.B., but in the first place it must be remembered that the sailor has to support a wife and family at home, and is out of employ a considerable part of the year; in fact his wages are not regular. But the real point where the shoe pinches, by reason of which I maintain he is inadequately paid, is that his shipmates are selected without discrimination, foreigners or landsmen, it is all the same, each A.B., whether seaman or not, receiving the same pay, so thus, when the ship is at sea, the real sailor has not only his own work but that of his land-lubber shipmate also; it is a very common case indeed to find that not one-third of the crew are good hands, and yet these men while having to make up for the short-comings of all the incapables, after all, only receive the same remuneration.

But even taking the figures of my honourable friend—for he, Mr. Norwood, admitted that both by experience, and as the result of inquiry, he had been convinced that a large portion of our merchant seamen (probably fully one-third of the whole) were lamentably deficient in seamanship, in *physique*, in health, and in moral character, in fact, "they were unseaworthy"—I say, without fear of contradiction, "that these figures prove that the good seamen are inadequately paid." The wages quoted by my honourable friend are a current wage; between the two-thirds who are capable and the one-third who are of such low quality, there is no difference in the rate of their remuneration; it follows then that either one of two things is the case—either the two-thirds are very much under-paid, or the one-third are very much over-paid. I leave my honourable friend on the horns of this dilemma, and adhere to my original statement, that the British sailor is inadequately paid.

In respect to my third proposition, that the sailor is badly fed and housed, there is no denying the fact, and no one in this discussion has attempted seriously to upset it. It is notorious that the forecastles of very many British ships are a disgrace; damp, dirty, dark holes, quite unfit for human habitation. There is no means of airing these dungeons without letting in the water. There are no mess tables for the men, who take their food on their chests as they can, and their bunks are mere troughs for catching the water, so that the seaman, even in moderate weather, hardly knows what it is to have a dry skin. In these forecastles, low fever runs riot; no wonder, then, that the seaman is found so deteriorated in *physique*, when such accommodation falls to his lot. By law the convict is entitled to 9 superficial feet of deck-room, and 57 cubic feet of air; every emigrant to 15 superficial feet, and 90 cubic feet of air; every soldier to 10½ superficial feet, and 63 cubic feet of air; every man-of-war's-man to the same as the soldier, but the merchant sailor has scarcely 6 superficial feet; but as to his cubic allowance of air, the least said on that delicate point the better.

With regard to the food, I am bound to say that my statement has not been controverted in the least. A more unsatisfactory state of affairs it is difficult to imagine. I say nothing of the injudicious nature of his food, which is expensive enough, but yet not one whit dearer than the food of any other person; but where, I ask, is the nutriment in very hard salt beef and rancid pork. The fact is, it is a rare case, that *all* the articles of which a sailor's food is comprised, are found to be thoroughly good, during the whole voyage, on board any ship. Certain articles are always of inferior quality—coffee, tea, sugar, vinegar, and limejuice—these are notoriously kept in store of most inferior quality, by those who provision the ships of owners of a penurious character who shave it fine; but I go further, and say that in these days of excessive competition, all such articles of consumption are adulterated, in spite of public analysts, and pains and penalties.

In short, a great deal has been made of the *quantity* of provisions issued, but how about *quality*? I have seen pork into the fat of which I could easily force my thumb to the hilt. The provisions supplied to the Navy from the Royal dockyards are of a very superior quality. Alderman Lusk and others have tried to introduce other victuallers, but even a Liberal Government resisted that, and stuck to the Royal victualling yards for meat. Again, a good cook on board a merchant ship is not often found; the contrast in this respect between the British and American merchant ship is very marked. I have had as good a sea-pie or lobscouse on board the latter ships as could be made.

I now come to my fourth proposition, that the sailor's life—a life of continued exposure—is rendered less endurable by systematic neglect, and that he is altogether worse than the members of any other class of his fellow-subjects, not even excepting the denizens of our prisons. Not the slightest attempt, so far as I can remember, has been made to reply to this statement, and indeed I do not see how anyone could make such an attempt; for the facts are notorious, and attested in a somewhat startling manner by the rapid decrease of British seamen in our mercantile marine.

I therefore feel justified in laying it down as proved—1st, That the sailor is ill-used; 2nd, That the sailor is inadequately paid; 3rd, That he is badly fed and housed; 4th, That his life—a life of continued exposure and hardship—is rendered the less endurable by systematic neglect, and that he is altogether worse off than the members of any other class of his fellow-subjects, not even excepting the denizens of our prisons. And this recollect—be it said with shame—of a class of men not only the most useful in the country, but essential to the very existence of the nation.

Now let us look at the condition of the officers, and what do we find? Why, they are as badly off as the men.

The discussion has not been silent on this point, but it is useless with regard to the officers to enter into detail, and I will content myself by reading the questions put by me to the President of the Board of Trade from my place in the House of Commons on Monday last, as follows:—

"Is it the fact that foreigners who are not naturalised as British subjects have been permitted to pass the Board of Trade examination for masters, for mates, and for engineers

in the Mercantile Marine of this country, upon certificates of service in foreign ships, in contravention of the Merchant Shipping Acts, which especially define the amount of service in the various grades in which the applicant must have served on board British ships before he can claim to be examined? Is it the fact that the Board of Trade is not in a position to verify the certificates of such applicants? Is it the fact that these certificated foreigners, owing allegiance to foreign States, are now serving as masters in command of British merchant ships, and as mates in British merchant ships, and as engineers in British merchant ships, in considerable numbers, exercising authority under the Union Jack? And is it the fact that any of the above-named foreigners have been permitted to change their names, and have had commissions in the Royal Naval Reserve conferred upon them?"

To which the right hon. gentleman replied "that it was true that foreigners not naturalised were serving as masters, mates, and engineers in the British Mercantile Marine."

Upon which I have moved for a return of these foreigners in the following terms:—

"Captain Pim,—Mercantile Marine (foreign officers),—Return from the Board of Trade of all foreigners who have been allowed to pass the examination of the Board of Trade for masters, for mates, and for engineers in the British Mercantile Marine; including therein the names of such foreigners, their nationalities, the date and nature of their certificate, the name and number of the ship in which they serve or have served, and also the name and address of the owner of such ships."

Now, I ask this meeting how can they expect to have good masters, good mates, and good engineers, competent men — zealous to do their duty, anxious to improve themselves, proud of their country, and jealous of its honour, when they are met at the very outset by a competition such as has been disclosed by the question I have just set out, and the answer I received from the Right Hon. the President of the Board of Trade. Now, as a seaman, and as one who has served in all parts of the world, I am bold to affirm that what the merchant navy requires at this moment, more than it ever has done, is a class of masters who shall be competent to act as moderators between the law, the ship-owner, and the crew; and this will be more and more a necessity until the Merchant Shipping Act and all its many incrustations in the form of amendments, and amended amendments, is rewritten from first to last, and arranged on such a concise method and in such precise language that we sailors one and all can understand it. I claim that this important covenant between British subjects shall be made so transparently clear that it shall be in future a bond between all parties, as easy of reference as the mode of procedure under its directions shall be simple; in fine, that "the wayfaring man, though a fool, shall not err therein."

The discussion has taught me much on one point especially brought forward by Mr. Dipnall, of Christ's Hospital, and Mr. Robert Greaves—namely, the education of the captains and officers. Mr. Dipnall showed clearly the enormous responsibility placed in their hands, the necessity of there being in emigrant and passenger ships finished Christian gentlemen, given to hospitality, able, not only to be the captain of their ship, but also to take the head of their table, diffusing a moral tone fore and aft.

Our merchant captains should be men to look up to; theories might be left to scientific speculators, but the thorough practice of navigation should be in their hands. They should know enough of steam to make them free of the caprice of any chief engineer.

With regard to Mr. Robert Greaves's remarks on the necessity of their having a sound acquaintance with plane and spherical trigonometry, I quite agree, especially as such knowledge is easily acquired with common industry. This knowledge would either make them independent of, or more thoroughly to understand, the rules of common navigation. We should not hear (if these things were fairly taught and men fairly examined in them by practical pilots, graduated, not at Oxford or Cambridge, but in the universities of the Atlantic, Pacific, and Indian oceans) of ships being lost off the Comoro islands, north of Madagascar, while fancying themselves near Natal. This captain knew not how much crossing the equator affected his rules. Years ago, when I was a midshipman in the old *Herald*, a surveying ship, commanded by that successful practical seaman, Sir Henry Kellett, a youngster joined us from Christ's Hospital. We did not think much of him; nothing particular in this Bluecoat boy. Yet, somehow, the urchin was ever in the cabin. When some problem, some knotty point, was to be untied, this youngster was sent for. Now, why was this? Because that school had taught him an art that other academies neglected. He had the practical use of plain and spherical trigonometry at his fingers' ends. The compasses and scale did his bidding; he was never at a loss; he could solve questions without books or tables. He could tell everybody by what authority he did these things. Of course, the success of a youth so educated was certain; and the career of my old friend Staff-Commander Hull, the Superintendent of Admiralty Charts, is a proof of the correctness of the views of Mr. Robert Greaves and Mr. Dipnall.

SHIPS.

Not one word in the discussion upon the seaworthiness of ships has led me to alter in the least my opinion as to the chief cause of the unseaworthiness of our ships, irrespective, I mean, of the acknowledged unshipworthiness of a majority of our so-called seamen. I said:—"I am prepared to assign to the unsafe and unhandy form of steamer now unhappily so prevalent, almost without an exception, the deplorable cases of foundering at sea with which we are now becoming more and more familiar." Now it seems, however, that a very potent agency has its eyes upon these ships and will not insure them.

Mr. Young, vice-chairman of Lloyd's, tells us:—"They know perfectly well who were the bad ship-owners, and they put a fine upon them, and sometimes they ostracised them. He could adduce scores of policies "Warranted not to be shipped in Blank and Blank's vessels,' or 'in Blank and Blank Company's (Limited) vessels'—hundreds he might say. They knew them. They took care of them. And they were perfectly able to look after those men." And, inasmuch as it cannot pay in the long run for owners to underwrite such vessels themselves, let us hope that the crying evil in these ships, their faulty construction, will effect its own cure, by forcing upon the owners the necessity of remedying so glaring a defect by an honest and intelligible tonnage law.

Mr. Dipnall, of Christ's Hospital, dealt with these questions in so intelligent a manner, especially in replying to the remarks of Mr. Young, that I cannot do better than repeat them. He said:—

"On the question of construction, he would say that ships built ten or eleven times the length of their width could not be normally safe. That opinion had been given by Sir William Fairbairn close upon the loss of the *Atlantic*. The model on the table was seven times the length of the width, and they could see how narrow it apparently was, and if they stretched that the length of three widths more they would see how narrow she would be. The *Atlantic* was 420 feet in length—that is to say, if she stood on her stern her forefoot would reach the cross of St. Paul's, and she would be twice the height of the Monument. Constructors had a good deal to consider in regard to the length of ships. Steamers were the chief sinners in this respect, and not sailing vessels; but, on the question of the deep load-line, sailing vessels he thought to be rather the sinners than the steamers. It was true that steamers often started with a deep load-line, but they lightened as they went. A gentleman from Lloyd's had stated at the last meeting that marine insurance was to some extent the cause of disasters no doubt, and that if in every case a person was his own underwriter he would take care of his ships. And he went on with some further remarks that legislation would be the best thing for underwriters, as it would then be so lucrative a business he supposed everybody would be going into it. He then proceeded to say that he could adduce scores of policies which were marked 'Warranted not to be shipped in ——— and ———'s ships,' or '——— and ——— Co.'s ——— Limited ships.' They knew them, and they could take care of them, and they were perfectly able to look after these men, he said. Now, he (Mr. Dipnall) would ask if there were such persons, why was not information given whereby such ships should not be permitted to go to sea at all, and thus save the lives now wasted. This was a most serious question. The real principle of marine insurance should be that of an equitable society, where it was everybody's interest to look after the interest of the others and see that they were honest. It was here confessed that a large number of ships were known to gentlemen which could not be insured."

Mr. Young said he did not say ships, but ship-owners. Mr. Dipnall was obliged for the correction, but it landed them in the same position, he thought, for ship-owners must have ships. Mr. Young observed that it could not be discovered till after the ship was lost and the damage done. Mr. Dipnall said it still left the matter as serious as ever. Much had been said during the discussion regarding the loss of British ships, and that it was not so large comparatively. He would venture to remind them that, with 22,000 sailing vessels and 2,500 steamers, the marine disasters of 1872 were, that 2,682 ships were totally lost, and that of these 1,310, or nearly one-half, were British. There were 240 steamers lost, and of that number 142 were British, making a total of 1,452 British ships alone in one year. That represented a loss of life and property at sea perfectly appalling!

With regard to the proposed method of measuring tonnage for fiscal purposes, I regret that the matter has not received greater attention and fuller discussion, yet as far as it has gone it has been confirmatory of the soundness of the proposal. Mr. Norwood admitted there was a good deal in what was said by me about the matter, and that "the present plan was by no means perfect, but in considering it (he said), it must be borne in mind that there were two things to be taken into account, one the dead-weight carried, and the other the measurement."

Now, as to there being two tonnages—one of "dead-weight" and the other of "measurement"—it is merely a mercantile fiction; because measurement goods, whatever they may be, have a certain definite weight. Let me take the case of, say, a vessel of a net register capacity of 1,000 tons, that is to say, 10,000 cubic feet; the cargo therefore, of such a vessel will be made up to that number of cubic feet of various specific gravities. Now, for the goods or merchandise, of which 40 cubic feet weigh more than one ton, the ship-owner or broker, as a rule, charges by the actual weight, but if the goods or merchandise of which 40 cubic feet weigh less than one ton, the ship-owner or broker, charges one ton for every 40 cubic feet, or makes a special charge. Such, it will be seen, are mere matters of trade arrangement between the merchant who has goods to transport and the ship-owner who has a ship for transporting the same, and that neither the so-called "dead-weight" tonnage nor the "measurement" tonnage corresponds with the legal or register tonnage; but that, in fact, the present "register" ton is equal probably to twice, if not three times, as much as the average ton of the ship-owner or broker—that is to say, taking the average specific gravity of average cargoes it may probably be assumed that on a general average 33 cubic feet of cargo would weigh one ton; or, in other words, that a register or legal ton of 100 cubic feet would actually weigh three tons; but let me take two tons weight to be equivalent to one ton register capacity. The matter at present then stands thus:—On every 100 cubic feet of capacity a tax, say, of 6d. per ton, is levied, and within that ton of 100 cubic feet two tons, more or less, weight is carried. This is well exemplified by the following list:—

Tons.				Tons.
Sandringham (S).		Official number—65,439.		
1,013	......	B.	Measure	1,400 dead weight.
1,159	......	G.	Tonnage	180 coals.
738	......	R.	do.	1,580 total.
Durham Castle (S).		Official number—65,746.		
1,420	......	B.	Measure	
1,607	......	G.	Tonnage	2,226 all coals—lost.
1,010	......	R.	do.	
Wellesley (S).		Official number—63,568.		
1,005	......	B.	Measure	
1,135	......	G.	Tonnage	1,450 coals.
737	......	R.	do.	
H. S. Edwards (S).		Official number—63,010.		
1,362	......	B.	Measure	
1,252	......	G.	Tonnage	1,800 copper ore.
796	......	R.	do.	
Mauritania (S).		Official number—63,340.		
786	......	B.	Measure	1,000 coal (cargo).
764	......	G.	Tonnage	180 do. bunkers.
481	......	R.	do.	1,180 total.
Retriever (S).		Official number—191.		
376	......	B.	Measure	237 oil.
329	......	G.	Tonnage	164 coals.
198	......	R.	do.	401 total.
James Groves (S).		Official number—67,518.		
862	......	B.	Measure	
939	......	G.	Tonnage	1,235 cargo.
596	......	R.	do.	

M. de Lesseps has evidently some cause for complaint.

By the proposed method of reckoning tonnage the amount of dues would not be increased, but

the rate reduced and made to correspond with the increased number of tons—say 3d. per ton—at the same time allowing unlimited space or capacity for every such ton of weight. The result would be the direct improvement of ships as regards efficiency and economy, for the Naval Constructor would be freed from those restrictions with which he is now hampered in endeavouring to meet and carry out the demands made upon him.

Mr. Merrifield said:—"There was no doubt that the proper quantity to charge was the difference between the light and the load displacement, but it seemed to him a very difficult question." He thus assents to the principle of my method, and it is more than probable that the "difficulty" of the matter arises in his own mind more than the result of his knowledge of the matter derived from a too hasty study of "the literature of the subject," and not from practical experience, for I am not aware that Mr. Merrifield has ever designed a ship, or built or commanded a ship. I am justified, therefore, in assuming the "difficulties" to exist merely in Mr. Merrifield's imagination, because he never specified what the "difficulties" were.

On the other hand, Mr. Scott Russell's remarks, contained in the body of my paper, which he did not seek to modify in any way, are in support of the proposed method, and the difficulty he there specified, it appears to me, Mr. Henwood has shown us the way out of very simply and effectually. Moreover, Mr. Henwood shows us that the proposed method of tonnage would lead to the strength of ships being measured by a scientific formula capable of universal application, instead of, as at present, being guessed at, and based on the rules and the *ipse dixit* of empirical constructors. And, lastly, I claim M. de Lesseps as an advocate of the proposed system, for he says, "I have not ceased to urge that the real tonnage of the ship is simply the number of tons weight that the ship is capable of carrying with safety." Before closing this matter I must draw attention to the startling theory suggested by Mr. Gray, the Marine Secretary of the Board of Trade—

Question 3,521, Mr. Rathbone—"You certainly do not wish to have your regulations for measurement, regulations which would really give inducements to an owner to build his ships in a way that was dangerous?"—Answer—"Certainly. The tonnage rules ought to be entirely free from anything whatever regarding or affecting seaworthiness. Measurement of tonnage is a fiscal operation purely, and you cannot mix up with it the question of seaworthiness as an argument for exemption of tonnage."

Mr. Gray would measure a ship as he would a warehouse on solid land, throwing buoyancy and stability overboard entirely.

With regard to the excessive length of ships compared with their breadth of beam, it may be, I concede, as Mr. Currie and Mr. Henwood have stated, quite possible to construct them of adequate strength. Yet I do not know whether either of these gentlemen have taken into consideration the question of depreciation which will take place yearly, or the case of local injury to the midship part, when the originally strong "tube-like" vessel would have a weak part, or a local "kinck" or "sag," and then if caught in a heavy sea the enormous leverage for the seas to operate upon, afforded by these long narrow vessels, would inevitably cause them to part asunder and go down.

Nothing in the discussion which has taken place has removed the strong objection I entertain to the unseaworthy character of long, ill-proportioned vessels. The difficulty in seeking their proper displacement in a heavy sea is, to my mind, insurmountable and extremely dangerous, as one glance at my model will convince the most sceptical.

In respect to Sir Charles Adderley's Merchant Shipping Acts Amendment Bill, 1854-75, I shall, I suppose, be expected to say a few words—to take a rapid glance through the Bill. Look at clause 6:—

Masters and Seamen (Part III. of Merchant Shipping Act, 1854).—Wages.

"Any document authorising or purporting to authorise the payment of money on account of a seaman's wages, and made before those wages have been actually earned, shall be void. No moneys paid in satisfaction or in respect of any such document, or otherwise advanced by or on behalf of a shipowner to or on behalf of a seaman on account of his wages before those moneys have been actually earned, shall be deducted from his wages, and no person shall have any right of action, suit, or set-off against the seaman or his assignee in respect of any moneys so paid or advanced, or purporting to have been so paid or advanced."

Everybody knows that an advance note is not a recognised legal document, and that the holder cannot sue upon it.

For the sake of all parties this ought to be remedied; but the Bill does nothing of the kind; but, on the contrary, will only tempt those interested to break the law—for the merchant sailor, under the present system, must have money to pay his debts and buy clothes before he can go to sea.

As an instance of the uneven way in which the Bill is drawn, take the latter part of clause 15:—

"Any seaman or apprentice to the sea service who, when on the look-out, is drunk or asleep, or otherwise neglects to keep the look-out, shall be liable, on summary conviction, to imprisonment for any period not exceeding eight weeks, and, at the discretion of the court, either in addition to or in substitution for such imprisonment, to forfeit out of his wages a sum not exceeding one month's pay."

The reply of the seamen, when they discussed this clause, is the best answer to it:—

"With this clause we are satisfied if there is a provision that will ensure for the seaman or apprentice a sufficient amount of rest, as there is a practice of keeping the whole of the crew up all day, oftentimes for the purpose of cleaning the paintwork, coaling, &c., sometimes unnecessary work. It should, when it demands so much at his hands, also protect him from injustice and secure him some stated periods for rest, and for the purpose of discipline should secure him his watch below under ordinary circumstances, and especially his Sunday when possible."

Discipline.—As to clause 17, it is so curious that I must draw especial attention to it:—

"Where any person is guilty of desertion or a kindred offence, the master, or any mate, or the owner, ship's husband, or consignee of the ship to which the offender belongs, or any person specially authorised in writing by the owner or master of the ship, may arrest the offender, without warrant, in any place in her Majesty's dominions, and also in any place out of her Majesty's dominions, if and so far as the law of that place so permits; and every constable shall give to the person so making the arrest such assistance as he may require. The person arresting the offender may, and in case the offender so requires and it is practicable, shall, convey him before some court having cognizance of the offence, and for that purpose may detain him in custody for such period not exceeding twenty-four hours as may be necessary. He may also, if the offender does not require to be taken before the court, or if there is no such court at or near the place, at once convey the offender on board his ship. If any such arrest appears to the court to have been made

on improper or insufficient grounds, the person who makes the same, or causes the same to be made shall incur a penalty not exceeding twenty pounds; but the infliction of that penalty shall be a bar to any action for false imprisonment in respect of the arrest."

It may be said that a seaman can be arrested from the shipping office now; true, but only by the constable employed there without warrant. The seamen, however, have always complained—most fairly complained—of this infringement of their civil rights. In the present instance they say, in reference to clause 17, "This simply means a suspension of the civil rights of any person suspected of being a seaman."

Clause 23 is most difficult to understand:—

"Nothing in this Act shall prevent any person from being liable under any other enactment of the Merchant Shipping Acts, 1854 to 1875, or under any other Act or otherwise to any other or higher penalty or punishment than is provided for any offence by this Act, so that no person be punished twice for the same offence."

Is the seaman amenable to the Merchant Seaman's Acts, 1854 to 1875? Is he also amenable to any other Act and to the common law of the land as well? I venture to think no sailor can understand this.

Safety (*Part IV. of Merchant Shipping Act*, 1854).—And now, leaving the men, and coming to the ships, the Bill is equally unsatisfactory.

The ship is covered with figures both sides, on the bow, on the stern, and amidships; but I fail to find a single word in the Bill directed against overloading; and as to deck loads, that is made legal by clause 28, as follows:—

"Whenever any British foreign-going ship is about to proceed to sea to any port in the United Kingdom, the Channel Islands, or the Isle of Man, and has any deck cargo on board, the master of the ship shall make an entry in the ship's official log-book in the place provided for that purpose, showing the weight, bulk, and description of all the deck cargo on board the ship at the time of her proceeding to sea, and shall leave a copy of this entry at the custom-house (if any) at the port, or in default shall incur a penalty not exceeding twenty pounds."

The last few lines are curious, and due, I fear, to want of practical knowledge on the part of those who drafted the Bill.

Mercantile Marine Fund (*Part VII. of Merchant Shipping Act*, 1854).—Clause 33 is so important that I must read it:—

"It shall be lawful for the Board of Trade to make out of the Mercantile Marine Fund grants to managers of training ships in respect of boys trained in those ships, who are in point of physical capacity, age, character, and acquirements qualified to serve in the merchant service and in the Royal Naval Reserve. The grants shall be made upon such conditions as her Majesty may from time to time by Order in Council determine."

But under the most favourable circumstances this grant could not be expected to stimulate the various recipients to such exertions as to yield to the mercantile marine within the next ten years 1,000 boys per annum, whereas the waste in the mercantile marine is now no less than 16,000 per annum. This part of the subject, instead of being dealt with in a short, and, I venture to think, illegal manner, undoubtedly requires a special Act to itself.

Liability of Ship-owners (*Part IX. of Merchant Shipping Act*, 1854).—The last working clauses, 41 and 42, are as follows:—

"Where, by reason of a ship having been sent to sea in an unseaworthy condition, any loss of life or personal in[jury] is caused to any person being carried in the ship, or damage or loss is caused to any goods, merchandise, or o[ther] things whatsoever on board the ship, then, notwithstan[ding] the provisions of Section 54 of the Merchant Shipping Amendment Act, 1862, the liability of the owner of [the] ship in respect of the loss, injury, or damage, shall be limited, unless he proves that he and his agents us[ed] reasonable means to make and keep the ship seaworthy, was and were ignorant of her unseaworthiness, or tha[t] going to sea in an unseaworthy condition was under the [cir]cumstances reasonable and unavoidable. Any agreement, [pro]vision, or stipulation having for its object or effect to [...] or limit the liability of a ship-owner in the cases referr[ed] in this section shall be void.

"It shall be the duty of every owner of a ship, as betw[een] himself and the crew of the ship, to make and keep [the] ship seaworthy, and if by reason of the neglect or de[fault] of the owner of the ship, or any of his agents, in makin[g or] keeping the ship seaworthy, any member of the crew [is] killed or injured, the owner of the ship shall be liab[le in] damages for the death or injury."

By these clauses the features of Lord Campb[ell's] Act are introduced, but without any of the de[ter]rent effect of that Act, for the simple reason t[hat] inasmuch as a man cannot be twice tried for [the] same offence, did the Board of Trade inquiry [pre]cede a trial at common law, and conclude [by] simply cancelling the certificate, another an[d] second trial at common law might and prob[ably] would be barred by such punishment. Such cla[uses] create an anomaly which no amount of sp[ecial] pleading can justify; the inquiry under the po[wers] conferred upon the Board of Trade, by which [...] are instituted and sentences pronounced, ough[t not] to be allowed to supersede the common law o[f the] land, or we shall discover at some future, bu[t] not very remote, period of time, that, instea[d of] legislating with a view to remove far from [our]selves the stigma which now attaches to fo[rmer] abortive efforts, we have been rather adding to [...] clenching all the present acknowledged comp[lica]tions and difficulties.

And now it will be necessary for me to reve[rt to] my five suggestions or remedies.

1st. As to the necessity, which I affirm t[o be] urgent, that a special department shall be cre[ated] and a special minister appointed, solely cha[rged] with the administration of the mercantile ma[rine.] It may safely be said that the Board of Tra[de is] no longer physically able to fulfil all the m[ulti]farious duties imposed upon it. Surely th[e in]terests of the mercantile marine are suffici[ently] important to demand the undivided attentio[n of] a department, to be specially created for, and s[olely] charged with, the supervision of its inter[ests.] When this department shall be in working o[rder,] and when legislation shall have been remodell[ed to] this end, the term now so constantly in e[very] one's mouth, viz., "Board of Trade interfere[nce,"] will be heard no more.

A memorial from Liverpool, presented to [the] Right Honourable the President of the Boar[d of] Trade, is couched in the following terms:—"Y[our] memorialists earnestly entreat that you, sir, [will,] during the approaching session of Parliam[ent,] cause such legislation to be effected as will at [once] secure that all ships needing repair shall be [re]paired, and that no ships shall be sent to sea w[hich] are overloaded, and that afterwards, whethe[r by] the creation of a separate department (which [the] importance and magnitude of the interests [...] of life and property involved in the opinion of [...]

...orialists make necessary), or by other means, ...general condition of our fellow-workers on the ... be carefully investigated, so that suitable ac...modation, wholesome food, and proper nu...cal strength of crew be provided on board of ...ry seagoing ship. Your memorialists again ...at your careful and favourable consideration ...his important subject, in order to diminish the ...ful waste of precious human life now going ... It therefore seems a work of supererogation ...sist further upon the necessity of a responsible ...d of the mercantile marine; indeed, that sug...tion of mine seems now to be a foregone con...sion.

...d. In reference to my second suggestion ...ting the passing a Maritime Lord Campbell's ... I am strongly of opinion that the tendency ...ch a measure would be even more beneficial ... I at first suggested. Now, my honourable ...d Mr. Norwood was very severe upon this ..., and said:—

"...e felt himself here on somewhat dangerous ground in ... with his honourable, gallant, and, he believed, also ... friend, because he could not but treat with the ... respect any statement with reference to an Act of ...ent coming from a gentleman who had a right to ... wig and long robe; but his reply was that the same ... principle was applicable in case of death through ...ity of the employer, whether on land or sea. Lord ...ell's Act was simply to this effect. By the barbarous ...tation of the common law, though a workman may ... employer for his culpable negligence or default ...ing the wounding or maiming of the workman, his ...atives could not claim any compensation if the man ...illed outright. Lord Campbell's Act went to this, ... the near relatives of any man who was killed by the ...negligence of his employer, if they could show a ...al interest in his life, could sue and obtain damages ... loss they sustained by his death; and that Act ... as much to a seaman on board ship as to a brick...'s labourer on land."

... my honourable friend had carefully read the ... of Couch v. Steel (Law Journal Reports, Q.B., ... 23, page 121) tried under the same Lord ...pbell whose Act is now in question some six ... after the passing of that Act, he would have ... that, there being no implied warranty that ...ship in which the seaman engages to serve ... be seaworthy, he, the seaman, has no remedy ... the owner or master; and inasmuch as ... Campbell's Act only transmits to near rela... a "cause of action" after the death of their ..., a seaman who may be mortally injured ... his life through the unseaworthiness of the ... cannot transmit a remedy to his nearest ...entative, for the simple reason that he never ...d such right.

...ut without entering upon technical details, I ... emphatically my opinion that such a step ...ld do far more than any other form of legisla... to improve both seamen and ships, because it ...ld imply that ship-owners would take very good ... to become personally acquainted with their ... crews, as well as thoroughly to inspect each ... their ships before allowing her to sail. Not...standing the fact that this measure would not ...ly affect the seamen, on a little reflection it ... obvious that indirectly such a step must ... in more ways than one to their advantage. ... much is unquestionably certain; it would ... that constant contact between owner and ... which speedily would bring about a mutually satisfactory, because mutually advantageous, settlement, and it would certainly at once put an end to the odious necessity felt by the Board of Trade of sending detectives to spy out the defects of merchant vessels. Everyone must feel that the estrangement now so unhappily prevalent can have but one effect, that of aggravating existing evils.

3rd. In reference to my third suggestion for a Mercantile Marine Medical Act, I am more than confirmed in my views, not only by clause 9 of the petition of the London Seaman's Mutual Protection Society, which, in the *ipsissima verba* of the seamen themselves, is as follows:—

"Ninth. That a serious evil arises from the shipping of foreigners, generally the outcasts of their country, from the amount of disease they introduce on board ship in spite of the beneficial working of the Contagious Diseases Acts. Your petitioners therefore pray your honourable House to so legislate that a compulsory medical examination of seamen shall take place before the crew will be allowed to sail in any ship under the British flag."

But also by the approval of such a ship-owner as my honourable friend, Mr. Norwood, who not only agrees with me, but has embodied the idea in the following resolution, which he has placed on the notice paper of the House of Commons, as follows:—

"Mr. Norwood—On second reading of Merchant Shipping Acts Amendment Bill, to move that any measure purporting to amend the law affecting merchant shipping is insufficient and unsatisfactory which does not contain provisions for securing a supply of properly qualified seamen by encouraging the carrying of apprentices on board ships, and the establishment of training ships, and which does not provide for a medical examination of seamen upon their engagement at a shipping office."

The draft of such an Act, if time would have permitted, I should like to have read now, but that is impossible. I shall, however, have much pleasure in laying it before that useful practical committee now about to commence its labours in these rooms under the auspices of the Society of Arts.

4th. My fourth suggestion, which aims at supplying the frightful waste of 16,000 seamen, the yearly deficit in our mercantile marine, I venture to think of the first importance, and upon it I cannot lay too great stress. I propose, by means of an Act of Parliament, to extend the Industrial Schools, such as that at Feltham, belonging to the county of Middlesex, and of which I have been a visiting justice, to every county in the United Kingdom, each supplying its quota of boys to a training-ship stationed on the coast as close to the school as possible. In England, Scotland, and Wales we have more than sixty desirable localities for these ships, and twenty at least in Ireland. Now, let us assume 200 boys per annum for each ship—and be it remembered that there are upwards of 100,000 pauper boys in England and Wales alone under sixteen years of age—we shall then have 16,000 trained and disciplined boys, the exact estimated loss in the merchant service per annum. The collateral advantages to our nation, a nation reeking and festering with pauperism, dissatisfaction, drunkenness, and crime, worse, I venture to think, than in any other country on the face of the earth, would be enormous; such a step would carry education and enlightenment into the remotest district of the land, decrease our poor

rates, and, above all, save from a life of crime, idleness, and vice a large proportion of our population—besides, and in addition, resuscitating, or, perhaps I ought to say creating a powerful body of seamen, better trained, better disciplined, and, as I trust and believe, in every sense better men than ever before were possessed among her priceless treasures by Great Britain.

5th. My fifth proposition deals with the question of tonnage. We are sadly in want of an honest tonnage law. This is acknowledged on all sides; the method for obtaining the true tonnage which I have proposed is extremely simple, and the rule, which is as follows, I should like to see embodied in an Act, and then it would meet all requirements, and, I venture to think, be satisfactory to all parties. It is as follows, and is that of Benjamin Sharpe, Commander Royal Navy:—Take the area in square feet of the horizontal plane at which the vessel floats when fully equipped, with her masts and sails (or machinery and coals), and with her crew and provisions on board, and the area of the horizontal plane at one foot above it; add the two areas together, and divide by 2, which will give the number of cubic feet. Then divide by 35 for the tonnage, repeating the operation foot by foot, between the light and load lines (leaving to the owner the responsibility of fixing the latter). Perhaps one of the greatest advantages of this mode of measurement is the making the foot tonnages coincide with the draught of water, so that nothing can be more simple than ascertaining at once the amount of tonnage or cargo on board. The sum of all the foot tonnages will be the entire tonnage, and, whether the vessels be three-deckers or boats, wedge-like or circular, or as dissimilar as human ingenuity can construct them, the same rule will equally apply, and the same weight, when placed on board, will give the same increase of displacement to each. As the cubical contents to be measured under this system are entirely confined to the space between the light and load lines, they will scarcely equal a fourth of all the numerous spaces included under the present Act.

CONCLUSION.

I have now, to the best of my ability, replied to the various speakers who have differed from my views, but have in no case refuted a single assertion made by me. I have endeavoured to reply in the spirit in which I wrote my paper—that is, with the earnest wish to avoid even the semblance of harshness or dictation; for no one can be more deeply impressed with the fact that this question is one of vast national importance, not confined to private individuals.

If in my reply I have in any way offended, I ask forgiveness. My object has been simply to make the subject better known to the general public, so as to bring an educated public opinion to bear upon the legislation, admitted on all hands to be essential to the welfare—nay, the very vitality of our country.

I have shown clearly that the area of our island is not large enough to support even a third of the population with the commonest necessaries of life. To keep open the approaches to our island home is therefore a matter of paramount necessity; in other words, the command of the sea is as essential to our existence as the air we breathe. To maintain this we must have ships and men—a mercantil quite as much as a Royal Navy; and the soone we set to work and see that both Royal and mer cantile navies are in proper order, the better i will be for our peace, for our wealth, and for ou happiness.

There is no use in shutting our eyes to the for midable rivalry our free-trade policy has rais up on every side of us. There is no use in igno ing the fact that Great Britain has not a solitar friend in either hemisphere; indeed, it will requi the utmost exertions on our part to hold our ow in the coming struggle.

Germany, as depicted but yesterday in *Punch* possessing only a plaything boat on a duck-pon is to-day the third maritime power in Europe, an is advancing with rapid strides. Even now, by coalition with Denmark and Holland, she woul equal our present naval force; and we are told th such a coalition is even now on the *tapis*. And th with 2,000 miles of coast line and a powerful fle we should not be in the most enviable of positi

It is a keen sense of the danger we are in th impels me to the course I have taken. Seneca, sa 1,700 years ago, said, "It is not the painting, g ing, or carving that makes a good ship; but should be a nimble sailer, tight and strong, endure the sea—that is her excellency."

Let us then determine to have our ships in order thus described.

A fine old admiral, Sir William Monson, sa long, long ago, "When you speak of the stren of ships, you must speak of the sufficiency of men within them—a sufficiency not of quan but of quality." Let us, then, lose not a mom in securing such sufficiency both in quan and quality. The maintenance of the honour, the glory, and of the power for doing good of beloved country is surely dear to the heart of of us. No one who reflects for a moment must feel a thrill of gratitude at the prosp with which the nation has been favoured, but w this feeling of thankfulness for the past sh surely be associated a keen sense of our du trustees for the future. Unless this sense of d is felt and acted upon right speedily we s richly deserve the decay, the humiliation, and remorse which only too certainly will overtake wicked apathy of the nation.

No one can now doubt, I hope and trust, the "state and condition" of our merchant touches very closely the health, the wealth, happiness, nay, the very vitality of the nation, is consequently of the deepest importance to e individual amongst us through the length breadth of these realms. As I told you in opening address, it is recorded of Alexande Macedon that he first laid down the principle "the command of the sea secures the possessio the land." In after times the great Roman or and statesman, in such words as these, expre how well he understood the value of the s reignty of the seas—"*Qui teneat mare, eum ne est rerum potiri.*" In times much nearer our an illustrious English sailor, Sir Walter Rale paraphrased the saying of Cicero after su fashion as this—"He who commands sea commands the trade of the world; an who commands the trade of the world comm the riches of the world, and consequently the w

self." We Englishmen have learned—and the lesson has come down to us for many a year from father to son—to apply the sentiment enshrined in the words of the Macedonian, the Roman, and our great but hapless fellow countryman, after a fashion of our own, in these four words, "Britannia rules the waves." If we are to transmit that significant saying, in its full force, to those who will come after us, without delay and in thorough earnest we must take in hand such a reformation of our merchant navy as now I think I have clearly proved to you to be absolutely necessary, and on behalf of which I lift up my voice.

The Chairman, in proposing a vote of thanks to Captain Bedford Pim, said the discussion had been conducted with no small amount of ability, with excellent temper, and with some amount of eloquence; and he felt highly honoured in being allowed to preside on each occasion. He should be glad to render any assistance in his power to any further efforts which might be made by the committee which had been appointed to watch the progress of the Bill, or to further the object which Captain Pim had in view in bringing forward this subject, viz., the improvement of the mercantile navy. He had boldly and conscientiously stated his opinions, some of which had been concurred in, and some not, but it would have been very strange if in such a large assembly they had all been of one mind. As he had before remarked, Captain Pim had painted a picture in very glowing colours, which had been to some extent toned down, but many of his statements had been confirmed. With regard to ships, not having studied naval architecture, he did not feel himself competent to pass an opinion, but judging it by analogy, he did not think ships so long and narrow were likely to be serviceable, any more than Admiral Rous, who was equally renowned at sea and on the turf, would choose a long, lanky race-horse, with no depth of chest or breadth of beam to run for the St. Leger or Ascot Cup; or than a captain would select all lanky, thin fellows, six feet high, without any breadth of shoulder, to man his ship. With regard to seamen he was better able to speak, and the opinion he had expressed on a former occasion had since been confirmed, that they were not equal to what they were some thirty or forty years ago. This statement had been challenged by one gentleman—and he believed a very ancient mariner—who said that more was expected now-a-days from sailors than formerly. He did not quite understand what was meant by that, as he supposed a seaman was always expected to do his duty on board ship, which was to properly work her. Old Boreas blew as hard now as he used to do, as was said by Sir James Gordon when he was attempted to be put off with a set of second-hand sails, on the ground that it was a time of peace, his reply being that the wind blew as hard in times of peace as in time of war. He did not allude so much to passenger steamers, which, after they got safely across the Bay of Biscay, passed into the quiet waters of the Mediterranean, and going through the Suez Canal soon got quietly to Bombay, Madras, and Calcutta, but to long-voyage sailing ships, though, even in their case, he did not care whether, now-a-days, they doubled Cape Horn or sailed through the straits of Magellan. Anyway, seamen ought to be as efficient now as they were formerly, but that they were not was pretty generally admitted. All would agree in the desirability of making a sailor's home at sea as comfortable as possible, for, with a very small verbal alteration, the old lines were equally applicable now—

> "His march is on the mountain wave,
> His home is on the deep."

The ship was the real sailor's home, and if that were made comfortable, there would soon be no difficulty in getting men as efficient as ever they were. He trusted these long and interesting discussions would not be without effect, and the proceedings of the last month would go far to remove any impression which might have existed in some quarters, that no public interest was taken in the welfare of the mercantile marine.

Mr. Greaves, in seconding the vote of thanks, said it would be, in his opinion, wrong to set about training boys for the merchant service unless the present system was altered, because a large number of them would inevitably, but quite unnecessarily, be drowned. He found that on an average six men were lost per day, and until this state of things was altered, he did not think they would be justified in training up even pauper boys for such a fate.

The motion having been carried unanimously,

Mr. Scott Russell moved, and **Mr. Wm. Botly** seconded, a vote of thanks to Sir J. Heron Maxwell for presiding so ably over the discussion, which was also carried unanimously.

MISCELLANEOUS.

PEERS AND PATENTEES.

The debate on the second reading of the Ministerial Bill for the amendment of the Patent-laws does little credit to either the judgment or the morality of the House of Lords. The conversation which followed upon the introduction of the measure some ten days ago served sufficiently to indicate the spirit in which their lordships seemed disposed to approach the consideration of the subject before them. It made it clear enough that recognising the issues raised as essentially one between inventors and manufacturers, they would by no means permit a generous sympathy with genius to weaken their natural veneration for capital, and that they would not for a moment allow the pretensions of the former to stand in the way of the interests of the latter. But it was reserved for the discussion of last Friday to show how completely their lordships were inclined to side with "the men of money-bags" against "the men of brains," as Mr. Mill has aptly designated them, and what small chance there was that they would attempt equitably to poise the beam in weighing their different and conflicting claims. Lord Belper was the only peer who had anything to say in defence of the Patent-laws, and seeing that the inventions of his ancestor's partner, Sir Richard Arkwright, founded the fortunes of his family, there was something peculiarly appropriate and suggestive in his advocacy. The other speakers in the debate were all of them more or less hostile to the principle of granting protection to inventors under any circumstances or upon any conditions. In the ardour of their controversial zeal, indeed, as the Lord Chancellor afterwards hinted, most of them appear to have altogether forgotten the provisions of the Bill which it was to have been presumed would have immediately engaged their lordships' attention. The majority of the speeches delivered do not require even a passing notice. Lord Selborne contented himself with referring to his utterances in the House of Commons and his evidence before Select Committees, while Lord Cardwell's humour and Lord Hatherley's anecdotes in no degree contributed towards the elucidation of the problem under discussion. The Duke of Somerset, too, avoided the main subject, and restricted his observations to certain details of the Bill. But Lord Granville, speaking with all the authority of the leader of the Opposition in the House of Lords, in a long and elaborate address committed himself to a series of propositions which

appear to us to be about as mistaken and mischievous as he could well string together.

Lord Granville seems particularly pleased with the discovery that the prerogative of granting letters patent for inventions was reserved to the Crown by an exception in the Statute of Monopolies. But, although, as an historical fact, letters patent for inventions were excepted from the operation of the Statute of Monopolies, it does not in the least follow that letters patent for inventions create monopolies. It is essential to a monopoly in the present sense of the term that it should affect commodities already in use, the privilege of exclusively dealing in, which renders them dearer than they formerly were to the public for the profit of certain individuals. But when a contrivance or a process which is new is patented, although some of the benefit to be derived from increased cheapness, whether absolute or comparative, is postponed for the advantage of the inventor, yet the world at large is no worse off than it was before the invention was made. Further, the patentee cannot, like the monopolist, command the market, and he is liable at any time to be driven out of it by some other and more successful discoverer. Between a privilege of this kind, and such monopolies as the Act of James abolished, there is really no resemblance whatever. Passing from legal history, Lord Granville turned his attention to scientific jurisprudence. "We have heard," he said, "much about the property a man has in his invention." But he added, "it is impossible to limit a man's right in property. If an invention were a man's property in the ordinary sense of the term, he would have a right to prevent any one else from using it, but he cannot do so without a patent, and this only confers on him the monopoly of the use of his invention for a certain number of years. "Now it is manifest that if this contention holds good against patents it holds equally good against copyrights. By the common law, copyright was a perpetual right vested in the author of a literary composition, and if, as Lord Granville asserts, it is impossible to limit a man's right in property, either an author's property in his work is no property at all, or the several Copyright Acts from Queen Anne to Queen Victoria have achieved an impossibility. But, so far from its being impossible to limit a man's right in property, there is scarcely any kind of property in which men's rights are not limited. Take an extreme case, a man's right of property in land for example. A landowner's powers of settlement are distinctly limited, for he cannot settle his estate, however much he may wish it, except pending lives already existent and for twenty-one years afterwards. Moreover, under the Lands Clauses Act, he can be compelled to sell as much of his land as may be required against his will, and he is not permitted to fix his own price for it. The opponents of patent right seemed to have overlooked the proposition that property under all its aspects is simply a bundle of capacities created by the law, which may be varied and restricted precisely as the Legislature thinks proper. Thus, although the Patent-laws limit the duration of property in patented inventions, and the Copyright Acts limit the duration of property in literary compositions to a longer or shorter period, the proprietary character of the patentee, or the author, or their representatives, is no more affected by this circumstance than the proprietary character of the landowner is affected by the law against perpetuities and the Lands Clauses Act. Lord Granville referred admiringly to Lord Selborne's well-known remonstrance against "property in ideas," in which his lordship replied, with much vigour and metaphysical subtlety, to an argument which had never been advanced by the advocates of the Patent-laws. No one that we know of has ever claimed any "property in ideas." What the inventor does claim, and justly claims, is that he shall be protected in the enjoyment of the fruits of his own ingenuity, industry, and outlay, as far as public policy permits, like other people. Considered from a
moral point of view, the positions of the inventor
author are precisely the same. Until their concept
are embodied in some definite form, it is impractic
for them to assert any proprietary rights over th
But when they take the shape of a book, a machin
a process, the writer or discoverer is as much entitl
what benefit is to be derived from them as a tail
to the benefit to be derived from the coat he
made, or a farmer is to the benefit to be der
from the produce of his fields. Lord Granville s
to draw a distinction between the claims of au
and inventors, not indeed in their nature but in th
effects. It is true, he says, that no one may repu
another man's book, but "there is not an idea or
argument in it that any other writer may not adop
make use of in his own writings." Still it is noto
that if this were carried on to an extent which interf
with the sale of the original work, it would be op
the author to recover damages from or obtain an inj
tion against the pirate. Besides, the "ideas" and "a
ments" would probably be couched in different w
from those in which they were originally clothed, a
difference similar in degree to this would suffic
secure an improver from penalties for the infring
of existing patents. It is an error to imagine that t
is a greater tendency among independent inventions
signed for a common purpose towards identity than t
is among books treating of a common subject. W
has been done of late years for the improvement of
of precision very strikingly illustrates this. There
of course, certain elements of likeness between the C
sepot, Snider, and Martini-Henry rifles, and the A
strong, Rodman, and Krupp guns. But they a
easily distinguished from one another as Macaul
Hume's, and Lingard's histories of England.

It is not, however, solely on abstract ground, or
in the interests of the public, that the repeal of
Patent-laws is threatened. Inventors themselves
it appears, the main objects of solicitude. They
benefactors to the human race, more so than "warr
poets, or artists," and they suffer from the Patent-l
as a class "in consequence of the monopoly whi
gives to articles which have been patented." We
fess that we do not quite understand what this means
means, perhaps, that the accident of time, and
sionally a very short time, may secure a patent to
rather than to another equally original inventor.
is no doubt unfortunate, but it is inevitable in our
sent imperfect condition. Precisely the same acc
has seated Lord Granville in the House of Lords in
of his younger brother, who has certainly as much r
to complain as an inventor who happens to have
anticipated by somebody else. But it seems also
"not one patented invention in a hundred has the
chance of success," and many patents under the pr
system are unremunerative; they do not compensat
inventor for his loss of time and money. In these
jections to the Patent-laws we see some of their
eminent advantages. It is impossible to tell
any certainty whether an invention will or will not
ceed until it has been tried. If Lord Granville is
pared to affirm that benefactors to the human r
superior to "warriors, poets, and artists," are deserv
of no reward for the advantages they have conferred
their kind, the position, however flagrantly unjust, i
any rate, intelligible. But if he admits, as com
equity suggests, that they are deserving of reward,
it seems to us that such reward should be proporti
as far as practicable to merit. It is for this, an
other reasons, that Mr. Mill, in his "Principles of Po
cal Economy," supports the Patent-laws, and cens
the efforts of those who would abolish them, w
efforts, he observes, "if practically successful, w
enthrone free stealing under the prostituted name of
trade." In his view, an exclusive privilege of lim
duration is preferable to other means of rewarding
ventors, "because it leaves nothing to any one's di

tion, because the reward conferred by it depends upon the invention's being found useful, and the greater the usefulness the greater the reward, and because it is paid by the very persons to whom the service is rendered, the consumers of the commodity." We assume that Lord Granville's tirade about the working man and "the spirit of gambling" was intended to be serious. But it would have been more appropriately used early in the fifteenth than late in the nineteenth century. It is conceived quite in the humour of the statute of labourers and the sumptuary laws. It may be true that some working men waste their time in visionary schemes of invention; but, like Arkwright the barber, they sometimes succeed, and they are, as a rule, quite capable of taking care of themselves. Besides, we will venture to say that even when success is not achieved, the mere prosecution of their inquiries is an improving and elevating occupation compared to the monotonous and mechanical round of labour which is assigned to them as their normal sphere of activity.

We shall not follow Lord Granville into his observations on the experience of Holland and Switzerland in the absence of Patent-laws. What Holland has done in the way of invention in recent times we have yet to learn, and Switzerland, according to the authority quoted, seems chiefly remarkable for borrowing inventions originated in other countries where Patent-laws are in force. We cannot to-day enter upon the general considerations which in our opinion not only justify the Patent-laws, but render them imperatively necessary. On the present occasion we have merely endeavoured to expose the more glaring fallacies of which Lord Granville has constituted himself the patron, and we shall postpone the examination of the larger question to some future opportunity.—*Pall Mall Gazette.*

GRESHAM LECTURES.

At a meeting of the Common Council of the City of London, on Thursday, Feb. 25, a report of the Gresham Committee as to a vacancy having occurred in the Gresham Professorship of Astronomy, gave rise to a conversation as to the alleged unsatisfactory results of the Gresham Lectures in the City. Sir Charles Reed, as a member of the Court, suggested that an opportunity was thus afforded for considering the position in which it stood in relation to the lectures. Outside, he said, the Court was held mainly responsible for the conduct of the lectures, and no doubt, forming with the Mercers' Company part of the governing body, it had considerable influence and power in regulating the delivery of the lectures, with respect to which the public feeling had been frequently manifested. It was not within his province to make any reference to the way in which that duty had been discharged, but that Court had many a time done its best to assure the public that, so far as it was concerned, that great educational trust should be faithfully discharged. But he wanted it to be understood outside that in relation to those lectures the Corporation were associated with another body—the Mercers' Company—though he had no reason to suppose that the action of the Corporation would be interfered with by that body. Ordinarily but a few persons—sometimes not more than one or two—were present at the delivery of some of the lectures, and he did not hesitate to say that the subject had become a public scandal. He felt with the advancement of education on all hands it was important that the trust confided to the Corporation and the Mercers' Company should be used for the very best purposes, and he reminded the Court, amid responsive cheers, that they would be responsible if those lectures were not of the best kind, and delivered in a language which was generally understood. Mr. Bedford and other members of the Court, from their own knowledge, bore out the statement of Sir Charles Reed that the circumstances under which the lectures were ordinarily delivered had become a public scandal.

VIENNA EXHIBITION.

(*Continued from page 330.*)

The report following those treated of in the last notice of this subject is that of Mr. A. H. Mounsey. It is divided into two parts, of which the first relates to small wares and fancy goods, while the second is devoted to some remarks on the industry and trade of Austria-Hungary since 1865, and on the probable effect of the Vienna Exhibition on the material development of the empire. The first part of the report does not call for any extended notice. In the second Mr. Mounsey points out the causes which accounted for the number of visitors being less than was at first expected, and for the financial results being in consequence less satisfactory in proportion than those of previous exhibitions. In London and Paris, as was natural, the chief support to the exhibitions came from English and French visitors. Vienna, however, as the scarcely yet acknowledged capital of an empire composed of many different nationalities, could hardly rely on the same sort of support, and various causes acted to diminish the hoped-for influx of foreigners. The projectors, therefore, of the exhibition, found they had to look to the future advantages of the empire rather than to any immediate financial gains, for its good results.

Previous to 1851, the Austrian tariff was one of the most exclusive in Europe. A less prohibitive policy was then adopted, and soon resulted in a lower scale being introduced in 1854. The increase in trade and manufactures in the following decade was considerable; and in 1865 a commercial treaty was concluded between Great Britain and Austria, under which still further reductions were made. Under this tariff the imports have increased in value from £25,075,379 in 1865 to £59,244,120 in 1872, this increase being principally in the following items:—"Firstly, entire fabrics, viz., cotton, linen, wool, silk, leather, iron and small wares, rails, machinery, chemical products, books, and newspapers; secondly, half fabrics of iron, tin, wool and leather, dyes, gums, precious stones, chemical products, and meal; and, thirdly, raw produce, viz., cattle hides, bristles, tallow, wood, coal, raw iron and other metals, silk, rice, copper, and cocoa."

Similarly, the imports increased from £34,068,134 in 1865 to £38,218,126 in 1872, the increase being chiefly due to large exports of the articles above-mentioned as being imported in large quantities. A corresponding increase is visible in other sources of revenue and manufactures. The amount of beetroot sugar rose from 1867 to 1872 to 24 million centners from 17 million. More than enough for home consumption is now manufactured, a considerable quantity being bought up by English merchants for exportation to the States. Owing to the want of fuel in many districts, for the manufacture of iron, much is still imported. In 1862 there were 40 flax-spinning factories, with 150,500 spindles. There are now 62, with 370,790 spindles. The glass manufactures has largely expanded. Notwithstanding the loss of Lombardy, whence most of the raw silk was obtained, the silk manufacture is in a flourishing state. On the whole, Mr. Mounsey considers that Austrian manufactures are well able to hold their own against foreigners, and that in consequence many of the duties now levied might advantageously be reduced in favour of consumers.

Although not remarkable for inventive powers, the native vigour and versatility of Austrians is such, in the opinion of the reporter, that the examples offered by the Exhibition are certain to be rapidly taken up and imitated, and that it will be thus of genuine service to the industries of the country. Recent advances have shown what the nation can do, and it appears reasonable to anticipate that the Exhibition will have given a fresh start to its energies.

The last portion of the report is devoted specially to Hungary. Here the same rapid advance is not to be

noted as in the other parts of the Empire. The sudden alteration of Government in 1867 produced an enthusiastic desire for the proper development of the resources of the country. Unfortunately, the efforts made in this direction were not always well directed, or rather they were in excess of the real capabilities of the country. Railroads were made before the country was properly supplied with roads; immense sums were expended on large and costly public works; in "fine, the treasury was exhausted in attempting to give Hungary the appearance of civilisation before the foundations were laid." The great beds of iron ore which will form the future wealth of Hungary are not yet available for want of proper means of communication. So soon as they can be properly worked, Hungary would be able, Mr. Mounsey says, not only to supply her home requirements, but to export largely to Turkey, where a market would be provided, owing to the growing civilisation of that country, and the consequent demand for iron for the construction of railways, bridges, &c. At present Hungary is entirely an agricultural country. Such manufactures as are carried on are of the most primitive character. Spinning and weaving are done by hand as household industries. Hemp, flax, and wool are produced in large quantities, but are nearly all exported.

(To be continued.)

COOKERY FOR THE POOR.

The National Training School of Cookery is engaged in collecting information on the subject of cookery for the poor. The committee feel that any reforms, to prevent waste and encourage better cooking, must have due regard to the customs which already exist, and the introduction of these improvements must therefore be gradual. Accordingly precise evidence of the present system is being collected. The following account of what goes on in a court at the West of London has been furnished to the committee by the Hon. Augusta Barrington; and it is published with the view of eliciting similar information from other parts of London and from the country at large:—

COOKING IN B—— COURT.

Nearly all the people I questioned eat meat once a day, when in work, but the "father" is served first, and the wife and children often get only a few scraps, which they eke out with bread and tea. They are very fastidious about their meat, seldom buying tripe, pigs-meat, feet, or tails. They say odds and ends are nearly as dear, and not so satisfying. They all object to rich or greasy food, and those who read the printed recipes said such a dish would make them ill. They buy what are called "pieces" from the best butcher in the neighbourhood, and on grand occasions get a breast of mutton, which they boil with turnips, or roast with sage and onions. Their meat costs from 7½d. to 8½d. per lb. They seldom bake it, as scarcely any have ovens in their rooms, and bakers charge 1d. for cakes, and 1½d. for dinners on week days, 2d. and 2½d. on Sundays. They roast by hanging the meat to a pin or skewer. If hung on a worsted line, they say it forms a self-acting jack.

The most universally popular dish is what they call an Irish stew, to which they add any vegetables they can get except potatoes; these they always boil or fry. With salt meat or bacon they only boil cabbages. They are rather shy of buying dripping from shops, but are very partial to all they can make, or buy from cooks. They make broth very often, but have no idea of a *pot au feu*, and rather scoffed at the notion of adding rice, bones, or pieces of bread to their soup. Several people told me their children would not touch stews or hashes, but ate dry bread in preference. As a rule, they care very little for sweet dishes, and use very little rice. None bake bread at home. When they do have a pudding, there is very little variety. Rice boiled with milk, suet dumpling with or without currants, and (rarely) a fruit dumpling are the usual dishes. Dark treacle is seldom used, but many of the children like golden syrup with bread. Where the mother of the family does not go out to work, the staple dishes are broth, stew, and boiled or roast meat. When the mother goes out, there is only an hour in the middle of the day to cook and eat the dinner. Then the meat or bacon is fried with vegetables. This is universally admitted to be extravagant, as well as the least wholesome form of cookery, but it is much the quickest, and saves fuel. The most comfortable home I know is one where the woman was a cook. The husband is a steady man, in regular work, and he gives her £1 a week to pay the rent and keep the house. They have different dishes every day, and always meat and a pudding or a cake. This man cannot eat onions, mustard, pepper, or salt, so the wife has to season everything with celery or herbs. Celery is very largely used by all. She criticised considerably the two printed recipes I showed her, and said that amount of tripe would require two large onions. She said tripe was very well for a small family, but with a lot of children it would not pay, it took so much milk. She evidently understood making soup with scraps, and dishing up all sorts of odds and ends, and she bakes rice puddings and plain seed or plum cakes in a Dutch oven, but rich cakes she sends to the baker's. She makes roly-poly with jam, but treacle pudding she makes in a basin, like apple dumpling, only alternate layers of paste and treacle. One remarkably tidy single woman told me she almost always had a large plum pudding on Sunday, and it lasted her nearly all the week, fried in slices. Those who are compelled by the wife's work to live on fried food all the week are fond of a sort of hodge-podge soup on Sundays, but they seem to have little idea of improving it with rice or barley.

They have not many kitchen utensils. Very few have more than one room for all purposes. One or two iron pots, a black kettle and a frying pan form the usual stock.

Only one showed me the Dutch oven, and none of the others spoke as if they knew of such a thing, but several of these woman go out "charing" in large houses, where they might pick up many hints.

They burn about ¼ of a cwt. of coals per day. If they let the fire out, they reckon 12 or 14 lbs. for cooking the dinner.

My impression of the instructions and receipts given at the School of Cookery is that they are rather above the capabilities as well as the requirements of the class for whom they are especially intended. Even if the mother knew how to make jellies, she would have none of the necessary appliances in her single room, overcrowded with children, and her one saucepan. The most useful thing would be to teach them to make savoury green soup, like what is made by the poor in France, using more bread and rice, and frying the vegetables beforehand to bring out their flavour. These people only make broth, and it is very poor stuff. I forgot to say that they use a good many eggs, when they are in season, but they only boil them. So many excellent dishes are to be made with eggs, with the most limited batterie de *cuisine*, that I think they would readily avail themselves of any simple recipes that might be furnished.

An improvement in window fasteners has been brought forward by Mr. Hopkinson. It consists of a projection on the left side of the arm when the window is fastened, by which the action of a burglar's knife in attempting to open the window is prevented, the guard or projection tightly wedging the knife.

The number of collieries opened out in the kingdom in 1872 was 3,001, whilst in 1873 they had increased to 3,527; 252 have been opened in 1874.

In the report of the last Chemical Meeting, the name of Griffith was inserted by error in place of that of Mr. Hughes.

CORRESPONDENCE.

MERCANTILE MARINE.

SIR,—From some observations which were made to me immediately after the close of the meeting at the Society of Arts last evening, I fear I did not state my proposition with regard to the strength of iron ships quite clearly. I may, therefore, put it thus, that if an iron ship whose length should be ten or eleven times her beam were constructed strong enough to be perfectly safe in a beam sea, or even in a fore-and-aft sea (of course with some "sea on"), the extra weight of iron used in her construction would so much augment her load immersion (say with engines, coals, and all necessaries in), and lessen so much her cargo or weight-carrying capacity, and therefore her freight-earning power, that she would not pay. First cost would be greatly increased; cargo-carrying power would be much diminished.—I am, &c., M. S. S. DIPNALL.

Feb. 25, 1875.

P.S.—In the report of what I said, the number of British steam vessels (as given in Captain Bedford Pim's paper) should have been printed as 2,500, [illegible] 22,000. The marine disasters also mentioned by me were those of 1872, not 1862. In alluding to the accident to H.M.S. *Agincourt* on the "Pearl Rock," I did not say the *ship*, but a reputation was lost.

SIR,—A great misapprehension appears to prevail among the ship-owners present that Captaim Pim has made a general and unqualified onslaught on their class and interests, where nothing of the kind was in contemplation. The ship-owners, as a class, have maintained a prominent and worthy position in the general progress of modern intelligence, but they are not a community of saints, any more than any other section of money-hunting humanity, and if there are exceptions among them they are no worse than their neighbours, though surely it would be somewhat arrogant to say they are much better and not as other men. It is to meet the exceptions that in any case legislative interference is required, for the rule is generally a law unto itself. But it is well known that when the exceptions are allowed with impunity, even the rule is apt to lose its exactness, and ship-owners have no right to claim a greater latitude in this respect than other classes of men. In the present discussion they have shown an undue sensibility, and by sweeping denials, introduced extraneous issues, have endeavoured to white-wash everything. For after all that has been said, the sailors in our mercantile marine are in one prominent and most important particular not so well off as any other workmen engaged upon our national industries. In the great majority of our ships, and more especially in those engaged on distant voyages, they are for protracted periods separated from medical aid and skill, and in this respect they are worse off than even convicted felons undergoing their sentence for flagrant crime. Nor is this disadvantage likely to be remedied in their behalf, for there is no likelihood that vessels, other than passenger ships, where the complement of men does not exceed a dozen or so, will ever be saddled with the expense of a competent surgeon. Why, then, should the men be allowed to enter on such a condition in a state of ill-health, to begin with? In another respect they are also worse off than any other British workman whatever. They are for long periods separated from society, and their pent-up passions are therefore more liable to break out on periodical opportunities, and hence their morality on shore is weaker, and their vices in a general state of excitement and temporary excess. Without prejudice to all virtuous exceptions this is the rule. To the waste of their money by which it is accompanied, add the impecuniosity which follows it; and Mr. Norwood's admission, that for two months' advance of pay Jack would not be very particular about the seaworthiness of his ship, has a remarkable significance, and I venture to think a very strong point of Captain Bedford Pim's paper is thereby only too fully made out. Another disadvantage affecting the sailor's condition is that trades unionism in his case is impracticable. I do not say that trades unionism is desirable, but desirable or not, whatever protection it gives to other workmen, is not available to seamen. They dare not combine on ship-board, for that would be mutiny, and they are separated for such long periods, and landed at so many different times and ports, that no considerable number of them, sufficient to give importance to a trades union, can rely on being long enough on shore together at any one place, or meeting regularly even at intervals of years. To the sailor therefore an amount of protection is required from the State which is not due or called for in the same degree on behalf of any other national industry. These are facts which no sophistry can displace, nor any mere education of the seaman remedy, and Captain Bedford Pim was fully entitled to proceed upon them as on a foregone conclusion.

Then as to ships and their insurance. Mr. Young, as an underwriter, was somewhat unnecessarily anxious to repudiate the idea that the underwriters allowed money to be made by the over-insuring of ships, though his statement that the underwriters were too sharp not to see through such attempts was not quite freed from something like an admission that they had occasional opportunities for exercising all their discrimination. But it is not necessary to go into this, for it is not necessary to make out cases of over-insurance to prove that insurance produces indifference to the vessel's fate on the part of the owner; perfectly fair and legitimate insurance man produce this feeling. Thus, if a vessel be truly worth £60,000, and be insured for £59,000, or a thousand pounds less than her actual value, the owner's anxiety is not anxiety for the safety of £60,000, or of a vessel of that value, but only an anxiety for a thousand pounds risked and uncovered by insurance on such a vessel. Even if the vessel reaches home, he may have to lay out a thousand pounds in repairing the wear and tear of the voyage, and he cannot lose more if she goes to the bottom. If machinery should break down the owner has to put up with his calamity. If a railway train should be smashed up, the company cannot fall back on Lloyd's to replace its ruined rolling stock. Happy it is if it do not have a dozen suits for compensation from injured passengers to attend to, in addition to the disaster. Yet railway companies are loudly blamed for callous indifference to human life, and seem fully to realise that idea of intangibility given by Lord Thurloe, of a corporation without a body to be kicked or a soul to be d——d.

Nor has a mining proprietor any such advantage from insurance as the ship-owner when detriment comes to his door. He has the whole loss to comfort him, and nothing but the loss. Yet owners of mines also are blamed for being indifferent to ventilation and explosions. If carelessness be bred where whole fortunes are at stake to stimulate attention, how much more likely is it to doze in its nightcap where the hazard is absolutely nil. Ship-owners have at all times, and by perfectly legitimate and honest insurance, the power to minimise their loss, and, as rule, they avail themselves of it. But, after all, how far does the vigilance of the underwriter go? Are ships only insured for the single voyage, and not for both voyages? What guarantee has the public from the underwriters attention that, when the vessel puts to sea on her return voyage, she is

then wholly uninjured and seaworthy? Is the safety of the one voyage less important than the other? What security, moreover, has anyone that the ship is at all times properly manned by competent hands? It is not necessary to impute bad motives to our ship-owners; but why all this excessive sensibility, of which Mr. Duncan was so nervous an exponent, if there be really no sore to cover? There is absolutely no commercially-invested capital whatever, which is managed at so much risk to others, and so little risk to its owners, as that invested in shipping property! That is a fact utterly beyond dispute, and there, also, Captain Bedford Pim was entitled to proceed as on a foregone conclusion.

Into the vexed question of construction I have no wish to enter. That question will not be settled for the next thousand years, unless the ideas of mankind are to reach an unexpected stage of finality, where further thought will be impossible. Without going into that interminable subject, however, I may be permitted to remark that certain first principles have been long since lost sight of and discarded from modern shipbuilding. Thus, when man first trusted himself voluntarily at more than swimming distance from shore, he must have done so on something which he made sure would float under all circumstances, even if it incurred the very ordinary contingency of getting filled with water. Whenever commercial enterprise put as much of any material inside of a vessel as, in addition to its fill of water, would inevitably send it to the bottom, that primary element of human safety was abandoned. When modern ingenuity brought iron to the task of construction, the buoyancy of the vessel ceased to have any dependence on the material employed, and became solely a question of mechanical arrangement. Yet the question of human safety is as important as ever—nay more important from the ever-increasing numbers of human beings now borne upon the ocean highways. Can modern ingenuity do nothing with its new materials to restore the original principle of floating power under all circumstances, and so save both the vessel and her crew? We are a very far way off that at present, and the public has been shocked by the magnitude of recent maritime disaster, which one gentlemen has vainly endeavoured to dissipate by spreading it over an average of years, and merging it in a general comparison. If the existing tonnage laws be in the way, as it certainly would be of devoting a portion of the space to restoring a floating power under all conditions, is it not desirable it should be altered, or, even, if that be necessary, abolished altogether as a source of revenue? It would not be difficult to do that without injury to the exchequer. At all events it is surely desirable to do everything possible for improving the safety and stability of our ships, and the well-being and efficiency of their crews; and a transparent fallacy to argue that we have already reached finality or perfection. Unless ship-owners will go in heartily for improvement, and welcome it in every way, they will incur morally before the whole public the very responsibility and turpitude they seem so anxious judicially to avoid. Lord Campbell's Act appears like most statutes to have had a coach and six run through it, and it would be more correct therefore to speak of the objects aimed at by Lord Campbell's Act in referring to that statute. But in no case would the Legislature inflict penalties for errors of judgment, as Mr. Duncan seems to fear, but only for culpability; and what right have ship-owners to impunity from that which hangs over every other man's head even at common law?

With the view of bringing the business of the meeting and its further discussion to a definite issue, I would conclude by suggesting that Captain Pim's propositions, or such of them as he still wishes to press, should be put as a series of resolutions, to each of which after it is proposed and seconded, any gentleman may move an amendment, and that the discussion should be confined to the motion and amendment strictly, Captain Pim being allowed his reply on the whole discussion before his propositions are put, or briefly in proposing each of them if he shall so prefer.—I am, &c., James A. Smith.

29, Great Marlborough-street, W.
February 20th, 1875.

THE QUESTION OF APPLYING THE ROMAN CHARACTER TO THE LANGUAGES OF INDIA.

Sir,—It is a good thing that this subject—a subject far too large to be decided in one of the Indian Conferences—is still being treated of in your *Journal*. I trust you will allow me to attempt an answer to some of Dr. Leitner's strictures on the scheme which I had the honour of advocating before the Society. I will take up some of the numbered paragraphs in Dr. Leitner's letter, and discuss the subject of each.

Dr. Leitner writes (Section 1), "That there are more sounds in the Indian alphabets than can be rendered by the Roman character." I showed in my paper that the sounds of both the Semitic and Aryan elements of Indian languages (which I spoke of as the Arabic and the Hindi) could be expressed by the Roman alphabet, with the addition of an accent for the long vowel sounds, and a diacritical mark to be attached to a certain number of consonants, not more than nine at the most, to distinguish differing but allied sounds. It is thus not enough for Dr. Leitner to make the statement above quoted; he should give some opinion for his objection; he should estimate the disadvantages that there may be in the use of the diacritical marks proposed. These marks are but an accenting of the vowels, which is as simple as the modification of vowels in German, and an underscoring of a few consonants, which is distinctly simpler than the addition of letters (in some cases not at all allied in form), by which the Oriental alphabets express these closely-related sounds. Dr. Leitner should also explain how it is that the Hindostani language (containing both the elements spoken of) can be fluently read from the Roman-printed books which Sir Charles Trevelyan showed at the conference.

In Section 2 it is written, "There is no chance of the Roman characters being accepted by the masses in India, who revere the Perso-Arabic and the Sanskrit characters." . . . . Dr. Leitner here fails to tell the whole truth, which is that those of the natives of India who revere Sanskrit do not revere Perso-Arabic, and those who revere Arabic look with contempt on and will have nothing to do with the Sanskrit characters. A great number of the former class—Hindus—have learnt Perso-Arabic without revering it, simply because, from its use by the Mohammedan governments of former times, it was an advantage to the Hindus to know it. In north-western India we have continued to this Perso-Arabic character the position which it only deserved to hold while it was the writing of the rulers, and in doing so we can hardly be said to be treating impartially Hindus and Mohammedans. Happily there is no religious feeling against the Roman; hence self-interest will be free to act on natives of both faiths to urge them to follow what, if it were followed by all, would be of so much advantage to all.

"Romanisation, could it ever be successful, would be the death of the vernaculars, &c." (see Dr. Leitner's Sections 5, 7, and 8). On this part of the subject some light will be thrown by our considering what changes are now going on in the spoken languages of India. These seem to me to be two. First, a tendency for some of the vernaculars (as Panjabi) to merge into Hindostani; secondly, a process of acquisition of English words, as European ideas and things are freshly made known to the people, who must have names to call them by. These changes are a necessary growth brought on by circumstances, the circumstances of our rule; we cannot hinder them, but we may accelerate, and possibly direct them. Let us see what effect Romanising would have upon their course.

If Roman were first adopted for Hindostani only, then, I believe, the spread of Hindostani would be helped;

that language would, by being written in the same character as is English, which is the educational goal of so many in India, gain an advantage over the vernaculars still written in the old way. But if Roman were adopted simultaneously for all the spoken languages—that is, if efforts were made in this direction in equal proportions for all the vernaculars, then I do not see that the balance would be altered.

The second process now going on, the acquisition of English words, would undoubtedly be much affected by the introduction of the Roman alphabet, but I hope to be able to convince Dr. Leitner that it would be effected for the better. The rough polype-like swallowing would give way to a healthy assimilation. Now-a-days an English word is caught up by the natives and soon made a mess of; neither the spelling nor the pronunciation is preserved. Now, it would be impossible under any system to keep both, seeing that in so many English words there is so little connection between the two; but with the Roman alphabet the natives would be able to keep either one or the other, as they might choose. This surely would be something; it would help to accuracy; it would help the vernaculars, and not, as Dr. Leitner fears, bring death to them. The "rich indigenous alphabets," as Dr. Leitner calls them (in truth they are either exceedingly complicated or exceedingly imperfect), cannot represent our words, while Roman can represent English, Sanskrit, and Arabic words, and so can serve as the quicksilver to amalgamate these with the vernaculars which they are to enrich.

Neither is it any part of the plan, nor can it be shown that there would come from it a tendency to eliminate Arabic and Sanskrit words from the vernaculars. Dr. Leitner's regrets about the results that would arise from such a process are superfluous. An effect that may really be looked for (besides the naturalisation of English words when they are required) is the selection and adoption into the vernaculars of Arabic or Sanskrit words according as the one or the other of those languages may be able to supply the words most fitted. At the present time the Mohammedans use one set of words and the Hindus another, each being, from its partial use, in a great measure unintelligible to the class that adapts the other. The adoption of an alphabet fitted for the words of the three great literary languages that supply ideas to the natives of India, would enable the vernaculars to enrich themselves from all these sources—would free them from the necessity now placed upon them, by the multiplicity of alphabets not fit for all kinds of words, of looking for new acquisitions to but one of them.—I am, &c.,

FREDERIC DREW.

3, Jermyn-street.

AIR AND VENTILATION.

SIR,—I should be glad if you would permit me, through your columns, to put one or two questions to Mr. Hartley, the author of the excellent paper on "Ventilation," reported in your issue for the 26th ult., and I believe the replies cannot fail to be of service to those of your readers who take an interest in the subject.

Will Mr. Hartley tell us whether the amount of change of air through walls, noted by Pettenkofer, and given in a tabular form at page 306 of your *Journal*, is the amount in an hour, or in a longer period of time? Also whether, in his tabular statement on page 307, the amounts are the cubic space per inmate which the respective wards, shops, &c., ought to contain? or the amount of cubic air per inmate which ought, in his opinion, to pass through the ward or shop in some given space of time? Lastly, whether "schools for children" mean dormitories or school-rooms?

If he will add a reference to the publications in which Pettenkofer's and Dr. Angus Smith's researches, and the Paris experiments can be found fully described, he will add to the value of his reply.—I am, &c.,

T. ROGER SMITH.

GENERAL NOTES.

Electro-plating Natural Flowers.—A very ingenious application of electro-metallurgy has recently been brought before the notice of the Society. It consists in the application of a coat of silver, by means of electro-deposition, on natural leaves and flowers. By this means very delicate ornaments are produced, since the precise form and texture of the natural leaf is preserved under the thin silver film. The special process by which these results are attained is the invention of Mr. Denton.

A Science College for Birmingham.—Sir Josiah Mason, on the 23rd ult., his eightieth birthday, commenced the erection of a science college, for the good, first of Birmingham and Kidderminster, and then of the district generally. The buildings, when completed, will occupy a site of rather more than one acre, with a south-east frontage of 149 ft. to Edmund-street, and extending through to Great Charles-street, with a frontage of 127 ft. Of this area, about 2,250 square yards will be occupied by the first portion of the college now commenced. There will be three large lecture-rooms, and in connection with each the necessary laboratory, preparation-room, and rooms for collections, &c., and private rooms for professors and assistants. The whole of the buildings will be of brick, with stone freely used in cornices, jambs, arches, &c. The style of the architecture will be Gothic of an early character. In addition to the outlay on the building, Sir Josiah Mason has already conveyed to the trustees—who are six in number—property valued at about £65,000 as the first portion of the college endowment, and it is understood that this will probably be considerably increased as time goes on. Heading the list of trustees is the name of Mr. W. C. Aitken. The founder declares by his foundation deed that, as far as practicable, the system of instruction shall include the following subjects:—Mathematics, abstract and applied; physics, both mathematical and experimental; chemistry, theoretical, practical, and applied; the natural sciences, especially geology and mineralogy, with their application to mines and metallurgy; botany and zoology, with special reference to the laws of health; and the English, French, and German languages; and may, in the discretion of the trustees, include all such other subjects of instruction as will conduce to a sound, practical knowledge of scientific subjects, excluding mere literary education. The trustees are also empowered to give popular instruction in evening or other classes, to provide for the teaching of art, to make provision for students of both sexes, and to found scholarships.

Wages in France.—The *Moniteur* gives the following statistics respecting the wages earned by the different classes of artisans in France. It states that the average daily wages obtained by those employed in the sixty-two trades recognised by the State in 1853 was 1·59f. In 1871 the daily wages averaged 2·65f., or an increase of 40 per cent. Workmen boarded by their masters are paid about half less, but except in the country a workman is seldom boarded by his employer, and these statistics do not apply to country workmen. Of all trades, the lowest wages are those of the weaver, who earns only 1·94f.; next comes the pastrycook, who is paid on the average only 2·31f.; the shoemaker, 2·34f.; and the rope-maker, 2·36f. The highest wages fall to the lot of the ornamental sculptor, who earns 4·50f.; the watchmaker, 3·43f.; the metal-turner, 3·47f.; the stonecutter, 3·48f.; and the jeweller, 3·58f. The class of workmen whose wages have increased the least since 1853 are the pastrycooks, whose earnings have only risen 17 per cent., whilst those of the bakers, on the other hand, have increased 54 per cent. The trades that have made the greatest progress are barbers and sawyers, and their wages have augmented 65 per cent. The average wages of workmen in all branches of trade, taken together, is 2·90f., and those of women 1·29f. Lacemakers earn 1·71f.; artificial flower makers, 1·70f., which trades pay the highest wages to female workers. The increase in women's wages during the above-mentioned period has been 38 per cent. In Paris wages greatly exceed the above-mentioned averages. There ornamental sculptors earn 7f. per day; watchmakers, 5f.; jewellers, 6f.; metal-turners, 6f.; stonecutters, 6f.; and rope-makers, 4f. The average wages of the Parisian workman is 4·99f., and those of workwomen, 2·78f.

Coach-makers' Company and Technical Education.—It appears that there is no likelihood of the City Companies drawing back from the work of promoting technical education; evidences that the work is steadily proceeding may be noticed in various quarters. At a recent dinner of the Coachmakers' Company, Mr. G. N. Hooper, the master, alluded to the fact that this was one of the first of the City Companies to move in the matter of technical education, prizes having been offered for special drawings and designs about ten years ago. The company had also, he said, been the first to assist her Majesty's Commissioners at the Exhibition, by appointing a committee of experts to deal with particular points, and besides collecting photographs of the carriages of the various sovereigns of Europe, they had founded a library bearing on the special objects of the company's operations. In concluding, Mr. Hooper was understood to hold out every hope that the energies of this company would still be devoted to the same object—the promotion of that branch of technical education with which it was specially connected. It will be remembered that the Society has been assisted by this, among other City Companies, for contributions to the Prize Fund for the Technological Examinations.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 10.—"The Art of Illustration as applied to Books and Newspapers," by HENRY BLACKBURN, Esq. The paper will be illustrated with a large collection of diagrams and sketches kindly lent by the proprietors of the *Illustrated London News* and other gentlemen.

MARCH 17.—"Food Adulteration and the Legislative Enactments Relating Thereto." By WENTWORTH LASCELLES SCOTT, Esq.

AFRICAN SECTION.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 9.—"Livingstone's Discoveries in Connection with the Resources of East Africa," by the Rev. HORACE WALLER. Sir T. FOWELL BUXTON will preside.

MARCH 30.—"Civilisation and Progress on the Gold Coast of Africa, as affected by European Contact with the Native Inhabitants." By ANDREW SWANZY, Esq.

INDIAN SECTION.

Friday evenings at eight o'clock, the followihg arrangements have been made:—

APRIL 2.—"Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India," by ROBERT H. ELLIOT, Esq., Author of "Experiences of a Planter," &c.

APRIL 30.—"Indian Manufactures," by ELIJAH HELEN, Esq., of Manchester.

MAY 14.—"The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East," by the Rev. JAMES LONG.

CHEMICAL SECTION.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

MARCH 12.—"River Pollution, with Special Reference to the Work of the late Commission," by W. THORP, Esq., B.Sc. Lond., F.C.S. U. J. KAY-SHUTTLEWORTH, Esq., M.P., will preside.

APRIL 16.—"Recent Advances in Photographic Science," by J. SPILLER, Esq., President of the Photographic Society. WARREN DE LA RUE, Esq., D.C.L., F.R.S., will preside.

MAY 7.—"Alum Shale and its Application," by SYDNEY RICH, Esq.

CANTOR LECTURES.

The Second Course of Cantor Lectures is by the Rev. ARTHUR RIGG, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

The remaining Lectures of the Course will be delivered as follows:—

LECTURE IV.—MONDAY, 1ST MARCH, 1875.

Picks, Axes, Adzes, Chisels.

LECTURE V.—MONDAY, 8TH MARCH, 1875.

Planes, Knives, Shears, Saws.

LECTURE VI.—MONDAY, 15TH MARCH, 1875.

Saws and Dove-tailing Tools.

MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Rev. Arthur Rigg, "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft." (Lecture V.)
Royal Geographical Society, University of London, Burlington-gardens, W., 8½ p.m. Lieut. V. L. Cameron, "Examination of the Southern half of Lake Tanganyika."
Medical, 11, Chandos-street, W., 8 p.m. Annual Meeting.
London Institution, Finsbury-circus, E.C., 5 p.m. (Travers Course II.)
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on Dr. Rose's Paper, "The Bill for Facilitating the Improvement of the Dwellings of the Working Classes in Large Towns." To be opened by Sir George Campbell.
Birkbeck Scientific Society, Southampton-buildings, W.C., 8 p.m. Mr. Harold Tinson, "Phosphorus."

TUES. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Rev. Horace Waller, "Livingstone's Discoveries in connection with the Researches of East Africa."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. A. H. Garrod, "Animal Locomotion."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Continued Discussion upon the paper by Messrs. Findlay, Cudworth, and J. T. Harrison, "On the Working, Sorting Sidings, and Statistics of Railways."
Photographic, 9, Conduit-street, W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Sir Duncan Gibb, "Ultra Centenarian Longevity." 2. Rev. Dunbar I. Heath, "Molecules and Potential Life."

WED. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. Blackburn, "The Art of Popular Illustration."
Geological, Burlington House, W., 8 p.m.
Graphic, University College, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m. Annual Meeting.
Archæological Association, 32, Sackville-street, W., 8 p.m.
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. G. W. Wigner, "The Provision of the Bill to Repeal the Adulteration of Food Acts, and to make better provision for the Sale of Food and Drugs in a Pure State."

THURS....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "Electricity."
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

FRI.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. W. Thorp, "River Pollution."
Royal United Service Institution, Whitehall-yard, 3 p.m. Dr. W. B. Carpenter, "The Voyage of H.M.S. Challenger" (continued).
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Abel, "Accidental Explosions."
Junior Philosophical Society, 6A, Victoria-street, S.W., 7½ p.m. Mr. O. S. Bartlett, "The Superstitions of Great Britain" (2nd paper).
Astronomical, Burlington House, W., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.
Civil and Mechanical Engineers' Society, 7, Westminster-chambers, S.W. Mr. C. H. Rew, "Trade Guild and Trade Unions."

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. K. Clifford, "The General Features of the History of Science."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,164. VOL. XXIII.

FRIDAY, MARCH 12, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW AMENDMENT.

The Council having appointed a Committee of the whole Council to consider this subject, and to watch the progress of the Bill now before Parliament, a meeting of this Committee was held on Thursday, the 5th inst., when it was determined to request the Duke of Somerset to present a petition on behalf of the Council to the House of Lords.

On Tuesday, the 9th inst., a deputation from the Council, consisting of Major-General F. Eardley-Wilmot, R.A., F.R.S. (Chairman of Council), and Lieut.-Colonel Strange, F.R.S., attended by P. Le Neve Foster and H. T. Wood, waited on the Duke of Somerset, and laid before him the following petition, which his Grace undertook to present yesterday (Thursday). The deputation at the same time explained in detail the views of the Council with regard to the various clauses of the petition.

To the Right Honourable the Lords Spiritual and Temporal in Parliament assembled.

The humble petition of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, sheweth—

That your petitioners have had under their consideration a Bill now before your Honourable House, intituled:—"An Act for Consolidating, with Amendments, the Acts relating to Letters Patent for Inventions."

That your petitioners desire respectfully to submit for the consideration of your Honourable House:—

1. That paid commissioners, specially charged with the administrative work of the office, are absolutely necessary for the proper carrying out of the Bill, and that the said Bill cannot be carried into satisfactory practical operation unless such paid commissioners are appointed.

2. That one of such commissioners other than either of the law officers of the Crown, who, it is admitted by the Lord Chancellor, have not the necessary leisure for attending to the duties connected with the granting of letters patent, be in Parliament.

3. That no adverse report of an examiner, even with a right to appeal, ought to preclude an applicant from obtaining his letters patent, at his own cost and risk, as any tribunal of the above character assuming infallibility in commercial and scientific questions would be repugnant to the feelings of the country, and fraught with much danger to the progress of Arts, Manufactures, and Commerce.

4. That whilst your petitioners approve of the principle of compulsory licenses by patentees, as contemplated by the said Bill, the process of obtaining and granting such licenses as therein proposed is unnecessarily complicated and expensive, and requires to be simplified.

5. That it would be of advantage if the prolongation of letters patent could be obtained on application to, and satisfying the Commissioners of Patents on the expediency thereof, and on payment of a high fee.

6. That, looking at the large amount of work contemplated by and necessary to be performed under this Bill, the staff proposed by the said Bill is wholly inadequate to its due performance.

That your petitioners submit for the consideration of your Honourable House the importance of enlarging what is commonly termed the Patent Museum, now under the charge of the Commissioners of Patents, into a general Museum of Science applied to Industry, as proposed in the report of the Commissioners on Scientific Instruction, and that such enlarged museum be placed under a Minister of the Crown, responsible to Parliament, who can devote attention to it, and that any surplus fees derived from the granting of letters patent be applied to the maintenance of such a museum.

Your petitioners humbly pray your Honourable House to take the premises into your favourable consideration, and take such steps for amending the said Bill and procuring the extension of the said Patent Museum, as to your Lordships may seem meet and right.

And your petitioners will ever pray.

Signed on behalf of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, this 6th day of March, 1875,

F. EARDLEY-WILMOT, Major-Gen.,
Chairman of the Council.

MERCHANT SHIPPING BILL.

At the request of the members present at the ordinary meeting of February 16th, the Council have appointed a Committee to watch the progress of this Bill in Parliament, and they requested the following gentlemen to serve thereon, with power to add to their number:—Captain Sir J. Heron Maxwell (Bart.), R.N., Captain Toynbee, Donald Currie, William Young, and Dr. Sandford.

The Committee met on Monday, the 8th inst. Present—Sir J. Heron Maxwell (in the chair), Major-General F. Eardley-Wilmot (Chairman of Council), Captain Toynbee, Wm. Young, and Dr. Sandford. The following gentlemen were added to the Committee—N. Barnaby, J. Fleming, R. Greaves, Morton John Riley, Captain B. Sharpe, R.N., J. Scott Russell, F.R.S., Rev. J. Scarth, Rev. R. J. Simpson, and Harry Leach.

The Committee proceeded to take into consideration the various clauses of the Bill, and after appointing a Sub-committee on the subject of advance notes, adjourned till Monday next, at four p.m.

TECHNOLOGICAL EXAMINATIONS, 1875.—NOTICE TO INSTITUTIONS.

Candidates intending to sit at these examinations should make early application to the Secretary of the Society of Arts, Adelphi, London, for forms for making a return of age, address, &c., as these particulars must be forwarded to the Society not later than the 31st instant.

AFRICAN SECTION.

A meeting of this Section was held on Tuesday evening, March 9th, Sir T. Fowell Buxton in the chair.

The Chairman, in introducing the Rev. Mr. Waller, said he could not speak of Dr. Livingstone without briefly expressing his own great interest in all connected with his name. It seemed to him that probably in the future Dr. Livingstone would rise in public estimation and usefulness; for while it could not be doubted that even his geographical discoveries were already accepted as of the highest value, it must not be forgotten that he would be remembered in another and a double aspect. He had thrown great light on the subject of the races which inhabit the interior of Africa, and his narratives on this point had created a marvellous interest in this country; but he had performed yet another work, which might prove in a distant future the most important of all, inasmuch as he had been the first to break ground in the interior of Africa, and to give to those teeming tribes some idea of what an Englishman and a Christian was like. He believed that this would in the end prove to be the greatest of his works, but it was one which could not yet be defined or measured. They could only say at present that it opened up a number of questions connected with Africa —commerce, missionary enterprise, and efforts for the suppression of the slave trade; and these points, he believed, would be brought before the meeting by Mr. Waller.

The paper read was—

LIVINGSTONE'S DISCOVERIES IN CONNECTION WITH THE RESOURCES OF EAST AFRICA.

By the Rev. Horace Waller.

Now that twelve months have passed since the arrival of Dr. Livingstone's remains upon the African shore, sufficient time has elapsed for us to scrutinise more closely the results of a career at once so extraordinary, and yet withal so valuable to the cause to which it was devoted. It needs no apology to descend, as it were, from the higher ground, to forsake for the moment the contemplation of his greatest motives, in order that we may follow him this evening in his endeavours to find out what Africa is capable of, and how far it is possible to raise up for her, from within, a better state of things, because Livingstone held firmly to the belief that civilisation and Christianity must be made to operate upon Africa together. If I have placed the word civilisation first to-night, it is because we are, as a Society, charged with a definite line of inquiry in which to employ our investigations, at the same time no portion of our subject will tend to sever us from that greater end which Livingstone always had in view whilst planning and contriving for the introduction of legitimate commerce into Africa. I should be an unworthy interpreter of the dead traveller's motives if I ever admitted for an instant that, in his own mind, he allowed commerce to stand before Christianity as a blessing to the races amongst whom he wandered, and for whom he died.

As a means to an end, how has Livingstone's life affected the present or the future of Africa; and if any substantial advantage has already been gained for her, how are we to detect it?

It will not tend to lessen our conception of his character or his deeds if I state at once that there is a danger of missing some of the greatest effects already produced by his devoted life, if we approach too close to the picture. For our purpose to-night I must ask you to recede from it till we can dwell on the lights and shades, as they will then fall into their proper places. It is not my purpose to lead you so close that we shall be able to detect every touch of the brush: we will not spend time in the analysis of a piece of coal taken from a seam on the Zambesi, or in testing the strength of the Buazé fibre on the Shiré Highlands, because we must begin as Livingstone began, that is, by looking forth on the whole gigantic expanse of this unknown land, to see first what are the obstructions to commerce, what the inducements to overcome them, and how far the physical features of the country hold out hopes that before long inner Africa will be laid open to the mind influences of the outer world.

Removing, then, as it were, the highest power from our microscope, let us examine Livingstone's latter explorations with a lens that will enable us to take much into the field at once. Persistently, from first to last, he was impressed with the idea that little or nothing can be done with the great lake regions of Africa, till the slave trade is broken down, and I don't think there is one of his followers or companions at any time that has not heartily echoed this assertion. I will briefly review with you one or two circumstances sufficiently evident to most here, in order that it may be seen that Livingstone was not misled in his assumption, and it is with thankfulness that we shall discern by the rapid confirmation which the history of the last few years affords, that the philanthropic desire which burnt within him has been aided by the interposition of the Power from which all human sympathy immediately radiates.

It is not too much to say that 12 years ago England had settled down into such an imperturbable and self-satisfied conviction regarding the entire extinction of the slave trade, that nothing short of the startling announcements brought to us by Dr. Livingstone could have roused her to look again into the matter. But to our shame be it said, the difficulty in arousing public attention to the rapidly reviving traffic did not arise entirely from ignorance and indifference. It was as well known then as it is now, that the increasing demand for ivory, copal, hides, and cloves threw a life into the trade with Eastern Africa which had not been seen for many centuries. It is useless to say that the dreadful energy which sprang up simultaneously in the slave trade was not apparent to everybody who chose to open his eyes; too many preferred to close them. Zanzibar rapidly became a very important place. Always the key position and the terminus of the caravan routes and the long-shore dhow traffic, merchants were attracted to it from the four winds. One fact was apparent, but it was hushed up and kept secret by the commercial population. Here an Englishman would be seen employing gangs of slaves behind the most transparent screen; there Banyan merchants, British subjects, would congregate; a German house would establish itself to-day, a French or American consulate would become a fact to-morrow; but there was a steady disposition to divulge nothing

to the outer world. The goose was being killed for the golden egg, and by common consent. Africa was being depopulated, instead of possessing territories filled with natives capable of cultivating and raising produce in the future. What did it matter if a whole tribe went down so long as it furnished a gang of slaves, before its extermination, capable of being driven to the coast with £50,000 worth of ivory? Such has been the state of things till recently. Everything for a quick return, and no questions asked; and everyone shut his eyes to the enormous extension of the slave trade, just because the indirect profits to be derived from it were so very sure and so very great. If time allowed, I might show you some more very startling facts connected with trade on the East Coast as it has been. Suffice it to say that sugar plantations were worked in an English name and by slaves bought at Zanzibar, and that a wholesome *exposé* has been followed by the speedy appearance of the traders' name in that portion of the *Gazette* devoted to bankrupts; that no sooner was it known that our Government intended to cleanse the Augean stable, than an enormous transhipment to England of all those goods which supply the slave trader, such as beads, calico, brass-wire, and so forth, took place at once. It was felt that the merchant's occupation was to some extent gone, that henceforth the slave dealer could only at a risk come to the European houses for the supply of goods with which to tempt poor savages in the interior of Africa, for their kith and kin—these matters are germain to my subject, but let us the rather look at them as gone, I hope, for ever. One bright exception we must mention before passing on. It is only due to the brave, noble fellows, who in the person of her Majesty's officers and sailors toiled year in and year out in suppressing this fiendish traffic, to record that they never swerved. Discouraged by the all-pervading tendency to keep matters quiet and pleasant, sapped and undermined by subtle influences at Bombay, with their work too often cut to waste by coming in contact with a state of things which, till General Rigby, Dr. Kirk, and subsequently, Sir Bartle Frere came upon the scene, approached as near as anything could to culpable blindness—yet they never relaxed their efforts to stay the evil.

Well, then, to follow the order of events, we cannot call it a mere coincidence that England began to awaken to the true perception of things when Dr. Livingstone came to England. It was he who first kindled a desire in us for more light on the subject within, and thorough investigation without. Since then we have insisted upon knowing what goes on at Bombay and Zanzibar. We have followed the Manchester calico into the country, and the dollars realised by the sale of slaves exchanged for it into the right pockets, and be they Banyans, Pirates, Portuguese settlers, or Persians, a salutary change has come about in the last few years.

To anyone as well acquainted with the inner wheels of these mysteries, these revelations, and repressive measures, as you yourself are, Sir, I venture to say it is as easy to credit Livingstone's words with the effect already produced as a means to an end, as it is to ascribe the movement of the hands on the clock's face to the power of the mainspring hidden away amongst the works.

Ladies and Gentlemen, as a Society you cannot have any development of the commerce of Africa worth naming in the same day with healthy progress till the slave trade is abolished, and the ebb-tide of human life and native industry turns. You must forgive so many allusions to it in a paper of this nature, but it is idle to raise up hopes which must be dashed down in the future if rudimentary principles are not attended to. Commercially speaking, I believe with Livingstone that when this foul tide does turn, a very different tale may be told.

On a former occasion I think I ventured to point to what I then termed a phenomenon visible in the African sky. I mean by this an altogether extraordinary interest in all that concerns its most unknown regions, a phenomenon surrounded too by a bright halo of real active advancement and enterprise, which seems as significant as it is hopeful.

Everything—no, I must not say everything, for I fear there is one sad exception—but a great many things seem to court the attention of the trader at the present moment. The export slave trade upon the coast is suddenly reduced to a minimum, and instead of some 25,000 slaves a year being shipped from the Island of Zanzibar and its vicinity on the main land, not as many hundreds are now sent afloat. If we could be sure that a large number were not marched up the coast as an alternative, and if we could say for certain that the repressive measures we have adopted with redoubled energy since Livingstone's later accounts have caused a diminution in demand and supply to that amount, viz., 25,000 souls, we have a saving of life to Africa of a quarter of a million lives per annum—lives, too, of the most valuable description, boys, girls, and women. I have taken these figures by our old rule, which was to reckon that for every slave sold on the coast ten lives are lost in the interior. I think those that have perused Livingstone's last journals, his account of the scenes on the road to Nyassa and on the Lualaba, at Nyangwe, will hardly be inclined to say we have overrated the case. Let me then make this point good, viz., that Africa has hitherto been so drained for her human wealth, I mean the very bones and muscles of her own people, that it has been idle to think of any definite industry, such as the production of cotton, oil seeds, grain, the fibres, the collection of skins and gums, and the quarrying of minerals, simply because the only people who could aid the traders' ends have been destroyed or removed hitherto.

That Livingstone's persistent denunciations and appalling revelations have aroused popular feeling to such a pitch, that this bleeding, so to speak, will be rapidly staunched, is, I think, a prediction fully justified. If a Wellington is to be credited for ever in history for a Waterloo, let Livingstone's name for ever stand at the head of this chapter of better things in Africa.

Two things, however, must be borne in mind. The Mohammedan Sultan of Zanzibar is about to visit England; he has faithfully endeavoured to help us to stop the slave trade at great personal risk; we must try to show him our appreciation, and to strengthen his hands; and the other is, that our utmost endeavours must be made to get Christian Portugal to see herself as

others see her in this question of developing East Africa.

After dealing thus far with the great obstruction to the progress of commerce in these regions, what do we find to be the second desideratum in Dr. Livingstone's estimation? It is a question that can be answered in a moment—a water communication with the interior.

And here I, for one, give him all praise for a discovery of incalculable value; but here, alas! we now find ourselves placed before a difficulty which will in time vanish, we must hope, inasmuch as it is not a natural one, but the rather one that seems almost unnatural in most of its features. When we know that experiment has proved it to be quite possible for a body of Englishmen to land at the mouth of the Zambesi on the first of the month, and to be sailing on the broad waters of the Lake Nyassa on the last day of it—not in a canoe, but in a large steel boat, capable of bearing tons of goods from one part to the other—when we know that this has been done in the case of Mr. E. D. Young; and moreover, when we reflect that all we want in Africa is a heart—a great organ into which legitimate trade can come, to be pumped out into arterial roads and rivers, and to bring back the blood of native produce in exchange, it seems as if we had the very organ here, and circulation willing to begin. But so long as Portugal forbids us access by shutting up these rivers, and denying us an entry by the Zambesi, I fear it will be long before we can say there is any active circulation in the veins.

When we remember the important step Portugal has recently taken in abolishing the Coolie traffic at Macao, it is hardly possible to conceive that she will hold her hand or much longer debar us from using the only possible remedy for the devastation and misery that goes on behind her borders.

But here we may, as it were, put on the higher power to the microscope and closely examine the method of carrying on trade at present on the East Coast of Africa, and in the Interior. First of all, let me mention one fact, which I am sure gentlemen acquainted with Natal will already have taken into account, viz., that immediately you cross the Zambesi you come to a working population in every sense of the phrase. Not to play with words, or to thrust the inevitable working man into the question, I must remind you, nevertheless, that he is, in a manner, always to be found to the north of the Zambesi, whilst he is comparatively absent to the south of it. The Kaffir and the Zulu are good enough with cattle, but when it comes to the hard labour of tilling the ground it is considered by them to be woman's work. Cross the Zambesi, and for five hundred miles or more this absurd notion is not to be traced; there men are just as industrious with the hoe as any of the women, and even more so. Now this is very important to remember, because, when cotton and oil seeds, and sugar and tobacco come to be cultivated, there will be no difficulty in finding willing labourers enough.

I would say, then, to those whom it concerns, keep your eye fixed on one point, and that point Lake Nyassa. I consider it, as I have said, the great heart from which commerce must be pumped into the country. I believe that there is no natural impediment to founding two trading stations on the lake, the one at the North, and the other at the South. From these depots trading parties could be sent out in all directions, not of necessity to bring in produce, so much as to make it known that there was a spot within reach where honest prices could be got for ivory, copper, gold, and other articles. Judging by a small experiment made, when I had the honour to be the lay superintendent of the Universities mission within a few miles of this country, I can only say that news spreads with marvellous rapidity, and, provided proper precautions are observed, I have little doubt about the results. In Livingstone's opinion the highlands around Lake Nyassa are cool and comparatively healthy. The lake is at all times surrounded by a very large population. Livingstone describes the towns of M'kata Marenga, M'ponda, and others, and Mr. Young's observations confirm him in every particular. It must be so. Africa is liable to famines from slave wars in the first place, and droughts in the second. On the occurrence of war the people, having lost the chance of cultivation in the wet season, repair to the lake, in which is an inexhaustible supply of fish, with damp soil along the shore on which rice and Indian corn can be raised with marvellous rapidity. Certain it is that a trading station in this locality would instantly be within reach of abundant provision at a very cheap rate. The appearance of a body of traders on the lake would likewise have another very significant effect, we may rely upon it. You will recollect that Dr. Livingstone found the Arabs alarmed beyond measure at his presence, when he came across them on one of their slave routes. The one Englishman was enough to send them off across country in dire apprehension. I am glad that he has placed this on record. He did not know, poor fellow, but we know since then, that the Arabs, if they had any strong opinions then about Englishmen when confronted with slave traders, have had every opportunity of confirming their fears since. It is known from one side of Africa to the other by this time, and nowhere better than at Nyassa and Tanganyika, that English efforts to stop the traffic are doubled and trebled now. If they see that we can get up the Shiré by water to the lake, they will at once, and very properly, regard their flank as turned; and I venture to say that so intense is their apprehension, that not an Arab will resort to Nyassa with any idea of slaving after the first twelve months.

What will be the result—for here we must rigidly keep Livingstone's experiences in view. The large amount of ivory yearly produced in the neighbourhood of the lake will be without purchasers. But it may be said, what is to prevent the Arabs from dropping an illegitimate trade for a legitimate one. Simply this. Hitherto they have relied on their slave gangs to be the porters; they have bought the slaves and the elephants' tusks in the same villages, and so have got their goods to the coast; but without the slave trade the ivory trade, as far as Arabs are concerned, must come to a stop. I dwell on this particular point because it will be a double incentive to any merchants who go there to crush the Arab slave trade, and althoug

it won't want any persuasion to get Englishmen to act whenever they come across the awful spectacle of a string of slaves bound for the coast, it is worth repeating that the legitimate and natural outlet for the trade of that region is down the Shiré and Zambesi. It cannot be forced in the opposite direction, that is, towards Zanzibar and overland, except with all the illegitimate and brutalising accompaniments we have mentioned.

Livingstone knew all this years and years ago, and never ceased to point it out. In one of his last letters, written to me from the lake vicinity, he deplores the failure of his attempt to carry his steamer, the *Lady Nyassa*, over the Shiré cataracts to launch her on the lake, and in bitterness he spoke of the Arab vessel which was engaged at the time in ferrying slaves across. This mistake in the construction of the *Lady Nyassa* cost him £6,000, every penny of which has been lost to his family, but others will profit by his mistake and avoid it. Already Mr. Young is constructing another large boat after the pattern of the last, with which he did such good service on Nyassa, and there is not any reason to suppose that he will not have sailed all over the lake within three months of reaching the mouth of the Zambesi River. Again, let us pause to reflect that but for Livingstone in all probability we should have been utterly ignorant of the existence of this great lake, with 600 miles of coast, draining off its waters to the sea by the Zambesi and Shiré. Nothing prevents it being turned to account immediately but the present policy of the Portuguese, not one of whom has ever been to the lake yet, or made a dollar out of the inducements it offers for trade.

Dr. Livingstone's last visit to this inland sea puts us in possession of many new facts. Cattle abound on the Eastern shore. The great copal field of East Africa extends from Zanzibar, it would seem, to Nyassa, and he mentions the gum yielding capacity of the trees again and again. Copper ingots of a certain size were current coin with the merchant when he and Dr. Kirk and Mr. C. Livingstone discovered the lake in former years, and if the produce of copper is confined to the mines of Katanga, certain it is that it finds its way as far as the region under consideration in quantities, for Livingstone tells us that it is circulated everywhere in pieces of from fifty to one hundred pounds in weight. But ivory must always take precedence of every other article, and the enormous number of elephants in the lake districts are capable of yielding a great supply. I have, however, stated before that gold is known to most of the men who come from the East of the lake with whom I have conversed. Coal is also perfectly well known; india-rubber abounds; indigo is a weed everywhere. I have here specimens of native tin, of malachite, of a peculiar fatty substance produced from a tree. Livingstone sent home specimens of coffee and the nutmeg, and I may mention as a coincidence that Dr. Hooker simultaneously received some of the same spices which had been discovered for the first time in a mummy case in Egypt, establishing the fact that the nutmeg has been known in Africa for thousands of years. Again, the Doctor found the palm-oil nut in these quarters, and I can testify to the universal cultivation of two kinds of cotton wherever there is peace in which to turn it to account. In short, I will never believe that any land is endowed by nature with greater natural resources; and were I to talk to you of the ebony, the lignum vitæ, the dye-woods, the iron-fields, and general richness of the country, I should perhaps employ the use of colours on the picture, but it would savour too much of the prospectus maker's lore, and do just what I purposely wish to avoid.

In a word, this picture has its canvas side. To say that you have a healthy country in all the regions Livingstone travelled in is exaggeration; but it is my conviction that any body of Englishmen can live there if they will avoid all manner of excess as they would poison, and turn to good account the experience of those who have had to buy it. Livingstone, at the outset of his journey, on the bitterly cold heights to the west of Nyassa, was without a blanket; a few miles further, and he lost all his medicines. I would avoid such strains on health as these. Again, just before he died, when he reached Bangweolo in that awful season of flood and rain, he had run out of coffee, in one place he had to limp along without proper boots, for years he had no quinine, and from first to last he knew himself to be liable to a dreadful chronic malady. You or I most likely would have given it up when either of these disasters happened; had he done so, perhaps we should have rejoiced in his personal descriptions of these countries to-night, but there never was and never will be another Livingstone. He used to say that difficulties were only raised up to be overcome, and it is marvellous how many of them that iron determination dragged his tough constitution over, under, and through; but he was killed by them at last, to our deep sorrow, and for our perpetual warning. No; men to live there must live well and carefully. Livingstone preached this always, but he could not always practise it. The fevers of Africa, though severe, are in seven cases out of ten capable of being kept within bounds. It may seem straining a point, sir, but at all events it is strained in honest belief, when I state that I hardly think Livingstone ever made a more important discovery for missionaries, traders, or explorers than when he found out exactly how to administer quinine in such a way as to nip an attack of bilious remittent fever in the bud. I have seen attacks literally by the score stopped at the very outset, and I know one man living at the present time who survived some eighty or ninety seizures. I am speaking of illness now that arose from privation and hardship, of fevers that would not have occurred but from the deadly nature of a particular locality. I will contrast the voyage of Mr. Young and his boat's crew to Nyassa and back (when not a single case of fever arose) by way of testimony that there is a right and a wrong way, a wise course to pursue and serious risks to avoid. But after all here stands the fact that with Livingstone's prescription in hand a case of fever in most cases left the patient none the worse 48 hours afterwards. To say that he always pointed out that intemperance in any direction was the most deadly of all diseases in tropical Africa, is not to credit him with discovery, but to add his warning to that of others who have known the secrets of so many deaths all round the Coast of Africa.

Before I close these remarks I must make one short appeal, if it only takes the form of an entreaty to be of good courage. I say this because there are some here who intend to go to Central Africa, and to try what can be done in the way of opening up a legitimate trade. Before Livingstone took his lonely journeys there, before he roused our indignation, our pity, and our energy by these bits of paper—these stained letters and pocket-books, you know what a *terra incognita* it all was. You know that the schoolboy who could tell where Zanzibar was would go up to the top of his class. I have even heard that five years ago one of those who sit in high places believed that the Mocambique channel was the entrance to the Persian Gulf! Well, see how marvellously all this has changed and in how short a time.

If you want commerce you must first have frequent and dependable communication: this is what scaffolding is in the erection of an edifice, and finally it becomes as necessary as wings to a bird, or rails to a train. Three years ago we have known an accumulation of the most vitally important despatches and letters to lie at the Seychelles Islands for six months waiting for a passage to Zanzibar; now, thanks to the noble-spirited enterprise of the managers of the British Indian Steam Navigation Company, we have always a monthly communication with Zanzibar, and it is possible to receive telegrams thence in about six days. As if this were not enough, the Cape mail steamers also run from the Cape to Zanzibar, so there are two strings to the bow, but far more pleasing it is to relate that the Portuguese Government have entered into arrangements with the more important of these two lines to open up their ports on the coast, such as Mocambique, Quillimane and Delagoa Bay. Nor must I omit to mention another circumstance which has occurred within the last few days. It may be known to many here that a movement has been set afoot in Scotland to raise up an appropriate memorial to their countryman, whom I trust we have kept in view throughout this evening. Taking him at his word, they have rightly conjectured that David Livingstone would rather have seen a brave determined effort made on Lake Nyassa to break in upon the darkness of these tribes from whom the slave traders' gains are derived, than any other form of monument to perpetuate his memory. Already a party is fitting out to accomplish this. Money has been subscribed with a lavish hand, and the necessary boats are being constructed. An appeal has been made to the Government of Dom Luiz, and it is very gratifying to state that it has been responded to in an excellent and gracious spirit. It has been pointed out in the first place, by Dr. Stewart, the organiser of this enterprise, that without the enormous Customs' dues payable upon goods at the Zambesi are waived in this instance in favour of the members of the missionary settlement, so that they may not be taxed upon goods which will be spent as money beyond the regions which Portuguese traders frequent, the thing must in time die a natural death. His Excellency Joao de Andrade Corvo, Minister of the Colonies, in Lisbon, has forwarded, through the Viscount Duprat, Consul-General of Portugal in this country, who is at all times the friend of progress, not only an official order under his own hand to the Governor of Mocambique, but we are assured in another form that all that has been asked for is freely granted, and that virtually no limit is to be put on the words "protection" and "help" for the party. Looking forward to the development of trade—legitimate trade—we have put the only pressure that is admissible on the Arab authorities, and with powerful results; but commerce will have to percolate equally through the great Portuguese seaboard between Cape Delgado and Delagoa Bay. Here let us hope that Portugal will see what an opportunity lies at her door. Confusion is spreading along the interior caravan routes on account of interference with the slave trade, and now is the time to divert trade, as I have shown, from the long unnatural course it takes to reach the Arab towns; the natural outlet must, and always will be, by the Shiré and Zambesi. Time was when, without doubt, the exports from Africa were enormous in comparison to what they are at present. We turn to maps printed hundreds of years ago, and we are astonished to find large inland seas laid down, and actual, though rough testimony borne to the fact that travellers wandered in those times in all directions. This was before the days of geographical societies, and before the thirst arose which now possesses us for accurate knowledge. But it was also before the slave trade. It is this which has made Africa unsafe to travel in—barren of treasure. It has been for many years as dangerous for the traveller as for the native; the one explores, the other lives with his life in his hand. Of a sudden Livingstone comes upon the scene; singlehanded he has pointed out both the disease and the remedy, and inasmuch as he has spent his life in a pure and single-minded endeavour to raise the down-trodden and oppressed, I repeat that we need not be surprised to observe that his efforts have secured more than human favour.

As in the pages of history we read that some old Pagan fortress gave way at last, that years of seige were brought to an end by one heroic act—that the assault took place, and that when the great gate of the citadel moved inward on its hinges it was just when the leader of the forlorn hope had cut his way through the garrison and reached the city gate to open it and admit his fellows, so has it been with Central Africa and Livingstone. To missionaries and traders it is left to swing the wide gate back. The leader has scaled every obstacle, he has flung to us the key of the fortress, he has died with his hand upon the drawn bolt, and now it only requires the united effort of Christendom to enable us to carry life and freedom, Christianity and civilisation, into the city where the demon of wickedness and cruelty has so long held the humanity of a continent in fetters.

DISCUSSION.

The Chairman called upon Mr. Young to open the discussion, a gentleman who, in 1868, when the news came of Dr. Livingstone's death, led an expedition up the Zambesi into the Shiré, followed up the course of Dr. Livingstone, and found that the rumour was false, it having been spread by his retinue to explain their desertion of him.

Mr. E. D. Young said he could bear testimony to what had been said about Lake Nyassa, and that until the slave trade in that region was put down nothing could

be done for the benefit of Africa. He was going there again, because he thought this was the time to do some good to Africa. It could be done, and ought to be done, and with God's blessing he hoped to be able to do it. He liked to go and do work—not talk about it beforehand, but he did not see any great difficulty in getting to Lake Nyassa, which was a large inland sea, abounding in fish. He had sailed on its waters, and thought if he could represents facts properly to those who had influence and who were desirous of suppressing the slave trade, they would put their shoulder to the wheel, and put the whole thing down. The slave trade there was carried on by a few poor, miserable, half-caste Arabs, almost too contemptible to talk about. In fact, half a dozen Englishmen on the lake, with a good boat, would be sufficient to put down the trade. There were 40,000 or 50,000 slaves taken across the lake in a few miserable dhows, which might easily be done away with. The great mistake in Dr. Livingstone's ship was, that it was too great altogether; one piece of it weighed four and a half tons, and it had to go sixty miles across a ridge of mountains. He believed the mistake was made here at home—not by Dr. Livingstone. However, he (Mr. Young) had profited by this experience, and took out a boat so constructed that it would take to pieces, and that each negro could carry a portion. With that boat he had sailed on that lake with twenty-five negroes and five months provisions. It had now been decided by the churches of Scotland that they would send out a mission there. They had asked him to go, and he could not refuse. The vessel he was now going to take would be somewhat larger, which would astonish the natives and the Arabs as well. It would perhaps require 600 men to carry it, instead of 240. When they were once established there, they would soon gain over the chiefs to their side, and he believed the natives, without any force, would put down slavery. They were people who only wanted to be told what was right, and to have a master mind amongst them, and the thing would be done. He believed in two years' time the entire traffic in slaves across the lake would be at an end. At any rate, in eight months' time he hoped to be there, and he was glad to say one obstacle was removed, viz., the Portuguese Government, through the influence of his kind friend the Viscount Duprat, were going to remove the duties entirely, in their instance, to assist in the enterprise.

Dr. Mann inquired the size of the vessel to be taken.

Mr. Young said she would be about 47 feet long, 10 feet beam, and 5 feet deep. She would be fitted with sails complete, and would also have an auxiliary engine. Her burden would be about twelve tons, and she would stand any weather she would meet with on the lake.

Mr. Trelawney Saunders said that all must be unanimous with regard to Dr. Livingstone, and also as to the desirability of trade penetrating into the interior or Africa. He wished he could say he perfectly agreed in everything which was proposed, but from some of the statements made by Mr. Waller he was compelled to dissent. For instance he had stated that any trade to the interior of Africa could only be carried on by means of the navigable rivers, and that overland trade was only possible in conjunction with the slave traffic, for that was involved in his proposition. He further said that if any legitimate trade was to be opened in the interior of Africa the slave trade must first of all be put down. To this he could not assent; on the contrary he contended that to put down this traffic in the interior it would not do to depend only on the cruisers on the coast, but they must be prepared to force legitimate trade into the interior, and there to contend hand to hand with these slavers. If Englishmen would resolve upon carrying trade into the interior of Africa with half the energy and the godly spirit which their forefathers had shown in India they would be sure to succeed. When he spoke of the godly spirit in which they went to India, he referred to the almost puritanical language introduced into the charter parties and various documents connected with the freighting of their ships. In his opinion, they should look for the development of legitimate trade, not only by the rivers, but overland, to be accomplished by establishing permanent stations at intervals, so that a constant communication would be kept up, and the resources of the country would find a ready sale at these depôts. Such was the instrumentality employed in India, and by the Hudson's Bay Company; and seeing what they had accomplished, what difficulty was there in applying the same method to Africa? The only difficulty was one which had been frequently expounded there by one of the governors of Bombay and several other persons, viz., the rapacity of the native chiefs. The way to get over that was to enforce law, and protect themselves by going armed, so as to maintain their legitimate rights. Another of Mr. Waller's remarks was that the Sultan of Zanzibar was coming here on a visit, and that he ought to meet with every encouragement and support as a potentate who exercised considerable influence on the East Coast. But how was he to be met? By telling him that the trade now carried on between the interior and his dominions was to be diverted to the Portuguese possessions.

The Rev. H. Waller remarked that he did not speak of the trade with the Sultan's dominions.

Mr. T. Saunders said it was with his dominions that the trade from Lake Tanganyika was now carried on, and it was an overland trade; and, moreover, trade might very well be carried on between the northern end of Lake Nyassa and Zanzibar, which would relieve them from the necessity of depending on the friendly offices of the Portuguese. No doubt they had acted with foresight as well as with liberality in relieving this expedition from the payment of duties; but what was to be reasonably expected from the Portuguese when English enterprise had succeeded in establishing trade with the interior of Africa, and when it came to be developed along the waters of the Zambesi, but an imposition of those duties upon which the kingdom depended for its resources.

The Rev. H. Waller—This is a missionary expedition.

Mr. T. Saunders said it was to trade with the interior of Africa that they must look for the development of its civilisation and the maintenance of missionary enterprise. What they were asking the Portuguese to do was inconsistent with any idea of politics or common sense in dealing with other nations; it was asking those, who could ill-afford it, to sacrifice their resources, and to be instruments in disseminating a religion contrary to their own. This was too much to ask of any nation, and what England herself would not grant. No doubt the Portuguese saw clearly the policy of assisting to establish a mission which would have the effect of developing the trade upon their rivers, but it would be a great mistake to suppose that they would sacrifice their system of raising a revenue. With regard to the Sultan of Zanzibar when he arrived, we should be prepared not only to tell him how much we admire his self-sacrifice in giving up the revenue which he had derived from the cultivation of the Arab slave trade, but also that we are prepared to assist him and his people with English capital, by establishing a trade with the interior, through the ports of Zanzibar. He looked forward to the establishment on Lake Nyassa as of great importance, but a mistake in this matter would mean the sacrifice of a generation of time. He hoped the time had arrived when the old Anti-Slavery Society might be revived, and when an African Society might be formed, to proceed upon the experience of the old territorial societies, and that thus they would have a legitimate trade competing with the illegitimate trade they wanted to destroy, and thus the Continent of Africa would be open to the light of knowledge, of legitimate industry, civilisation, Christianity, and all the other benefits which would follow.

The Rev. H. Waller remarked that if Mr. Saunders would look on the map he would see that Cape Delgado, the Portuguese northern coast boundary, came immediately opposite the north end of Lake Nyassa, so that all the trade coming down the lake and out of the Zambesi and Shiré was fairly within the Portuguese line. He had not alluded to the region of Tanganyika as one from which trade should be withdrawn. He should be the last to advocate any attempt to mislead the Sultan of Zanzibar, but he had an enormous territory near him at present quite undeveloped, and so unmanagable did he find it, that, according to the latest news, Unyanyembe, the great central station on the road to Ujiji and to Tanganyika, had been abandoned altogether to rebels against his authority. He should be the first to rejoice in land traffic being opened up; but, unfortunately, between the coast and Lake Nyassa the country was almost depopulated, and it would starve out any stations or any trader going overland. He looked forward to the time when the country should so far have "recuperated," and the population spread over that belt between the lake and the coast, that it would be possible for trading parties to go backwards and forwards, and furnish themselves with provisions on the way. But when only one person had travelled there, viz., Dr. Livingstone, they must take his experience as a guide. He was nearly starved on the way to Lake Nyassa, and in a letter written to him (Mr. Waller) shortly after passing the lake, he strongly deprecated any attempt at going to it overland, by pointing out that the true legitimate way of opening up that part of Africa was by water, and that water the Zambesi and Shiré navigation. It was not an idea of his own which he had brought forward, but he had tried to reflect the views which Dr. Livingstone had held when they were together on those rivers, and which he believed remained with him to the time of his death.

Mr. T. Saunders protested against the idea that the Portuguese boundary was to be recognised as a line from Cape Delgada straight across the continent.

The Rev. H. Waller said that was not his meaning. Such a notion was not entertained by any enlightened person, either Portuguese or English. He had merely taken this point on the coast as one from which to draw an imaginary line in dividing the natural trend of trade towards the Portuguese territories on the one hand and Zanzibar on the other.

Mr. E. Hutchinson thought all who had read Livingstone's writings must be persuaded that there was no chance of any development of internal commerce with Africa until the slave trade was put down. One point, however, had, he thought, a little escaped the notice of Mr. Waller, viz., that slavery was not confined to that part of Africa of which he had spoken, and with which he was most familiar. He quite agreed in the proposition that the introduction of legitimate commerce would destroy the slave trade, but he did not think the establishment of a mission and trading station on Lake Nyassa would accomplish the purpose. Nor was it correct to say, as he understood Mr. Saunders, that they must not rely on English cruisers. Dr. Livingstsne had stated that it was impossible to introduce commerce while the slave trade existed, depopulating and ravaging the country, and destroying all faith in ordinary commercial transactions. He would therefore venture to state broadly that until English power was brought into play in the Indian Ocean to stop this traffic, we should never accomplish what was desired. This had been proved by the experience of the West Coast, where there was no chance for developing trade whilst the Yoruba country was ravaged by slaves. The establishment of this mission station on Lake Nyassa would not check the slave trade at its roots or stop the source of supply. Slaves were now being brought down to the coast and smuggled off to the markets of Persia, Turkey, and Arabia, and so long as their demand continued, and the profits were almost fabulous, the trade would be continued if not forcibly put a stop to. England had the power to stop it, and it was her destiny so to do, as had been grandly said by Lord Palmerston, and any Government which carried out that policy would, he was sure, be supported in it. The Sultan of Zanzibar would no doubt receive a hearty welcome here, and though a Mohammedan, and therefore accustomed to slavery all his life, he appeared to have cheerfully acquiesced in the views of the English Government, and even to have put a more liberal interpretation on the treaty he had signed than the law officers of the crown; but as to compensating him for giving up a profitable trade, it must be remembered that by the treaty of 1822 it was only the domestic slave trade which had been permitted; and whilst it had been calculated that a yearly supply of 3,000 would amply suffice for the wants of all his dominions, it appeared that some 35,000 per annum came down to the coast, 20,000 passing through the custom-house of Zanzibar, and paying a duty of two-and-a-half dollars a head. So that in asking him to abandon this, we were not calling upon him to forego a legitimate trade, and we had also agreed that he should no longer be called upon to pay the subsidy of £2,000 per annum to his brother of Muscat. Still he deserved and required every encouragement, for his own governors were now in rebellion, and he had many difficulties to contend with. He must say he envied those who, responding to Livingstone's invitation, were now preparing to settle upon Lake Nyassa; but the Church Missionary Society were engaged in perhaps a still larger if a humbler task. Looking to the future, they expected to have a large number of liberated slaves to deal with, for even at present there was constantly intelligence arriving of the capture of slave dhows. What was to be done with them? Some were sent to Natal, where he was glad to find they could be received, some to Bombay, and some to the Mauritius; but he believed it far better, if they could, to keep the negroes in their own country, and the Church Missionary Society, therefore, had sent out a considerable party to establish a settlement near Mombas, where they were kindly received by the Sultan of Zanzibar, at which they would accommodate any number of liberated Africans. By this means they hoped to carry into the interior by native agency commerce, civilisation, and Christianity, as had been done very successfully, he believed, on the West Coast.

Mr. Swanzy said there were two simple reasons why legitimate commerce could not co-exist with slavery. One was that the native chiefs obtained what they wanted in exchange for slaves; and the other that it caused a depopulation of the country; and where the population was sparse, the negro would never work as steadily and industriously as he would where it was more dense. He would only add one word to give his entire concurrence, as a merchant of long experience, in the statement made by Mr. Waller as to the importance of keeping open communications. Unless this was done, it was impossible to carry on trade. With regard to water navigation, he would remind them that in India trade was first devoloped at Calcutta by means of the Hooghly. For the present, it was hopeless to think of trading with the interior of Africa by means of carriers. Mr. Petherick had told them on former occasions how he had succeeded, but he had only brought down ivory, which could afford to pay for such means of transport, which was not the case with cotton, palm-oil, and things of a bulky nature. He certainly should not advise anyone to attempt to carry on a trade with the interior of Africa sword in hand.

The Viscount Duprat wished to say that the duties levied by the Portuguese Government in Mozambique were less than those imposed in Natal; and at Delagoa Bay everything was free. In reply to a question from Mr. Swanzy, he said the differential duties in favour of goods carried in Portuguese bottoms were now abolished.

The Chairman said one fact brought out very pro-

minently in the discussion was that legitimate commerce and the slave trade could not exist side by side. A certain amount of trade in fire arms might go on, because it was connected with it, but it was now absolutely established all the world over that there was no correlation of legitimate trade and slavery. A question had arisen whether commerce was to be carried on by water or overland, but he thought the different views might easily be harmonised. Whether they looked at Africa in the future, or America in the past, it was pretty evident that in the beginning water carriage was essential, but as time went on and the country developed, other means of transport were adopted. He had recently met with a remarkable instance of this, for being recently at St. Louis, he found that the traffic on the Mississippi in steamers was abandoned in favour of the railway. The Sultan of Zanzibar, whose approaching visit had been alluded to, already knew something of English Government, having resided for some time in Bombay, and he hoped, therefore, that his sojourn in England would prove pleasant to him and useful to his subjects. There could be no doubt that progress was being rapidly made towards a happier future for Africa, and that more and more interest was taken year by year in that great country. Only a few years ago the lakes Tanganyika and Nyassa were unheard of, but now missionary societies were about to establish settlements on their borders. Wherever Christianity had been introduced there was good reason to believe that it had gone a long way towards producing immediate results, and therefore he could not but hope that these efforts if successful would be still more beneficial. He concluded by moving a vote of thanks to Mr. Waller.

Mr. T. Saunders seconded the motion, which was carried unanimously.

The Rev. H. Waller briefly acknowledged the vote, and the proceedings terminated.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 10th, 1875; Lord ALFRED S. CHURCHILL, Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, Charles, Sligo.
Binko, Henry Bock, 28, Bath-street, City-road, E.C.
Cole, Henry Aylwin Bevan, 5, Northumberland-terrace, Tynemouth, Northumberland.
Dugan, John William Gustave Leo, 3, Plowden-buildings, Middle Temple, E.C., and Clarendon-house, St. John's-wood-park, N.W.
Duncan, George, 2, East India-avenue, E.C.
Holland, W. H., St. Mary-street, Gloucester.
Langton, George, 2, Northfield-villas, Wandsworth, S.W.
Langton, John, 1, Northfield-villas, Wandsworth. S.W.
Langton, Joseph, jun., 2, Northfield-villas, Wandsworth, S.W.
Robinson, William, Mount-pleasant, Wembdon, Bridgwater.
Sharpe, Captain W., J.P., Hanwell-park, Middlesex.
Seto, Don Carlos Ernesto, Consul-General of the Republic of Uruguay, 3, Spring-gardens, S.W.
Steel, James, F.C.S., Messrs. Steel and Co., Glasgow.
Waymouth, B., Lloyd's, 2, White Lion-court, E.C.
Young, William, Lloyd's, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Atkinson, George, 66, Aldersgate-street, E.C.
Austin, Henry Felix, 125, Bermondsey-street, S.E.
Blood, William, East-street, Crowland.
Bly, J. Henry, Great Yarmouth.
Buist, A. J., Broughty Ferry.
Caldicott, J., 24, Wood-street, E.C.
Caldicott, T. P., 24, Wood-street, E.C.
Hunt, John, Hope Works, Communication-row, Birmingham.
Leney, Charles F., Phoenix Brewery, Wateringbury, near Maidstone.
McPherson, James, Savannah, Georgia, U.S. America.
Mawle, J., Banbury.
Sandford, F. Vavasour, M.D., Hammam-chambers, 76, Jermyn-street, S.W.
Saunders, James Ebenezer, F.R.I.B.A., 9, Finsbury-circus, E.C.
Scott, Sir John, K.C.M.G., 21, Kensington-park-gardens, W.
Wood, Christopher, Bunscall, Chorley.

The paper read was—

THE ART OF POPULAR ILLUSTRATION.

By Henry Blackburn.

If it were possible in a short half-hour to attract serious attention to a subject in which all are more or less interested, it might be worth while to consider to-night whether, in the matter of illustrating books and newspapers, we are really keeping pace with the times; whether we, who provide the illustrations which are tossed from steam presses at the rate of five thousand copies an hour, are doing the best work we can. The art of illustration, as practised at present, is a large subject, and would take several evenings to discuss; I will therefore confine my self to that, perhaps inferior, branch of it which relates to the production of popular illustrations for the type-printing press, suggesting at the same time that a "Society for the Encouragement of Arts, Manufactures, and Commerce" might continue the discussion on a future evening.

It was well remarked lately by Mr. Waterhouse Hawkins, in a paper on "The Graphic Method of Teaching," that through the pictorial system the mind receives impressions with the least effort, and in the quickest way, and that the graphic method was the true way of imparting knowledge. Are we then, in the matter of giving information or in imparting knowledge through the medium of illustrations, adopting the truest and simplest methods? I venture to say that in the majority of cases we are doing nothing of the kind. We have pictures in abundance which delight the eye, which are artistically drawn and skilfully engraved, but in which, in nine cases out of ten, there is more thought given to effect as a picture than to illustrating the text. This question was discussed in the columns of the *Athenæum* about two years ago. Speaking of the system of book and newspaper illustration then and now in vogue, it was argued thus:—

"The great want at this time is a simpler and better form of illustration for novels, tales, magazines, newspapers, and for all literature of the butterfly kind. The present system is too cumbrous, too costly, and too absurd to last. It is an absurdity, for instance, committed every day, to give an elaborate drawing of furniture, made out to the exact square of the page, for the purpose of expressing a lover's devotion, and almost as unnecessary to make a careful view of Hyde-park as the groundwork for a pun."

To standard works and those of high artistic aim these remarks do not of course apply.

The objections pointed out in the *Athenæum* to the carefully shaded view of Hyde-park and to the imaginary drawing-room were :—

1. That for necessary reasons of speed and economy such details can seldom be well engraved.

2. That they are generally untrue.

3. That the space occupied and the cost incurred in production tends to decrease the number of illustrations and to a lack of variety.

Let us, then, ask our artists if they cannot, as a rule, express their ideas in fewer lines; in short, give us better work and less of it—put half the work in one illustration and give us two. That is the principal question to-night. With so many facilities for reproduction, and improvements in machinery for rapid printing, is it not high time to make a study of the best methods of drawing for the press; to stand aside, as it were, for a moment and ask ourselves whether, in the style and pattern of our illustrations, we may not have been working in the old grooves too long—whether the moulds we have used so often are not beginning to lose sharpness and significance? The old, practical answer will come back to us as surely as the returning tide—"The public is satisfied, and the system pays." But if it were not worth while, from an artistic point of view, to do the best and truest work we can, I think it may be shown that, rightly managed, a simpler system of illustration would be commercially successful, and increase work for artists, engravers, and everyone concerned. The cost of illustrations, as at present drawn, undoubtedly reduces their number, and a fashion being set for a particular style of engravings (as in our magazines), it would be hazardous to make a change all at once; but it may be worked gradually, and it rests with our younger artists to do it, for the processes of reproduction are to hand. The time will surely come when we shall look back upon the present monotonous system with considerable amusement, and upon a book or newspaper that is not illustrated, as an incomplete production.

Let us consider shortly the means at our command, both artistically and mechanically, and see what are some of the possibilities in illustration.

First, in the daily press. A "special correspondent" is sent, we will say, to what is called the seat of war, or is stationed in some remote country, to give the readers of a newspaper the benefit of his observations.

What does he do to express himself most clearly and quickly?

In the imperfect clumsy language which he possesses in common with every Minister of State and national school-boy, he proceeds to describe what he sees in a hundred lines, when two or three skilful strokes of the pen might have expressed his meaning pictorially. I think you will admit that our ordinary-written language is clumsy, when I remind you that in order to provide the copy for a newspaper correspondent's letter, such as we see written in the *Times* every morning, the point of the pen has had to travel over a distance of more than one hundred feet! This is the actual ascertained measurement, taking into account all the ups and downs, crosses and dashes of an average letter as it arrives from abroad; and yet we hear of letters "written under fire," "written on a drum-head," "in the saddle," and under the greatest difficulties when rapidity of record is everything. By systems of shorthand the time occupied in transmitting intelligence by letter is reduced, but the pictorial method of communication should come to the aid of the verbal, especially as simple forms will soon be transmitted by telegraph.

Think what interest would have been added to Dr. Russell's letters in the *Times*, from the Crimea, if it had been possible to have inserted here and there with the type a line or two pictorially, or even a little diagram of a movement or position. It may be said, "we had our illustrated newspapers, with every event of interest ably sketched by special artists." True, but the illustrations took time to prepare, and the reader of these vivid letters had "gone on to something else." The pictorial record should have been simultaneous with the verbal—the picture was wanted when the letter was read. Again, in time of peace there are many events of interest, and scenes passing before the newspaper correspondent's eyes, which cannot be adequately described in words. In every city or town, in every place, there is some leading feature, architectural or natural, that gives character to it; and it would add greatly to the interest of letters from abroad to have them headed sometimes with sketches. On important occasions, and for special subjects, the foreign correspondent would be accompanied by an artist trained for the work, but there is much that he could do for himself. He could present to us, often in outline, the aspect of a street or the curve of a line of hills, on which some event of public importance was taking place; he could indicate the shape of a church spire, or a new bridge, and the plan or diagram of many objects of interest. If he could not do this actually with his own pen, he could often get it done, or transmit photographs, from which it is now possible to make a little outline in relief to print with the type in six or eight hours. The point is, that the sketch should appear side-by-side with the written description, and really illustrate the text.

In descriptions of scenery, words so rarely convey the right impression to the mind of the reader, that it seems to me wonderful that we have no better method in common use. Let me give an instance, taking a few lines from a summer correspondent's letter in the Harz Mountains, an average decscription of scenery, such as we see in our newspapers, in the month of August and September. [Remember, the correspondent is doing his best to describe to perhaps 100,000 people, a scene which they may never witness for themselves].

"We are now on the heights above Blankenberg, a promontory 1,360 feet above the plains, with an almost uninterrupted view of distant country looking northward and eastward, a view which is called one of 'the noblest in the Harz.' The plateau of mountains on which we have been travelling here ends abruptly. It is the end of the upper world, but the plains seem illimitable. There is nothing between us and our homes in Berlin—nothing to impede the view which it almost is impossible to describe in words. The setting sun has pierced the veil of mist, and a map of Northern Germany is unrolled before us, distant cities coming into view one by one. First, we see Halberstadt with its spires, then Magdeburg, then another city, and another.

. . . . . .

"We have been so occupied with the distant prospect, and with the objects of interest which give character to it, that we had almost overlooked the charming composition and suggestive lines of this wonderful view. There is an ancient castle on the heights, the town of Blankenberg at our feet, the strange wall of perpendicular rocks in the middle distance; there are the curves of the valleys, flat pastures, and undulating woods, and the roads winding away across the plains. The central point of interest is the church spire, with its cluster of houses spreading upwards towards the chateau, with its massive terraces fringed with trees. There is the most exquisite variety of forms in their curves and windings, which are worthy of note, if only as suggestive of feudal times, when the feeling of support and protection from the castle was a natural expression of the people, and not, as now, only a picturesque effect."

This is all very well in word-painting, but think what a veil would have been lifted from those 100,000 eyes by some such sketch as that you may see upon the wall!

Again, in describing a picture, how much the interest would be heightened if the written description were accompanied by a little outline indicating its composition and general effect. That it is possible to do this sufficiently to interest the reader, and without infringing the law of copyright, I proved by experience when conducting the *Pictorial World*. When the exhibition of the Royal Academy was opened last year, I accompanied a description of the leading pictures in that newspaper with little outlines indicative of their general composition and effect. These sketches were produced in relief in a few hours, and printed with the text; the success of the experiment was very great, and the testimonies received from a distance as to the value of pictorial notes in describing pictures were numerous and gratifying.

These are practical examples of what may and will be done in our newspapers, as soon as we have artists trained to give us more simple sketches—sketches which may be engraved, or otherwise reproduced, whilst the type is being set up, and printed on cylinder machines.

Whilst contemplating the possibilities of a more general pictorial record of events, and of a *new daily* illustrated newspaper which I hear is imminent in London, mention should be made of the *Daily Graphic* of New York, an evening paper, which has been published for two years, and which, the proprietors assure us, is a financial success. It consists of a sheet of four pages, about the size of our *Globe* newspaper, and is published at 5 cents (2½d). Through the courtesy of the proprietors I have just received a long and interesting account of their enterprise, from which I will read one or two extracts. But the experience of the *Daily Graphic* of New York will not help us much in our considerations to-night, because the side of the sheet bearing the illustrations (at least half of which are borrowed from European sources) is printed by the comparatively slow process of photo-lithography; and also because on the staff of that paper they once, you may remember, kept a balloon! The illustrations are printed from six steam presses, generally between the hours of 9 and 12 in the morning, and have to be drawn often at dead of night. There were six artists on the staff when I was in New York, with varying powers of skill, imagination, and endurance; one I know has survived, for he is in this room. The paper wa published at two in the afternoon, and between thas hour and six there were spread over the city ot New York the most remarkable illustrations of events it has ever been my lot to witness. That some were artistic, and produced in a marvellously short space of time, I must admit; that the majority were sensational from a European point of view—sensational in the most aggravated sense of the word—you may judge by the copies before you. The proprietors of the *Daily Graphic* state that, although the paper was started during a period of great financial depression, they have "abundant reason to be satisfied with their success." They attribute it principally to the founding of a large lithographic business through the publicity of the paper, a system rather new to us in England, and also, curiously enough (I am using their own words) "to an absence of all sensational news." "Pictorial records of crime," they write, "executions, scenes involving misery, and the more unwholesome phases of social life, are a positive detriment to a daily illustrated newspaper. In fact, the higher the tone, and the better the taste appealed to, the larger we have found our circulation to be." I quote the sentence for the sake of the noble sentiments it contains. Taking, then, the experience of the *Daily Graphic* as an example or as a warning as we please, I believe that the form a daily illustrated newspaper would take in London would be a morning paper, published at twopence, with several editions during the day and evening. It would probably consist of 16 pages, in the style of, but rather larger than, the *Pall-Mall Gazette*, and one of its principal commercial features would be illustrated advertisements. The *modus operandi* of its rapid news illustrations would be, roughly, as follows:—Your sketch is handed in to the office, say between two and four in the afternoon. It is probably quite unfit for publication, but it contains an item of news of great public interest, which can be expressed on a small scale by an expert in a few lines; and so, between the hours of three and six p.m. it is re-drawn, and between six and twelve p.m. it is engraved or otherwise (most probably otherwise) brought up in relief, as in the blocks before you, ready for placing in the form with the type. Between twelve and two a.m. a paper cast is taken, by simply pressing a sheet of *papier mâché* upon the surface of the form; this sheet is then bent to the shape of the cylinder (a diameter of twelve or fourteen inches), another cast is taken in metal from the paper on this curve, and—the work is done. By half-past three or four a.m. the cylinder will be revolving and be hurling off copies at the rate of 10,000 an hour.

On the general question as to whether daily illustrated papers are desirable in England, I will only remark that it is scarcely consistent with the feverish haste with which everything connected with newspapers is conducted, that events happening, say on a Wednesday or Thursday, cannot be recorded pictorially for ten days, even though, as in the case of a portrait, it may be ready for the printer. The great art of conducting a daily illustrated newspaper would be to know what to leave out—when, in fact, to have no illustrations at all!

Returning to the more immediate subject of this paper, the best method of illustration for the press, and taking next our *weekly* illustrated newspapers, it must be admitted, I think, by all, that we have arrived at a point of great proficiency, where

there is little left to be done. We *have* arrived at great proficiency, and from London are issued the best illustrated newspapers in the world. But our artistic skill has led us into temptation, and by degrees engendered a habit of making pictures when we ought to be recording facts. We have thus, through our cleverness, created a fashion and a demand from the public for something which is often elaborately untrue. It is not too much to say that the records of events in our principal illustrated newspapers seldom bear the stamp of reality, or impress the reader with a belief in their absolute truth. And yet our artists have wonderful power in recording impressions, as was shown last week in the collection of sketches exhibited in the City and Spitalfields School of Art, many of which are on the walls to-night.

Would it then be too much to ask of those who cater for and really create the public taste, that they should give us one of two things, or rather two things, in our illustrated newspapers, the real and the ideal?

1. Pictorial records of events in the simplest and truest manner possible.

2. Pictures of the very highest class that can be produced on wood, and printed with the type.

If I were pressed for examples of excellence in each division as issuing from the press to-day, it would be difficult, and might seem invidious, to select them. Mr. Simpson, of the *Illustrated London News*, making a sketch on a cigarette paper as he walks to prison between two *gens d'armes*, ready to smoke or to swallow it on an emergency, is a good picture of artistic activity in this direction; but speaking generally I would say that, in the first division, *i.e.*, "the real," some of the best sketches from the seat of war have appeared in the *Illustrated London News* and in the *Monde Illustré*, published in Paris. They do not fulfil all the conditions asked for, and even they sometimes lack the simplicity and decision of touch which we hope to attain by training.

In the second division, "the ideal," the public need not be reminded that the *Graphic* newspaper is producing work of a higher artistic order than anything we have been accustomed to in newspapers. The illustrations by Small, C. Green, Herkomer, H. Allingham, and others, which have appeared lately, reach, I believe, both in drawing and engraving, in composition, colour, and in all technical qualities, the highest standard of excellence yet achieved. In this branch of illustration there is legitimate scope for both artist and engraver; but it is a question of taste how far events of the day should be treated imaginatively, such, for instance, as the accident on the Matterhorn, depicted by Doré, and the burning of the *Cospatrick*, by Durand. Some will think that such scenes should be left to the historian, be he painter or man of letters. In illustrations to novels and tales in newspapers and magazines, there is often more thought given to producing a work of art than to illustrating the text. The result is generally satisfactory to the public, but it is scarcely illustration in the true meaning of the word. Portraits, although they have been well described as the "ideal biography of the man," belong to the first division, the real, and in no branch of illustration do our newspapers more legitimately excel. The portraits of Dr. Manning and of Carlyle, which have appeared lately are remarkable examples of what may be accomplished, both in drawing and engraving on wood, for the weekly press.

Here, then, are two opposite methods of illustration, which only require to be kept distinct, each in its own place, and our interest in them would be doubled. We ask first for a record of news, and then for a picture-gallery, and to know, to use a common phrase, "which is which."

In the illustration of books, I would remark generally that the present fashion of drawing and engraving is too elaborate, the cost of which discourages publishers, and deprives the public often of what it would care to see. Instances of this occur every day. I saw lately the author of a book of travel and exploration lay before his publishers a collection of sketches, photographs, and the like, which he had taken years to collect. To have some, or most of these, presented in some form in his book, would have been a valuable addition to our store of knowledge. But the publisher was wise, from a business point of view, and out of some fifty of the most important subjects he selected ten, and had them drawn and engraved in the best drawing-room manner. The book is a success financially, and everybody is satisfied excepting the author himself, who knows that perhaps half the interest of that book lies in a drawer in his own chamber—waiting for the millennium!

There are many reasons for this state of things on which I cannot dwell now, but the chief one is Fashion. We cannot hope to alter it all at once, but with increased facilities for producing illustrations a change will come, and the book of the future will not be considered complete unless the author has *helped* to express himself pictorially, and to consider this a legitimate part of his work. In the great mass of illustrations, to works of fiction especially, there is waste of labour and superabundance of details—details which, for business reasons seldom have a chance of being engraved properly. Exceptions prove the rule, and wherever such details are artistically carried out the result is delightful, as for instance, in some illustrations now appearing in the *Cornhill Magazine*, and in *Good Words*, where the chief interest lies in accessories.

But great excellence in drawing on wood must still be said to be exceptional. It is a fact—strange to say it in these days when more money is expended on wood-engravings than ever—that from an artistic point of view, we seem to be retrograding rather than advancing. Few of our great artists can be prevailed upon to draw for the press, and when they do undertake an illustration, say of a great poem, the drawing, which is to be multiplied over the world 100,000 times, has far less thought bestowed upon it than the painted portrait of a cotton-king. This may, or may not be necessary; at any rate it is an argument for making book and newspaper illustration a special study and profession, now that so many processes for reproducing drawings are to hand. Wherever this work is made a speciality, as in the instances quoted, and also in the case of the artists on the *Punch* staff, the result is, as we all know, *excellence;* but we have no time for admiration to-night—our business is to see what more can be done, what degree of progress

efficiency we can reach, by method and training, in drawing for the press. Remembering how much the eye and mind, even of the uneducated, will supply and picture for itself, if only the leading lines of a figure or landscape are correctly indicated, it would seem worth while to treat the subject scientifically, and, for purposes of popular illustration, to learn exactly where to stop,—in short, to master "the short-hand of pictorial art," at least as perfectly as the scene painter has mastered it.

This seems to me the gist of the whole matter, and that the kind of practice most required of pupils, after they have passed the elementary stages, is to draw from the object, no matter what, and to aim at giving effect in the fewest lines. As matters stand at present, it is not too much to say that the younger school of draughtsmen in this country are "all abroad"—lacking not industry, or capacity, but method. That they do good work in abundance is not denied, but it is not exactly the work required.

In the discussion referred to in the columns of the *Athenæum*, as to the best methods of drawing, and the evident want of training amongst our draughtsmen, the following pertinent remarks were made by a correspondent:—

"Why is not drawing in line with pen and ink taught in our own Government schools of art? The present system in schools seems to render the art of drawing of as little use to the student as possible, for he has no sooner mastered the preliminary stage of drawing in outline from the flat with a lead pencil, than he has chalk put into his hand, a material which he will seldom or never use in turning his knowledge of drawing to practical account. The readier method of pen and ink would be of great service, as a preparatory stage to good drawing, but unfortunately drawing is taught in most schools as though the student intended to become a painter."

The importance of special training for making drawings which are to be reproduced, perhaps a million times, cannot be overrated, and the subject is, I am happy to say, attracting attention in the right quarters. But as the majority of our draughtsmen cannot attend our schools and must to a great extent help themselves, I have thought it worth while to suggest generally a system of sketching which, if practised continually before the object, would lead to greater proficiency than we have yet achieved, especially in expressing effect and colour by lines, in work out of doors. Remember we can always elaborate, the difficulty is to know what to leave out.

The diagrams before you are not intended as precise examples, but they will serve to explain my meaning more clearly, and may suggest the possibilities of obtaining effects by simple means. Some of the illustrations in *Punch* are the best modern examples for the purpose, whether treated in a comic light or not. The drawings by Charles Keene are marvellous in their suggestiveness and in the instinctive knowledge of what to leave out. Since the days of John Leech—who could throw a bloom over the face of a young girl with two strokes of his pencil—we have had no such master of this art.

And here it may be asked, is all this practical? Are we not speaking of something that can be accomplished only by the few, by that gifted three per cent. of human nature who possess the power of drawing in line, a gift which if cultivated is a fortune to its possessor, and which, if uncultivated, renders him a nuisance to all his friends? My remarks refer, not to that gifted three per cent. of humanity, but to the remaining 97, at least to as many of them as are occupying themselves in book or newspaper illustration; to those who by years of patient study will follow so closely in the path of genius that only the expert can distinguish one from the other; to those who in drawing for the press endeavour to distinguish clearly between two paths "the simple right and the elaborate wrong." That greater skill and certainty of drawing can be attained by our younger draughtsmen, I feel assured; and bearing in mind that nearly every book and newspaper in the future will be illustrated, and that the best qualified reporter for the press will be the best draughtsman as well as short-hand writer, the importance of cultivating "the short-hand of pictorial art" is greater than may appear at first sight.

How is this to be attained?

1. By teaching the pupil to use his dormant powers of observation, by encouraging him to express himself pictorially, in short, by educating him, not in the popular, but in the true meaning of the word, not "sticking something into him," but "drawing something out."

2. By encouraging the young artist, who has passed through the schools, to draw continually from life, and to make notes of everything he sees out of doors. The latter practice will give him simplicity of treatment, and simplicity in drawing means power.

As this paper is intended to be suggestive, I may note in passing what abundant and neglected material there is for sketching in London itself. Its characteristic features may be vanishing, but there are lines of beauty everywhere if we will only observe them. The most picturesque views of any city in the world have been made on our river. Let me recall one, for a moment, close to our own doors. A calm summer's morning on the Thames, soon after sunrise, viewed from the Surrey side just opposite the Adelphi-terrace, the tide half-an-hour from flood, the broad sweep of water bearing upon it bright-coloured barges laden high with straw, and little oyster-boats with their weather-beaten sails. These drop one by one round Hungerford-stairs, and the market people crowd on the bank in the morning light. Looking to the left, there is a little fleet of wooden steam-boats, moored side by side, just under the chains of an unfinished suspension bridge. Sharp-pointed wherry boats float past, and disappear under the falling arches of old Westminster-bridge, behind which rise the towers of the new Palace of Westminster, crowded with scaffolding. To the right a cluster of city church towers, and the distant dome of St. Paul's; immediately in front, a stone water-gate, some bustling wharves and warehouses, overtopped by a terrace and the roof of a building, which is called the Society of Arts. The lines of beauty which marked that view, and impressed it most upon my mind were the grand curve and breadth of river, the harmonious proportions of the suspension bridge, and the fringe of city spires.

"It was easy to be picturesque in those days," you will say, "but now all is changed." That is true, for the narrow river rushes between stone walls; above and below the tide there is the shrieking of steam and the grinding of iron against iron; whilst

high in the air has been erected, by Act of Parliament, the most hideous tin canister ever conceived by man, or engineer. And yet, *mirabile dictu!* in Mr. Hamerton's *Portfolio* of last year there is a beautiful etching made of this very spot; the principal object is the Charing-cross Railway Station, and he called the picture "The After-Glow!" Thus we see what may be done with the most unpromising materials by any one who has the artistic sense.

Let us not be deterred by the changing aspect of things, for—excepting in men's costume, which is still a hideous blot upon the land—we are surrounded by what is picturesque. Speaking now to Londoners, I say, "I wish you would sketch our city, especially its architectural features." We do not half realise, because it is seldom depicted for us, the grandeur and fitness of design of the great dome of St. Paul's, and we have scarce discovered the grace of line of the spire or finial to the clock tower of Westminster, and other modern work which is rising around us. We want more sketches of city life and landscape, and there is no better preparation for the kind of illustration which will soon be in demand than practice of this kind. Following in the steps of Whistler and one or two other great artists in monochrome, give us pictures of London as you do of Rome, and send them to the "Black and White Exhibition" which is to be held in London next summer.

Next, as to the processes for reproducing drawings, especially those adapted for the *fac-simile* reproduction of sketches. During the past few years so many processes have been put forward for producing drawings in relief, for printing with the type, that it has become a business in itself to test and understand them. First, as to wood-engraving, I need not tell the practical part of my audience that on the 10th of March, 1875, the best known process is wood engraving, at least it is the best for *fac-simile* reproduction of drawings, as at present understood in England, whether they be made direct upon the wood or transmitted by photography. There is no process in relief which has the same certainty, which gives the same colour and brightness, and by which gradation of touch can be more truly rendered. Nobody knows—nobody ever will know, how much the engraver has done for the artist. "For good or evil,"—it may be said; but I am thinking now only of the good, of occasions when the engraver has to interpret the artist's meaning, and sometimes, it must be confessed, to come to the rescue and perfect imperfect work. The artist who draws for reproduction by chemical and mechanical means is thrown upon his own resources. He cannot say to the acid, "Make these lines a little sharper," or to the sun's rays, "Give a little more light;" and so—as we cannot always have good wood-engraving, as it is not always cheap enough or rapid enough for our needs—we endeavour to draw in positive black lines exactly what we want reproduced, either a sketch in line or a diagram, or a more finished drawing, with tints obtained as in steel engraving, and resort to one of the photographic processes by which a stereo block can be produced, if necessary, in six or eight hours.

A wonderful and startling invention is here, worthy of a land of enchantment, which, without labour, with little more than a wave of the hand, transfixes the written thought, and turns it into a monument; by which the most delicate and hasty stroke of the pen is not merely recorded in *fac-simile* for the eye to decipher, but it is brought out in sharp relief, as bold and strong as if hewn out of a rock! Here is an argument for doing "the best and truest work we can," a process that renders indestructible—so indestructible that nothing short of cremation would get rid of it—every line that we put upon paper, an argument for learning for purposes of illustration the tools and method best adapted for photographic reproduction by the press. As to the relative value of the different photographic relief processes, that must be decided by experts. Speaking generally, I may say that there are six or seven now in use, each of which is, I am informed, the best, and several of which I know to be applicable to cylinder machines in the same manner as a metal cast from a wood block. Improvements in these processes are being made so rapidly that what was best yesterday may not be the best to-morrow, and it is a subject of such importance that it might be worth while to devote a special evening to its consideration.

In answer to the question—perhaps on many lips to-night—"Has anything worthy of the name of an artistic result been produced by these new processes?" I answer emphatically, "Yes;" and that the results obtainable are, as yet, only half revealed. Drawings reproduced in relief by photographic processes differ curiously from each other, and all of course differ widely from wood-engraving, which is never in absolute *fac-simile*. As adjuncts to, but not as substitutes for, wood engraving, the processes have great value, both for time and economy, and the results give us sometimes a quality of work which, for technical reasons, cannot be accomplished by the graver—a quality for which there is no other word than artistic. Some of the blocks are deficient in printing and in the bearing up of the fine lines, but some have answered admirably, and have had as many as 100,000 impressions printed from them. The specimens put forward by the promoters of the photo-relief processes are very unequal; some are very good, and some, I must admit, are very bad indeed. They say, "give us good work and we can reproduce it;" but they want something more than this; they want drawings that will bear being reproduced mechanically; they want something, in fact, which, for want of practice, few artists are able to give.

Besides the photographic processes there is the well-known French system of drawing on lithographic transfer paper, or on stone, from which relief blocks for printing with type are quickly obtained. This is largely used in France and England for periodical illustration of "the butterfly" kind, and as a substitute for the common kinds of engraving. There is also the system of drawing on waxed plates with an etching needle, which has been known for ten years, but which has only lately made much advance. In the *Portfolio* there have appeared some artistic etchings by Alfred Dawson, printed with the type; and the process is now largely used both in books and newspapers. This system, however, requires special knowledge and practice on the part of the artist on the plate, which, once attained (I believe it can be learned in a week) produces the sharpest and best results—

In fact, the nearest approach to wood-engraving we have yet seen.

These two last processes are, I believe, the most suitable for making rapid illustrations for books and newspapers, it being now quite possible to take a drawing by these means at six in the evening and publish it next morning in a newspaper. That the blocks print well, and are in sufficient relief for working on cylinder machines, you will be able to judge by the specimens in the room. There are yet other relief processes, some of which, like the "Graphotype," have been known for years, and it is unnecessary to describe them. The reason for calling attention to processes generally is this, that owing to the perfection of the beautiful system of electrotpying the surfaces of casts in copper and steel, and to the great improvements in printing illustrations rapidly, there is an opportunity for their use which did not exist even a year ago.

Besides the above, there are, as is well-known, many other photographic processes for reproducing drawings in *fac-simile*, such as the "Autotype," the "Heliotype," the "Woodbury," and others; but as they are not yet available for printing with type at ordinary presses, I will not refer to them further than to express surprise that they are not more utilised for the immediate reproduction of paintings, drawings, and sketches. On the Continent it is generally the artist's first thought to prepare a copy of his picture in monochrome on purpose for the camera, so that accurate copies are obtainable almost simultaneously with the completion of the original. The facilities for copying drawings photographically are only half-developed in this country, and the result is this, that works which would instruct and delight the public pass out from the studio to the lonely halls of a mansion in some private park. Not one in fifty of our best pictures are seen by the multitude, unless they happen to be exhibited for three months at Burlington-house.

I shall be reminded, perhaps, that the engraver's and the etcher's art have supplied and are supplying the public with copies of our best pictures, and, in fact, "meet the public want." But a good line engraving takes years to produce, and is never an exact *fac-simile*. Some of the plates in the *Art Journal*, for instance, take eighteen months to produce. Consider this; a journal of art in the latter part of the nineteenth century taking more than a year to present its readers with a copy of a picture! I am thinking at the moment more of the title, and what a real *Art Journal* might be with the present facilities of reproduction at command. The excellent publication which bears this title, and in which *fac-similes* of Sir Edwin Landseer's sketches are now appearing, hits off, I believe, exactly the public taste, and need not be disturbed, for it is doing good and useful work; but my theory of an "art journal" is a paper that should present to its readers, in some pictorial form, monthly (or weekly would be better) the art events of the day, and give in outline (on some such plan as I have suggested) an idea of the composition and leading lines of every new picture as soon as it is exhibited.

Let us not be blind to the fact that the public is, as a rule, either impatient or indifferent; that if you do not give it a good thing quickly, it will take a bad one. We who have only a few years to live, and many of us really only a few hours left to devote to art, cannot rest content with a process that reproduces one work in two or three years.* Let the originator devote half a life-time to a picture if he will, and if his health and enthusiasm hold out well; but for reproduction in the press let us use the quickest and truest method that science can now supply. That method at the present moment seems to be wood-engraving, which, in its quality of work, aided by good printing, almost approaches steel. Looking at the wood-engravings in the leading illustrated newspapers and at the publications of such houses as the Messrs. Cassell (I mention them because they represent, perhaps, the distribution of the largest numbers of cheap and good pictures), there would seem little left to be done. But we are moving on, and on, I believe, to a more artistic period still, when, by the power of photography, we shall attain far more simplicity and truth in popular illustration.

It was gravely argued lately, at one of our learned societies, that the art of printing was, after all, but a questionable blessing, on account of the amount of error and evil disseminated by it. Without going into that question, I think we may find (if in these terrible hurrying days we had time to think) that the art of printing with moveable type has led to some neglect of the art of expressing ourselves pictorially, and that the apparently inexorable necessity of running every word and thought into uniform lines has actually cramped and limited our powers of expression and of communicating ideas to each other. The child of three years old endeavours to express itself pictorially, but when it puts forth its hand to draw, there is no one to guide it. It has been born in an age of advanced civilisation, which knows no method of expression for the young but one—"pothooks and hangers," and so for seven years of its growing life the subtle fingers are cramped to the achievement of parallel lines; and when the day comes to "learn to draw," say at ten years old, the delicate index is less sensitive, much of the freedom and power of expression by the hand has gone for ever. That is the experience of most of us in this room, but happily no longer so with the young; therefore there is hope that, even in our generation, we may see a great advance.

With the means now at command for reproducing any lines drawn or written in perfect *fac-simile*, mounted on squared blocks to range with the type, giving little or no trouble to the printer, we should more frequently see the hand-work of the author and the artist appearing on our pages. We need not fear the multiplication of much crude amateur work by these means—our publishers will take care of that, but we should infuse more character and originality into every publication that comes from the press, and when I speak of originality I refer specially to the originality of the author. The fact is, that in all our books, but especially in books on art, and "editions of luxury," we are too neat and tidy. We fall submissively into the same mechanical toils, our noblest thoughts are printed like our weakest, and are all run out in lines together, as in the making of macaroni. I

* According to Mr. Hamerton, there are in some etchings more than three hundred thousand strokes of the hand.

fancy the editor of that most artistic periodical, the *Portfolio*, must often chafe under the mechanical restraints imposed upon him. Think what increased interest would have attached to his papers on "The Sylvan Year" if a spray of grass, or leaf, or rare flower had been permitted upon the page—if it had not been swept so clean, if his forest walks had not been so highly rolled.

It is all a question of fashion, but the fashion may change suddenly, and a call be made upon us to produce more numerous but less elaborate illustrations. Let us, then, cultivate more systematically in our schools the art of drawing for the press, and treat it as a worthy profession. Let it not be said again, as it was to me to-day by one who has devoted half a life to these things, "The processes of reproduction are to hand, where are your artists?" There is the talent amongst us, the power of expressing ourselves pictorially, to a much greater extent than we are aware of. It is in this room to-night, but it plays about us like summer lightning, whereas we want the precision and accuracy of the telegraph.

In conclusion, shall it be said of our artists that the chariot-wheels of the press move too fast for them—that chemistry and the sun's rays have been utilised too soon—that, in short, the processes of reproduction have been perfected before their time? I think not, and that an art which has existed for ages, and is now best understood by the Japanese, may be cultivated amongst us to a more practical end.

DISCUSSION.

Mr. W. Simpson could hardly agree with Mr. Blackburn in his strictures on the present style of newspaper illustration. He considered that the use of light and shade was most necessary, and a series of pictures in mere outline would have a very monotonous effect. Without referring to any of his own sketches, he might say that some of the other pictures on the walls were as admirable examples of excellence as could be desired in existing style, and they served to show what he meant the by the proper use of light and shade. A point where he saw room for improvement was in the use of colour, and he ventured to predict that before long we should find a very extended use of colour in illustrating journals. He did not mean a picture with a great variety of colours, but such as employed a few tints, browns, greys, and greens, in a judicious way. A method of reproduction which was much neglected, especially in this country, was lithography, and though he did not propose its use for newspapers, he yet thought that, for general purposes of reproduction, artists might use it much more freely than they did. In France all the best artists used lithography for reproducing their pictures, and the *Daily Graphic* was also produced by that process. He was a great admirer of etching, and was glad to see artists returning to that process.

Mr. Thos. Sopwith, F.R.S., thought the paper worthy of great commendation, the liberality of sentiment shown in it being one of its most conspicuous features, because it was not brought forward with a view to advocate any of the new improvements which had been made, but to bring before the Society a general view of what was one of the most interesting problems of the present time. Great interest was taken in illustrated papers, and the walls of that room showed how very rapidly the art of illustration was being extended. In order that the art might still further be extended, attention had been directed to two or three points, and one of the most important was the desirableness of cultivating, as much as possible, the art of drawing from original objects, an art which might be cultivated to a greater extent than was imagined, for he had found, in attending at schools of the humbler class, that when a drawing was put before children, accompanied with an anecdote to attract their attention, they showed a marvellous aptitude, not merely for making accurate drawings, but for pursuing mathematical drawings to a great degree of perfection. If the art of representing objects from nature were cultivated, it might be a means of benefit in afterlife. Of all the employments pointed out as an occupation for ladies, he knew of none more adapted to them than drawing and wood engraving. The effects produced by the autotype and other methods were very remarkable, and, if persevered in, would enable reporters and others to add sketches to their descriptions of any subject. He had listened to the paper with great pleasure, and believed it to be a most valuable contribution to the kind of knowledge which it was the express object of the Society to promote.

Mr. Gilkes concurred with the last speaker as to the suggestiveness of the lecture, but was a little disappointed that Mr. Blackburn had not particularised the six new processes which he suggested for carrying out his enlarged ideas. It was well known that a great many processes had been carried out, but at the present time the connection between photographical and typographical illustration was the great point to which public attention was directed. He believed the six new processes referred to would fail, as all previous ones had, notwithstanding Mr. Blackburn's assurance to the contrary, in consequence of that middle process to which they had to be subjected, namely, stereotyping. However beautiful might be the work of the artist, after it came out of the stereotyper's hands it was changed by the contraction of the metal and other causes, and could not be compared with a wood engraving. Mr. Blackburn must surely know that attempts had long ago been made to print illustrations from cylinders, but it had been found impracticable. He thought it would have been better if mention had been made of the way in which the several processes were to be accomplished. There was no doubt, as stated in the paper, that fashion had a deal to do with illustrations.

Mr. Williams said he had seen not only wood engravings, but many of the processes referred to by Mr. Blackburn, and thought it would be an admirable thing to have a daily illustrated paper with pictures of events just after they happened. But there would be an obstacle to this, viz., the time occupied in making the sketch, so that the news, which would be put before the public at once, would be later than the picture. He agreed with the lecturer, that the application of many of the processes was limited, and thought that in wood engravings they had an art which would never be surpassed, for many of the effects produced on wood could not be touched by any other process. The Dawson process, the photographic processes, and Leitch's process were good for certain things, being admirably adapted for expressing outlines, but for a shaded picture they failed completely, there being a want of atmosphere about them, the figures almost invariably seemed stuck to the building behind, and there was no power to get at the minute gradations of tint which could be obtained in a wood engraving. Even in photographing fine steel plates he understood it was impossible to get very fine gradations of tone. The last speaker had condemned the processes mentioned in the paper on account of the blocks having to go through a middle process, but he could assure them the very finest illustrations in the world were produced by electrotypes, which had the advantage that more copies could be obtained from them than from the block, which was important when more than 40,000 impressions had to be be taken from one engraving. What was probably the finest work of its sort ever issued

the Messrs. Appleton's "Picturesque America," was now being produced by that process, and there was nothing like it in the way of serial illustration. The large publishing house with which he was connected, and to which kindly allusion had been made by Mr. Blackburn, had a large quantity of their work electrotyped, and it was known to be the case that even steel engravings were reproduced by this process to a large extent. He would undertake to put before anyone, who was not an accomplished expert, impressions from an electrotype and a steel plate side by side, and he would not know the difference; and the same with wood engraving. This style of sketching had been admirably employed to illustrate one of Mr. Blackburn's own books of travels, and he thought in their own sphere these processes would be very useful, and might be more extensively employed, though, as far as he had seen at present, they could not take the place of wood engraving.

Mr. E. Lawrence, in reference to the remark just made that a great many of the wood blocks used for popular illustration were electrotyped, asked whether a softer wood than box might not be employed, such as lime or pear-tree, and thus the time and labour of the engraver be saved.

Mr. Gilkes said he had referred to the stereotyping, not the electrotyping process. Every person with any knowledge of the subject would see the difference between a stereotype and a wood-block, because the soft material contracted in cooling, and therefore the finest part of the work of the engraver was destroyed.

The Chairman, in moving a vote of thanks to Mr. Blackburn, said he had made some most valuable suggestions, but he could not quite see at present how they were to be carried out. As an illustration, he might refer to the beautiful word picture in the *Times* of the Alpine mountains; for he did not see how it would be possible to introduce into the London daily papers those artistic views which had been suggested. If adopted at all, they must be in a paper specially devoted to the purpose; and though it was quite possible they might succeed, the art of pictorial literature was certainly one which needed a great deal of development, and required artists who specially devoted themselves to that particular line. If anything had to be done rapidly it would not receive that same elaborate care which was given in some of the highly finished engravings on the wall, but must be accomplished in a more sketchy manner. He remembered one *facsimile* illustration, in the *Illustrated London News*, of the battle before Coomassie, which struck him at the time as being a remarkably clever engraving of the battle, taken on the spot by the correspondent of the same paper. He had no doubt, if the same thing were carried out more generally, in papers specially devoted to it, it would prove a very useful style of pictorial literature.

Mr. Blackburn, in reply, said he quite agreed with Mr. Simpson with regard to coloured illustrations, which probably would be seen by-and-bye, but the time had hardly come yet. With reference to the remarks of Mr. Gilkes, it was necessary to say that the diagrams on the wall were not intended for reproduction, being much too large; they were merely drawn on this scale to give everyone in the room an idea of the style of drawing he advocated. He did not advocate that style of drawing if there was time for more finished and artistic work, but if there was not time to do more, why not do as much as that; and he believed this method would lead to much more artistic results than had been as yet attained. Mr. Gilkes had said something about illustrations not being printed from a cylinder, but at the present moment a machine was being constructed which would print illustrations from a cylinder at the rate of 10,000 per hour. How this machine was going to be employed he did not know, but he was assured it would be ready in a few months. He would only say further, that he hoped this discussion would lead to another meeting, when those who had processes which they thought the best might explain them, and let the results be compared. He had tried them all, and in his opinion there was not one which came up to wood engraving. The comparative cost of producing light illustrations by wood engraving and the relief processes referred to, was, roughly, thus—those produced by photographic relief came to about two-thirds the cost of wood, and those without photographing to one-third. He had omitted to mention one thing, viz., that if a sufficiently simple method of drawing for news illustrations could be arrived at, they might be engraved, if necessary, in eight or ten hours. The real desideratum was a simpler method of drawing.

The paper was illustrated by a large collection of original sketches and specimens of various reproductive processes, lent by the proprietors of the *Illustrated News*, *Graphic*, and *Pictorial World* newspapers; by Messrs. Cassell, Petter, and Galpin, the Woodbury Permanent Photographic Printing Company, Messrs. Banks and Co., Mr. D. C. Dallas, Messrs. Dawson, Mr. Leitch, the Typographic Etching Company, Mr. R. J. Scott (wood blocks), Mr. R. F. McNair (drawing, by Miss E. Thompson), and examples of drawing and engraving by the Illustration Company.

MISCELLANEOUS.

INDIA MUSEUM.

A memorial from the Associated Chambers of Commerce has recently been presented to Mr. Disraeli. It points out that the commercial and industrial prosperity of England is in a great measure due to the rapid utilisation of newly-discovered raw materials, the consequent growth of new branches of manufacture, and the ready adaptation of those materials to the requirements of new markets, and that India is one of the principal sources of supply of raw materials, as well as one of the principal outlets for our manufactures. The vast capabilities of India for supplying raw materials was exemplified by the development of the jute trade, the imports of that material having increased six-fold within the last ten years, the aggregate value of jute and jute manufactures exported in 1872-3 from Calcutta amounting to more than £5,000,000 in value; the jute imports now into the United Kingdom exceeding considerably those of flax and hemp taken together, although the whole trade was only a creation of the last 30 years. The memorial proceeded to urge that the India Museum contained a great variety of specimens of the animal, vegetable, and mineral products of India hitherto only little known, but which the enterprise and ingenuity of our manufacturers might render important for our mills and factories as jute has already become and rheea promises to become; and that the museum might also afford useful guidance in the selection of profitable exports—a guidance which would be particularly useful at a time when foreign competition and the growth of native manufactures in India rendered it more and more imperative to study the taste of the native consumers. The Chambers stated that hitherto "this magnificent collection has been comparatively useless from want of suitable accommodation, and practical organisation, and it is in the interest of English trade and commerce that the collections should be located in a suitable building in some central position," and the Association held the opinion "that they should be arranged in such a manner as to be not merely helps for scientific inquiry

and teaching, but available for reference to practical men of business." For that purpose the Association suggested that provision should be made to render accessible the stores of information "which the East India Company and the present Government must have accumulated with regard to many of the products of the country, in such a manner that the important manufacturing and commercial centres throughout the kingdom may be able to draw from the depot of the Museum samples of such raw material as they may desire to experiment upon." The memorial concluded by stating that, "considering the many efforts of the East India Company in past times and the more systematic efforts of the present Government in promoting the material development of India, the Association is confident the Secretary of State for India in Council cannot but be anxious to further an undertaking tending so directly to the benefit of India. Considering, however, the equally direct interest of England in this matter, and the financial circumstances in which India has been placed by the late famine, the memorialists are of opinion that the subject is of sufficient importance to render it desirable that her Majesty's Government should afford such assistance as may be required to insure the efficient working of an institution which may be made subservient to the best interests of both countries."

AMERICAN PATENTS.

The report just issued by the United States Commissioner of Patents comes in usefully at a time when our own Patent-law is undergoing revision. From it it appears that the number of applications for patents in America during the year 1874 was 21,602. Of these 16,160 were allowed, though as 2,561 were not issued for want of the final fee, 13,599 only were really granted. The 5,442 remaining were stopped by the preliminary examination, thus showing that about one in every four applications was refused for want of novelty. It may be remembered that during the same twelve months 4,492 applications were made in England, a difference which may partly be accounted for by the fact that an English patent is allowed to cover much ground than the American, and consequently several American patents are required for the equivalent of a single English patent. In the American list also "designs" are included, whereas these are, with us, registered in a separate office. It appears from the report that the Americans have not yet nearly completed the work of printing all their old specifications. All those since 1866 have been printed, but with regard to those granted previous to 1866, the Commissioner states that only very meagre information can be obtained, in many cases only from one or two manuscript copies. In fact, it is even said that the officers of the American Patent-office are better acquainted with the records of the English than with their own, the former having long since been printed and distributed to the Patent-offices of all countries. Another feature of our own office is commended as worthy of imitation. We have now complete digests in nearly all classes of our old specifications, and the necessity for a similar publication is urgently put forward by the United States Commissioner. In some other respects the Americans are ahead of us. Their general index of subjects and names of patentees is now nearly complete, whereas in our own office such a work is not even begun. Then again in their weekly *Official Gazette*, they publish not only descriptions but drawings illustrative of the inventions for which patents have been granted during the week previous to publication. These drawings are reduced *fac-similes* of the originals, produced by the heliotype process. These, though of course on a very small scale, are most useful, and in nine cases out of ten serve to give a very good general idea of the invention. As there seems a considerable probability of our adopting a system very nearly resembling that of America, it is interesting to see how that one works. The Commissioner complains of the mistakes arising from the varying individual opinions of a number of examiners. He expressly urges that some means should be provided of revising favourable as well as unfavourable decisions. The latter can be disputed on appeal, but there is no direct revision of the patent once granted. He also speaks with considerable earnestness of the difficulties surrounding patent legislation, difficulties certainly not less pressing in this country. With regard to the internal administration of the office, it is curious to notice that a complaint is put forward that the official examiners are apt to leave the service for more remunerative employment, as soon as they gain experience from their work.—*Times*.

NATIVE LITERATURE OF JAPAN.

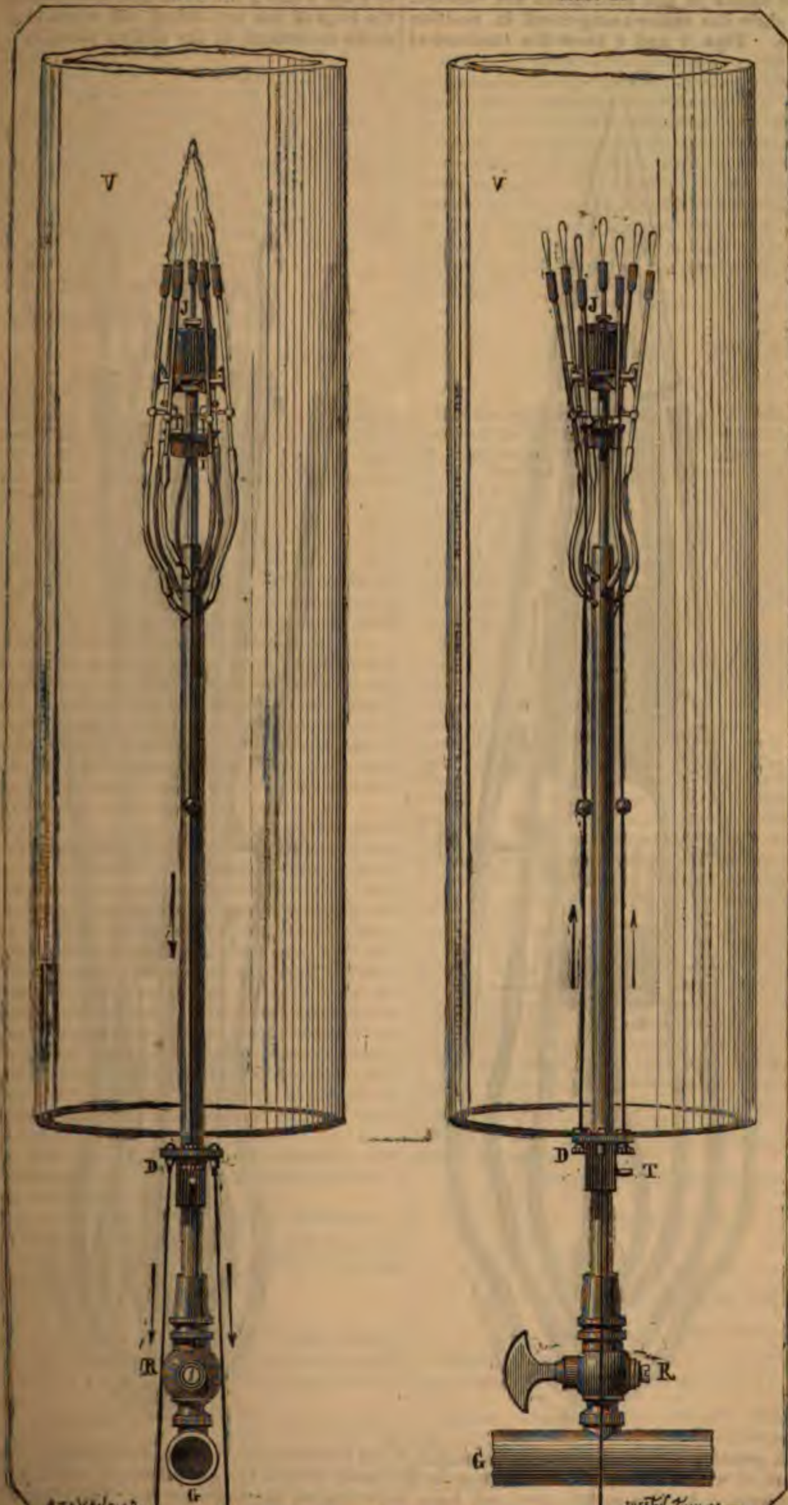
The Japanese possess a copious literature, and have as a nation a strong predilection for reading, which the ample time at the disposal of most classes affords abundant opportunity for indulging. Their catalogues of published works are both numerous and voluminous, and class the native books in the following sub-divisions:—*Kangaku*, or Chinese classical literature and works on the subject. In this class may be included books upon Buddhism, written in Chinese, as well as the commentaries on these, and the form of verse known as *shi* by native authors. *Wagaku*, or native works upon exclusively Japanese subjects, as history, geography, books upon subjects of local interest, art, and old poetical tales, &c. *Kesaku*, or novels, tales, and historical events worked up into romances. Of this class they possess a boundless variety, and many of their circulating libraries are principally formed of these books. Among the older of their staple writers are Kiosan, the Japanese "Swift;" Kioden, the "'Smollett;" Sekku, the humourist, who wrote the *Heza Kurei;* Geo Samba, a humourist, whose works resemble our Thackeray in his "Books of Snobs;" Hokuba, a writer of ghost stories, fairy legends, tales of bewitchment, and of inanimate objects being endowed with lip and speech, &c.

The writers of later times, says the *Japan Mail*, are Bakkin, whose tales embody real names and descriptions, and who professed to render them vehicles of moral teaching. The scene of some of his stories is laid in China. He may be styled the "Scott" of Japan. Tanehiko, a contemporary of Bakkin, flourished during the last generation. His chief work, "Maka Gengi," a story pourtraying the times in which he lived, and which was written not long before the opening of the country to foreign intercourse, furnishes an admirable description of the mode of life of the various classes at a recent period. Tanehiko was a small *hatamoto*, and the composition of the work named procured for him his degradation by the Government. He was reputed to possess considerable ability as author of tales from the native stage, which are known as *Skohongi tate.* The works of Tamenaga Shin, which chiefly consist of novels and love tales, are held in considerable estimation by his countrymen. Being modern compositions they afford fair specimens of the production of writers of this class at the present day. The authors of legends, travels, tales of folk-lore, &c., swell the list of *littérateurs* to no mean length. Each year sees copious additions to the monstrous catalogue of literary productions, and gives much cause to wish that a judicious censorate were in existence. One class of this garbage is happily dying out, but it is said that one volume of it, at least, is reputed to confer good luck when kept among the dresses of females.

The *Journal des Travaux Publics* states that the number of passengers that crossed the Channel from Dover to Calais and *vice versa* during the past year was 201,804, showing an increase on the previous year of 18,268.

THE PYROPHONE.*

FIG. 1. FIG. 2.



* See the paper on this subject by M. Dunant, in the *Journal* for February 19.

The accompanying illustrations serve to show in detail the mechanism by which the separation and conjunction of the flames in this instrument are effected. Figs. 1 and 2 show the entire arrangement in position within the tube. Figs. 3 and 4 show the mechanical details on a large scale. The letters of reference are the same in all the figures. The wires seen at the bottom of Figs. 1 and 2 are connected to levers set in motion by the keys of the key-board, and serve to give an up and down movement to the sliding piece, D. This, by the

FIG. 3.

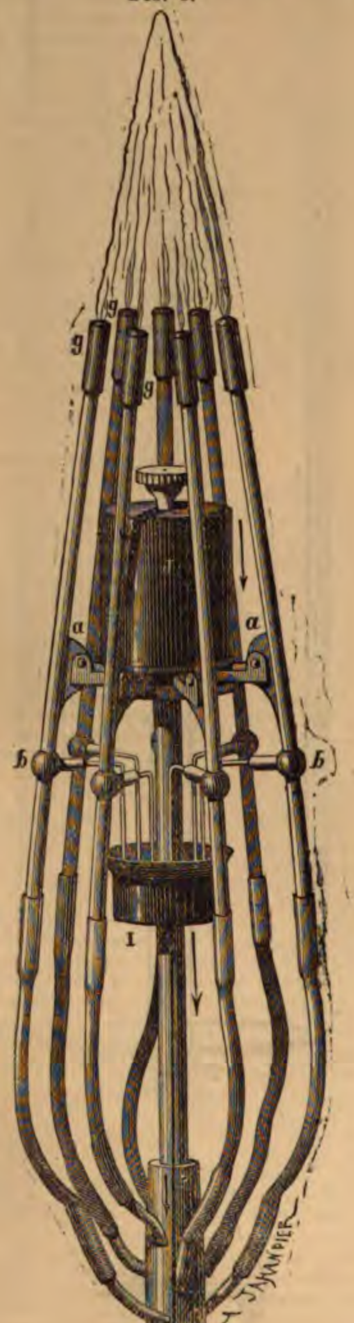
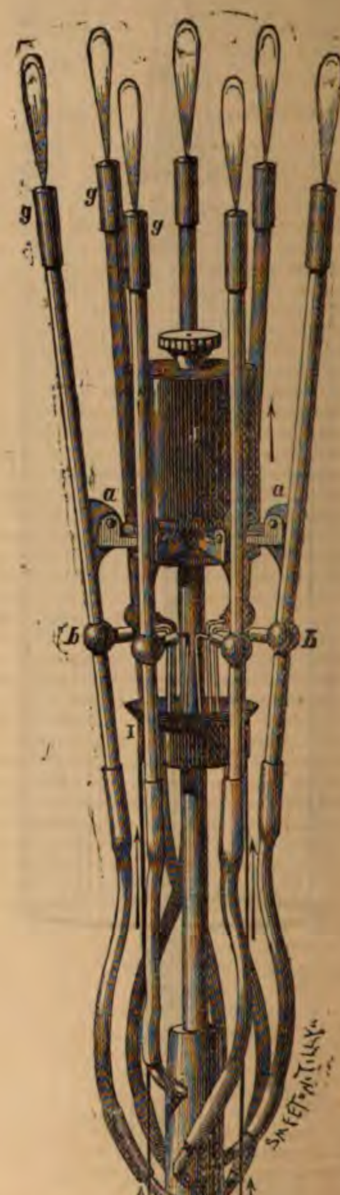


FIG. 4.



wires above it, actuates in a similar manner the socket, I, the upper part of which is bevelled, and surrounds the trackers as shown. As this socket rises and falls, it accordingly draws together the trackers, or allows them to fall outwards. These trackers are connected at the outer ends to the gas-tubes, *b b*, which are hinged at a ring on the central stem. The effect of this is that the trackers are drawn in towards the centre, the low

ends of the tubes are similarly drawn together, and the flames separated, as in Figs. 2 and 4. When the ring, I, is lowered, the weight, J, pressing on the ends of the short arms by which the tubes are pivoted to the ring, brings together the upper ends of the tubes as in Figs. 1 and 3, and unites the flame. The gas-tubes at bottom are connected by flexible tubes of india-rubber to the main supply pipe rising vertically from the pipe, G, which supplies all the tubes of the instrument. R is a tap by which the supply of gas is regulated. T a pin on which the slot in the slide, D, works. N is the glass tube. *g g* are gas burners on the ends of the tubes *b b*. These details are the same in all the tubes, the difference in the note being effected solely by the variation in size and position of the surrounding glass tube.

CORRESPONDENCE.

AIR AND VENTILATION.

SIR,—In reply to the questions of Mr. T. Roger Smith, the table referred to on page 306 gives the rate of change per hour. For instance, when all crevices were stopped in the doors, windows, stoves, &c., 1,060 cubic feet of air per hour passed through the walls.

On page 307 the amount of air in cubic feet per hour for each person is intended by the figures 3,000. The tabular statement of general motion also refers to each person per hour. By "schools for children" is meant, strictly speaking, school-rooms, but whether sleeping or awake human beings require the same supply of fresh air; it is therefore also applicable to dormitories.

Those who wish to refer to works on the subject may consult Dr. Angus Smith's "Air and Rain," and Dr. Parkes' "Practical Hygiene." The reports of the Royal Bavarian Academy of Sciences, containing papers of Pettenkofer, also the "Zeitschrift für Biologie" can be dispensed with by reading Pettenkofer's popular lectures, translated by Dr. Hess, entitled "The Air in Relation to Clothing, Dwelling, and Soil."

As the proofs of the paper were read under some pressure, may I ask you to note the following corrections. On page 304, second column, for "nevertheless, the air of the mountains on the sea shore of Scotland," read, "nevertheless, the air of the mountains and on the sea shore." Page 305, for "when there are two atmospheres in two different states, one hot and the other cold, there is between these a porous medium for the passage of the gas from the cold to the hot side," substitute, "when there are two atmospheres or rather one atmosphere in two different states, one hot and the other cold, and between these a porous medium, there is a passage of the gas from the cold to the hot side." Page 307, for "yet this fresh air contained 4·8 volumes of carbonic acid in 10.000," read, "yet this so-called 'fresh air' contained 14·8, &c." Further down the same column "the proportion was 22·1, and something over, in fact it reached up to 25" substitute "up to 22·25."—I am, &c.,

March 11th, 1875. WALTER NOEL HARTLEY.

P.S.—I may also state that I have a small work in preparation in which the object of "Air and its Relations to Life" is treated in a popular manner.

A discovery of rich quartz on the Upper Yarra, at Reefton, about sixty-four miles from Melbourne, has been reported, and some of the specimens exhibited are stated to be very rich.

Boxwood is brought to Constantinople for shipment to Liverpool, from Southern Russia, and from the Turkish ports of the Black Sea. The forests of Turkey are nearly exhausted; in Russia, however, a considerable quantity of these wood still exists, but it can only be obtained at an ever increasing cost, as the forests near the sea have been denuded of their best trees.

OBITUARY.

Dr. J. E. Gray.—The late keeper of the Zoological Department of the British Museum, Dr. Gray, died at his London residence on Sunday, the 7th inst., at the age of 75. Dr. Gray's contributions to Zoological literature were numerous, and it is by them, and by the results of his long labours at the museum, that he will best be remembered. In 1847 he read a paper before the Society on the subject of "Shells for Cameos," with the view of extending the art of cameo-cutting in this country. In later years he also sent to the *Journal* several communications on the subject of "Decimal Coinage."

GENERAL NOTES.

Electro-plating on China.—M. Hausen has recently patented in France the following process for electro-plating on a non-conducting material. Sulphur is dissolved in the oil of *Lavendula spica* to a sirupy consistence. Sesquichloride of gold or sesquichloride of platinum is then dissolved in sulphuric ether, and the two solutions are mingled under a gentle heat. The compound is next evaporated until of the thickness of ordinary paint, when it is applied with the brush to such portions of the china, glass, &c., as are desired to be covered with the electro-metallic deposit. The objects are baked in the usual way before immersion in the bath.

Analysis of Italian Wines.—F. Sestini, G. Del Torre, and A. Baldi have analysed 520 samples from the fine collection of Italian wines at the late Vienna Exhibition. The average amount of alcohol present in these wines is high, about 13 to 14 per cent. of their volume. In very few is it less than 10 per cent.. In Sicilian wines it is 16 to 20 per cent., and in one of them (Marsala) it averages 22 per cent. The proportion of free acids, determined with 1-10th of normal alkali, averaged 6 to 7 per 1,000, and even in the sorts richest in free acids (Venetian wines) did not amount to 1 per cent. The amount of residue at 110 deg. C. varied greatly both in the northern and southern wines. In a few samples the proportion of mineral substances amounted to $\frac{1}{2}$ per cent.; in some it was 3 to 4 per 1,000; in most, less. In 82 samples of the best wines, the amounts of extractive matter, glucose, glycerine (approximate), and the proportion of the fixed to the free acid were also determined. The Sicilian wines were richest in sugar, giving an average of 13 to 20 per cent. In most of the wines from Central and North Italy the proportion did not exceed 1 to 2 per cent. The proportion of the extractive matter to the sugar was not determined. In a few samples it was found not to exceed 1 to 2 per 1,000, and in the saccharine wines was only $\frac{1}{2}$ per 1,000. The largest percentage of glycerine was in the Sicilian wines, $1\frac{1}{2}$ per cent. The average of volatile acids was about 1 to 2 per 1,000, or $\frac{1}{4}$ of the whole amount of acid present. The volatile acids were present in largest proportion in the aromatic wines.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 17.—On Milk and the Adulteration Act." By Professor WANKLYN, Corresponding Member of the Royal Bavarian Academy.

MARCH 24.—*No Meeting.*

MARCH 31.—"Food Adulteration and the Legislative Enactments Relating Thereto." By WENTWORTH LAS-

celles Scott, Esq. On this occasion Dr. W. B. Carpenter, F.R.S., &c., will preside.

April 7.—"Captain Liernur's Improved System of Town Drainage." By Adam Scott, Esq. On this evening Thomas Hawksley, Esq., will preside.

April 14.—"On the Best Method of making Field Experiments practically useful to Agriculturists." By Professor John Wrightson.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

March 30.—"Civilisation and Progress on the Gold Coast of Africa, as affected by European Contact with the Native Inhabitants." By Andrew Swanzy, Esq.

April 13.—"On the Probable Influence of Railway Construction in Natal upon the Trade, and upon the Civilisation of the Native Races, of the Colony and adjacent Territory." By Arrott Browning, Esq.

Indian Section.

Friday evenings at eight o'clock, the followihg arrangements have been made:—

April 2.—"Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India," by Robert H. Elliot, Esq., Author of "Experiences of a Planter," &c.

April 30.—"Indian Manufactures," by Elijah Helm, Esq., of Manchester.

May 14.—"The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East," by the Rev. James Long.

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

March 12.—"River Pollution, with Special Reference to the Work of the late Commission," by W. Thorp, Esq., B.Sc. Lond., F.C.S. U. J. Kay-Shuttleworth, Esq., M.P., will preside.

April 16.—"Recent Advances in Photographic Science," by J. Spiller, Esq., Vice-President of the Photographic Society. Warren De La Rue, Esq., D.C.L., F.R.S., will preside.

May 7.—"Alum Shale and its Application," by Sydney Rich, Esq.

Cantor Lectures.

The Second Course of Cantor Lectures is by the Rev. Arthur Rigg, M.A., on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft."

The remaining Lecture of the Course will be delivered as follows:—

Lecture VI.—Monday, 15th March, 1875.

Saws and Dove-tailing Tools.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Rev. Arthur Rigg, "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft." (Lecture VI.)

Royal United Service Institution, Whitehall-yard, 8½ p.m. Major A. Moncrieff, "Harbour Defence."

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. 1. Discussion on "The Rating of Country Mansions." 2. Adjourned Discussion on the Home Secretary's "Bill for Facilitating the Improvement of the Dwellings of the Working Classes in Large Towns."

Entomological, 12, Bedford-row, W.C., 7 p.m.

British Architects, 9, Conduit-street, W., 8 p.m.

Medical, 11, Chandos-street, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. (Travers Course III.)

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Mr. A. H. Garrod, "Animal Locomotion on Land, in the Air, and in Water."

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Continued Discussion upon the papers by Messrs. Findlay, Cudworth, and J. T. Harrison, "On the Working, Sorting, Sidings, and Statistics of Railways."

Statistical, Somerset House-terrace, W.C, 7¾ p.m. 1. Mr. T. Geo. H. Darwin, "Marriages between Cousins in England and their Effects." 2. Mr. Henry Jeula, "The Mercantile Navies of the World in the years 1870 and 1874 compared."

Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.

Zoological, 11, Hanover-square. W., 8½ p.m.

Royal Colonial, 15, Strand, W.C., 8 p.m. (at the Pall-mall Restaurant, Waterloo-place.) Mr. A. Mechi, "New Guinea."

National Indian Association (at the House of the Society of Arts), 8. Mr. Subrahmanyam, "Hindu Homes."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Professor Wanklyn, "Milk and the Adulteration Act."

Royal Horticultural, South Kensington, S.W., 1 p.m.

Thurs...Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W., 8 p.m. Dr. Collingwood, "Thirty-nine new Species of Marine *Planaria*, from the Eastern Seas, &c."

Chemical, Burlington House, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Professor Ella, Musical Lecture.

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. G. F. Teniswood, "First Principles in Art Study."

Royal Institution, Albemarle-street, W., 3 p m. Professor Tyndall, "Electricity."

Numismatic, 13, Gate-street, W.C., 7 p.m.

Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Institution of Naval Architects (at the House of the Society of Arts), Morning Meeting, at 12 o'clock. 1. Mr. John Scott Russell, F.R.S., "Imperial Legislation as it affects Naval Construction and the English Merchant Navy." 2. Mr. W. W. Rundell, "The Load-draught of Steamers." 3. Mr. C. Davidson, F.R.S., "Free-board." 4. Mr. C. W. Merrifield, F.R.S., "The Telegraph Ship *Faraday*." Evening Meeting, at 7 o'clock. 1. Mr. W. W. Rundell, "A Mode of Obtaining the Outlines of Sea Waves in Deep Water." 2. Mr. W. Froude, F.R.S., "The Graphic Integration of the Equation of a Ship's Rolling, including the Effect of Resistance." 3. Mr. B. Tower, "A Method of obtaining Motive Power from Wave Motion." 4. Mr. John McFarlane Gray, "Notes on Polar Diagrams of Stability, &c." 5. Mr. R. Sennett, "Compound Engines."

Fri.......Royal United Service Institution, Whitehall-yard, 3 p.m. Major E. S. Tyler, "The New Works proposed for the Defence of Paris."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Dr. R. Liebreich, "The Real and Ideal in Portraiture."

Philological, University College, W.C., 8 p.m. Professor Payne, "Midland Patois."

Institute of Naval Architects (at the House of the Society of Arts), Morning Meeting, at 12 o'clock. 1. Mr. John Scott Russell, F.R.S., "The Duties, Qualities, and Structure of the Modern Man-of-War." 2. Mr. Nathaniel Barnaby, "Iron and Steel for Shipbuilding Purposes." 3. Mr. John Scott Russell, F.R.S., "The Requisites of New Naval Guns and Gun Carriages." 4. Mr. A. Sedgwick Woolley, "Torpedo Steam Launches." 5. Right Hon. Viscount Bury, "A New Binnacle Indicator." 6. Mr. W. Fleming, "The Rig of Ships." 7. Mr. W. Forbes, "The Rig of Ships." Evening Meeting at 7 o'clock. 1. Mr. W. M. Panning, "The Proper Relation which should exist between Ship-builders, Ship-owners, and Ship Insurers." 2. Mr. B. Charles Stephenson, "Seaworthiness and Insurance." 3. Mr. J. Wigham Richardson, "The Strains and Strengths of Ships."

Sat.......Royal Institution, Albemarle-street, W., 3 p.m. Professor Clifford, "The General Features of the History of Science."

Institute of Naval Architects (at the House of the Society of Arts), Morning Meeting at 12 o'clock. 1. Mr. E. J. Reed, "The Bessemer Steamship." 2. Mr. F. C. Coxhead, "Hydraulic Gear for Watertight Doors." 3. Mr. G. W. Sly, "Apparatus for Cleaning Bilge Pumps." 4. Mr. Charles Hemje, "A New Centre-board Yacht." 5. Mr. Edward Jackson, "A New Base for the Form of Vessels." 6. Mr. A. B. Cruikshank, "Safety Cleats." 7. Mr. F. Summerson, "An Improved Water Gauge Fitting for Marine Boilers."

OURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, MARCH 19, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
(Second donation)	2	2	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
(Second donation)	10	10	0
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John Bloomer	5	5	0
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Mrs. Alexander Kerr	5	0	0
Francis Bennoch	3	0	0
W. A. Gilbee	1	1	0
W. Sparks	1	1	0

The Council will be glad to receive further contributions to this fund. Members can obtain information as to its nature and objects on application to the Secretary.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1875, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufacturers, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to C. W. Siemens, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of

April, the names of such men of high distinction as they may think worthy of this honour.

MERCHANT SHIPPING BILL.

A meeting of this Committee was held on Monday, the 15th inst. Present—Captain Sir J. HERON MAXWELL, Bart., R.N. (in the chair), John Fleming, R. Greaves, J. Scott Russell, F.R.S., Dr. Sandford, Rev. J. Scarth, Captain B. Sharpe, R.N., Rev. R. J. Simpson, and Capt. H. Toynbee.

TECHNOLOGICAL EXAMINATIONS, 1875.—NOTICE TO INSTITUTIONS.

Candidates intending to sit at these examinations should make early application to the Secretary of the Society of Arts, Adelphi, London, for forms for making a return of age, address, &c., as these particulars must be forwarded to the Society not later than the 31st instant.

CHEMICAL SECTION.

A meeting of this section was held on Friday, March 12th, 1875, U. J. KAY-SHUTTLEWORTH, Esq., M.P., in the chair, the subject being

RIVER POLLUTION, WITH SPECIAL REFERENCE TO THE WORK OF THE LATE COMMISSION.

By W. Thorp, Esq., B.Sc. (Lond.), F.C.S.

The inquiry into the best means of preventing the pollution of rivers, which has just been concluded, has been conducted by two Royal Commissions, the first consisting of Messrs. Rawlinson, Harrison, and Way, appointed in 1865, and the second consisting of Sir William Denison, Dr. Frankland, and Mr. J. C. Morton, in 1868. These Commissions have presented in all nine reports, which include a mass of matter so large that although my subject this evening has especial reference to it, I need not say that it will be impossible for me to enter into details, and the utmost I can do in the short time at my disposal will be to touch briefly on a few of the more salient points in the inquiry.

I think it is only just that I should say at the outset that, although I have been honoured with the charge of the laboratory of the Commission during the whole of the inquiry, and the opinions which I shall express this evening will be almost—entirely perhaps—in harmony with those contained in the report of the Commissioners, yet I wish it to be distinctly understood that the Commissioners are not in any way responsible for anything I may say. I shall bring forward certain views because I believe them to be true, and I alone am responsible for their expression here.

A river, I think, may be viewed as the lowest line in a valley or series of valleys, along which rain falling on the surface finds its way into the sea.

As a supply of water is a necessary of life, the inhabitants of any country must place themselves on the side of a river, and the stream above them would contribute their water supply. Having used the water, it must be disposed of in some way, and whatever they do with it, whatever intermediate process it may pass through, it must ultimately go into the river down this line of drainage. In this way the river above the point of habitation is a water supply, and below it is a sewer. Then let us consider the position of someone situated further down the river. To him, also, the stream supplies water, and it also serves as a sewer; but the intermediate portion of the river between the two places is at the same time the water supply of one man and the sewer of another. In a largely populated country waste divides itself into two kinds, waste from manufacturing and waste from domestic purposes. We will take them in this order. Taking the mechanical pollution first, we find that the use of rivers, although legitimate enough for the removal of liquids, that is to say, the aqueous portion of the refuse, has not been confined to that, for they have been used to remove the solid portions as well. An institution prevails in the north, and to some extent in other parts of the country, called the "cinder tip." The manufacturer uses huge quantities of coal, and for every eight tons he so uses he produces one ton of ashes. This must be disposed of in some way, and although it may seem absurd to us, it seems quite natural to the inhabitants of Lancashire and Yorkshire to throw such ashes into the river. A river is naturally the channel for removing liquids, but though it will carry away a certain proportion of solid matter, that is to say, that amount which it is capable of removing by the rapidity of its current, it is not sufficient to carry away cinders, and they are, for the most part, heaped on the banks of the river, forming elevations of considerable size, and then one of two things happens—the channel of the river is narrowed, and when a flood comes either the cinders are washed away into the bed of the river, where they form shoals, or if the mass is too solid to be removed in this way, the water cannot get past, and an inundation occurs, which often causes great mischief. These floods are by no means uncommon in the basins of the Irwell, Aire, and Calder. An official report stated that, in 1862, the Mersey and the Irwell, and their tributaries, received no less than 69,000 tons of cinders.

Passing on from this to a somewhat similar evil, though one of less standing, we come to what is called coal-washing. This has only been introduced within the last ten years. During coal mining large quantities of small coal are raised, and so small that it cannot be used for ordinary purposes. This, which is known as slack, was formerly kept near the mouth of the mine in enormous heaps, or it was to some extent got rid of by burning. But a large mass of it was disposed of by the "slack tip," which is just as injurious to the rivers as the cinder tip. Coal washing has to some extent varied this state of things. The only hindrance to the use of this coal, when of a bituminous nature, for the manufacture of coke, was the quantity of sulphur which it contained in the form of pyrites and shale. It was found that, the specific gravity of coal being much less than that of the impurities mixed with it, by forcing a powerful current of water in a succession

of pulses through the mass of slack, the coal might be removed and the shale and pyrites left behind. The larger particles of coal subside very rapidly, but the water passes off in a very turbid condition, on account of the finer particles which remain suspended in it.

I have here a specimen of coal-washing water, and it looks very foul, but this is due to the coal in suspension only, and the soluble constituents of the water are not affected by it. The proportion may amount to 300 parts in 100,000 parts of water, the variation depending upon the time given to it to subside. This black liquid is necessarily run into the rivers, and the coal is afterwards to a great extent deposited, thereby forming shoals, and when a flood comes it is carried further down, or, as in case of the cinder tip, it produces an inundation, and the fine coal dust is spread over the land, causing great injury to property. The shale and pyrites which have been removed are in some cases kept out of the river, but they also are frequently thrown into it, or piled on its banks to be removed by the first flood which comes.

The next pollution which we will consider is one of a different nature, but, being also due to suspended matter only, is so far related to this. I refer to that caused by lead mines. The lead ores in this country are almost entirely galena. This, when raised from the mine, is first picked over by hand, the richer portions being selected, and those which contain no galena thrown away. The selected portions are first stamped, and then spread on wire sieves, which are immersed in water and subjected to a succession of sharp jerks. Their weight being lessened by immersion in water, the fragments have considerable freedom of motion, and the heavy galena subsides to the bottom, the rocky matrix coming to the top. The latter is scraped off, and is of no further use. The purified ore thus obtained usually undergoes a second stamping, and is then washed on a series of inclined planes, the galena settling immediately, and the rocky matter being washed away into the river. This matter is called "shine." The water as it flows off contains as much as 400 or 500 parts of solid matter in 10,000 parts of water, and much galena is lost in this way, as from its very fine state of division the water carries it away in suspension, to be deposited in the river. The river mud has been found to contain, in one case, as much as 25 per cent. of galena. This may have been concentrated to some extent by a gradual process of washing by the action of the current, but it is sufficient to show that very large quantities are lost, and sometimes the mud is worth working over again for the galena. The remedy for this evil, and also for that due to coal washing, is a very simple one; it is merely that reasonable time should be allowed for the solid matter to subside. Coal-washing water containing 1,048 parts of suspended matter deposited 58 per cent. of this in 15 minutes, and nearly 40 per cent. more of the residual suspended matter in six hours, leaving a little less than 1½ per cent. in suspension at the end of that time. It was still a somewhat black liquid, but the reduction effected in this way is certainly much to be desired. In another sample such good results were not obtained, for 28 per cent. only was deposited in 15 minutes, 37 per cent. in six hours, leaving 33 per cent. in suspension, but this was owing to the coal being of a lighter character, and in a finer state of division. In a large number of samples of lead-mining water, in 15 minutes from 20 to 29 per cent. of the suspended matter was deposited, and in six hours from four-tenths to 62 per cent., leaving from a half to 18 per cent. still suspended. These variations seem very large, but they can easily be explained. In those cases where a large quantity was deposited at first, the original sample contained a large quantity of matter suspended. In all cases where a small proportion only was deposited there was very little originally present, and the matter was in a very fine state of division, the water in the mines having been already allowed a considerable time for subsidence. I have here two samples to illustrate this. This is some of the water leaving a mine, and this is some of the same sample after it has been allowed to stand for six hours. You see the improvement is very marked. It may be said that it is an unreasonable thing to require a mine proprietor to allow six hours for this subsidence, but when the statistics are considered I do not think the objection will hold. Few even of the largest mines require so much as 400,000 gallons of water daily, and for this it will be sufficient to have three tanks, each 100 feet long, 40 feet wide, and 8 feet deep, 5 feet of this depth being available for subsidence. The water should be discharged for six hours into one of the tanks, each tank being sufficiently large to contain the water used in that time. At the end of the six hours the first tank should be closed, and the water discharged into the second. After five hours rest the first tank might be emptied by gradually lowering a sill, so that the upper strata of water would flow off first, the operation occupying one hour, so that at the end of six hours the tank would be ready for another charge. The third tank would be out of use, to admit of repairs or the removal of the accumulated deposit. In coal washing, the largest works known to the Commissioners were at the Brinley Colliery, near Chesterfield, where 40,000 tons were washed annually in 60,000,000 gallons of water, or 120 tons daily, in 200,000 gals., and for this quantity tanks of half the above size would be sufficient by using the same water several times. The quantity requiring to be submitted to this treatment would be greatly diminished. In both lead mines and coal washing the pollution is due to suspended matter only; in some cases it has been found that the organic matter present in water in solution is actually diminished by being subjected to this treatment being carried down by the finely-divided mineral matter. Lead mining is largely carried on in Cardiganshire, Durham, Northumberland, Cumberland, and Westmoreland. Coal washing is carried on at Chesterfield and Whitehaven, and at other places.

Passing from the mechanical kinds of pollution, we come to an industry of the very greatest importance to the commerce of the country, but one which gives rise to a pollution of great extent and most objectionable character. I refer to that arising from alkali works. In the process of making soda there is produced a great quantity of waste, which is piled in mounds, the drainage from which is a most objectionable fluid, containing large quantities of sulphide of calcium, and other

substances. There is also discharged from the condensing towers a large quantity of dilute hydrochloric acid, and when these two pollutions meet, sulphuretted hydrogen is disengaged, which can be smelt at a great distance. The acid is so strong that in some of the streams, and especially in that known as the Sankey Brook, iron fittings cannot be used in the barges and lock-gates because the iron is so speedily dissolved. This source of pollution has been very successfully grappled with by M. Ludwig Mond, who has discovered a process by which the waste is utilised. He forces a current of air through it, then lixiviates it, and adds hydrochloric acid from the condensing towers to the solution, by which means a large quantity of sulphur is precipitated. At the Nethem Chemical Works, near Bristol, the drainage from the alkali heaps is treated in this way with great success. The moist waste contains about 12 per cent. of sulphur, and 3-5ths of this can be recovered at a cost of 40s. to 50s. per ton, and as it is worth £6 per ton, there is a large balance of profit.

The last manufacturing pollution which I shall refer to is that arising from the woollen trade, which is carried on so largely in the North and West of England. This is caused to a great extent by indigo dye waste, which is discharged to such an extent into the rivers that they look almost black. There is a small stream at Bradford, in Yorkshire, called the Bradford Beck, which would make very fair ink, and at Wakefield, the pollution is so great, that a very legible memorandum was written by one of the manufacturers with the water which flowed past his works. Bradford Beck is so notorious, that "as foul as the Bradford Beck," is a proverbial expression. It has been attempted to purify this waste by several methods; in one place it is filtered through beds of cinders and ashes, and afterwards passed over a field by irrigation; a very efficient purification being effected in this way. In the laboratory of the Commissioners further experiments were made, and it was submitted to intermittent filtration, about which I shall have to speak later. It was thus rendered perfectly clear, and almost or quite colourless, containing very little organic matter, but a large proportion of saline matter, which, however, is comparatively unobjectionable. The Commissioners, at the conclusion of the inquiries, proposed certain standards of purity as follows, specifying the maximum proportion of certain polluting matter which a liquid might contain to be admissible into a river or stream:—

Proposed Standard of Purity.

The following liquids to be deemed polluting, and inadmissible into any stream:—

1. Any liquid which has not been subjected to perfect rest in subsidence ponds of sufficient size for a period of at least six hours; or which, having been so subjected to subsidence, contain in suspension more than one part by weight of dry organic matter in 100,000 parts by weight of the liquid; or which, not having been so subjected to subsidence, contains in suspension more than three parts by weight of dry mineral matter, or one part by weight of dry organic matter, in 100,000 parts by weight of the liquid.

2. Any liquid containing in solution more than two parts by weight of organic carbon, or ·3 part by weight of organic nitrogen, in 100,000 parts by weight.

3. Any liquid which shall exhibit by daylight a distinct colour, when a stratum of it, one inch deep, is placed in a white porcelain or earthenware vessel.

4. Any liquid which contains in solution, in 100,000 parts by weight, more than two parts by weight of any met[al] except calcium, magnesium, potassium, or sodium.

5. Any liquid which, in 100,000 parts by weight, contain[s], whether in solution or suspension, in chemical combinati[on] or otherwise, more than ·05 part by weight of metallic arseni[c].

6. Any liquid which, after acidification with sulphur[ic] acid, contains, in 100,000 parts by weight, more than o[ne] part by weight of free chlorine.

7. Any liquid which contains, in 100,000 parts by weigh[t], more than one part by weight of sulphur, either of sulph[u]retted hydrogen or of a soluble sulphuret.

8. Any liquid possessing an acidity greater than th[at] which is produced by adding two parts by weight of re[al] muriatic acid to 1,000 parts by weight of distilled water.

9. Any liquid possessing an alkalinity greater than th[at] produced by adding one part by weight of dry caustic so[da] to 1,000 parts by weight of distilled water.

10. Any liquid exhibiting a film of petroleum or hydr[o]carbon oil upon its surface, or containing in suspension, [in] 100,000 parts, more than ·05 of such oil.

Note.—No effluent water shall be deemed polluting if it [be] not more contaminated with any of the above-named pollutin[g] ingredients than the stream or river into which it is di[s]charged.

Many objections have been made to the[se] standards. I have nothing to say this evening [as] to whether they are fixed too high or too lo[w], but rather as to whether they should be fixed [at] all. It has been said that the proportion of th[e] volume of the discharge, and of the water in th[e] stream should be considered. This appears [at] first sight very reasonable, but I think it [is] impracticable on many grounds. The first wou[ld] be the difficulty of ascertaining these volume[s]. The discharge takes place at various times, som[e]times in great quantities, and sometimes in smal[l], and the stream also varies in volume, and th[e] difficulty of gauging these irregular amoun[ts] must be very great. It would also allow th[e] manufacturer to at once pollute the strea[m] opposite his works up to the standard; that is [to] say, provided the quantity of pollution he put [in] did not raise the pollution of the whole stream [so] as to infringe the appointed standards, he cou[ld] not be restrained. The result of this would [be] that all the manufacturers above that point wou[ld] be able to pollute the water at pleasure, and tho[se] below it would not be able to use the water at al[l] unless they returned it as pure as they receiv[ed] it. A difficulty would also arise as to wh[o] would be to blame, supposing there were tw[o] works on opposite sides of the stream, and th[e] stream were polluted. I am afraid we should fin[d] a great many of them bringing forward the argu[]ments which I suppose we have all heard in ou[r] school days, and which was expressed in the no[t] very grammatical sentence, "Please, sir, it wasn['t] me, sir," and it would be very difficult, indeed, t[o] settle the question. Unless we can produce among[st] manufacturers what I may call an enthusiasm o[f] cleanliness, which would be the best remedy of all, I do not think it could be efficiently done. Ther[e] is a kind of rider at the end of this list of stan[]dards, to the effect that no liquid should be deeme[d] polluting if it be not contaminated to a greate[r] extent than the stream or river into which it i[s] discharged. I have no objection to make to this, but I think it would be unnecessary if the stan[]dards were fairly enforced, for unless a manu[]facturer could pass the whole volume of the stream through his works, the river could never by an[y] possibility become polluted up to the standard, because there would always be a quantity of wate[r]

passing outside the works which would be less polluted than that passing through them, therefore this proviso would become inoperative. It has been said, too, that a manufacturer might sometimes be compelled to return the water in a purer state than he received it, but I think this has already been disposed of, as such a thing could not occur if the standards of purity were uniformly enforced.

Passing from the pollution arising from manufacturing processes, we come to that derived from domestic waste or sewage. By this I mean excreta, kitchen refuse, washing water, refuse from stables and slaughter-houses, and other refuse, incident, not to manufacturing operations properly so called, but to aggregations of human habitations. The methods for removing these matters may be divided into two classes, water-carriage and other means. It has been urged that if the excreta could be kept and removed apart from the other constituents, the question would be solved, and the sewage difficulty disposed of. I think, however, that you will see from the diagram here that this is not the case. It shows the comparative composition of the town drainage of fifteen midden and sixteen water-closet towns, using the term midden towns for places where water-closets are not used.

The proportions of the various constituents are very nearly the same. The organic matter in solution and the mineral matter in suspension are a little greater in the sewage from towns in which water-closets are used, and the organic matter in suspension and the chlorine are a little less than in that from towns where they are not used. Of course, the volume of sewage from the latter class of towns is somewhat less than the volume from the former for the same populations, but the difference is not very great; and the character of sewage thus shown renders it perfectly evident that it equally needs purification before it is admissible into a river. The objection to the liquid sewage is not overcome by the exclusion of the excreta. The solid matter, too, is the least valuable part of the excreta. The liquid portions contain nearly eight times as much nitrogen as the solid, and the nitrogen for agricultural purposes is the most important constituent; so that, though the solid matter might be removed as manure, that would be the least valuable portion. There have been a great many processes proposed for such removal, other than by water-carriage. Tanks and vessels of various kinds, and cesspools, which are periodically emptied by carts, have been employed, but the difficulties attending their use, and the objection to keeping large quantities of excreta for a long time in or near a dwelling-house, are, I think, sufficient to justify the opinion that they are undesirable in a large town. The dry-earth system brought forward by the Rev. Henry Moule has been strongly advocated, but there are very great difficulties connected with its practical working. In this climate the difficulty of getting dry earth during a continuance of wet weather would be extreme, and at the present price of fuel the expense of drying it artificially would be very great. Then the question of management arises. It may work very well under careful superintendence, but how would it work in a large town, left to the care of domestic servants, or of persons who are not very particular about any of their household arrangements? Is it not evident that a system which depends upon the earth itself being so dug that it will run readily down a shoot, and the periodical removal of this just at the right time, must be far more likely to get out of order than a water-closet? Then there is the mechanical difficulty of supplying the earth, and the removal of the manure which is formed. Imagine the long procession of carts and waggons going to and fro which would be required to effect this in the case of London! Moreover, it is still doubtful whether it is expedient from a sanitary point of view to keep excreta, even thus mixed with earth, in a house for any considerable length of time.

If the excreta could be otherwise disposed of, the surface water, the drainage from the streets and roofs, the washings of foul linen, stables, slaughter-houses, &c., would still, as we have seen, require purification if they are not to pollute the rivers.

It may be well to notice here that the large volume of water flowing through the sewers of a town on the occasion of a storm is for some time much more polluted than ordinary sewage. The sewers are necessarily constructed to convey a much larger volume of water on occasions than the normal flow, so that the stream running through them under ordinary circumstances only fills them to a small extent, and is sluggish. It therefore deposits much solid matter on the sides and in every nook and corner of the sewers, and when a storm comes the first effect is the washing away of these accumulations, the result being that storm water in towns, no matter whether provided with water-closets or not, is, at all events at first, very much the worst sewage.

Turning then to the water carriage of sewage, the simplicity of the system is manifest. The water, the carrying vehicle, is brought in by pipes; there is no necessity for carrying it through the house, because the pipes once laid require no further attention. The removal of the excreta is also effected in a similar manner. They are removed immediately, and not kept on the premises for weeks or months. But it has been said sometimes that this might go straight into the river without any further treatment, since once mixed with the river a run of about twelve miles would completely destroy the organic matter. The diagram here will illustrate this point. It represents the water of the Irwell just below Manchester, and the same eleven miles lower down. There is a diminution of the organic matter that perhaps may be due to the accession of purer affluents, but it is very small. Here are three cases where the differences are all in the opposite direction. In the Mersey below Blackburn, there is scarcely any effect, and in some other cases after a run of some miles there is almost exactly the same proportion of organic matter in solution, although the suspended matter is not quite so great. More rigidly accurate experiments on the Thames, where no affluents were known to have come in for four miles, also showed the same thing. Some of the mineral matter had been deposited, but the organic matter was almost exactly the same. It may be said that there is here an improvement, but for this purpose we are not seeking for a small amelioration, but for complete destruction, and it is evident that the con-

dition of the water is not materially improved in a sanitary point of view, by a run of 12 or 13 miles. It is certain, then, that something must be done to purify sewage, and several methods have been proposed. The earliest of them, and those which seem to be most popular, are those which are called precipitation methods. But the difficulties in the way of doing this are very great. Sewage, it must be remembered, is after all, no matter how strong it may be as sewage, a very dilute solution. The sewage of 31 towns contained on an average 77 parts of solid matter in solution in the 100,000 parts of sewage, that is to say, ·077 per cent., and this, everyone will admit, is an exceedingly unpromising solution to precipitate from, especially as nearly all the known compounds that can practically be produced in it are by no means insoluble. The process which has perhaps met with the greatest notice is that called the A B C process, which is brought forward and practised by the Native Guano Company. It takes its name, "A B C," from the initials of the three principal constituents of the mixture employed, or perhaps I should rather say the initials of the three constituents that are brought most prominently into notice, that is to say, alum, blood, and clay. The alum and the clay are decidedly the principal constituents, for the blood, after all, is almost a vanishing quantity.

According to the specification of the patent that was taken out, only eleven grains of blood would be required for 1,000 gallons of sewage, or about one ounce of blood to 4,000 gallons. It would probably not be difficult to show that the sewage of every town would be likely to contain a larger quantity of blood derived from the slaughter-houses necessarily within it. Besides this alum, blood, and clay, magnesia, manganate of potash, burnt clay, common salt, animal and vegetable charcoal, and magnesian lime-stone are used. These are all in small quantities, that of blood being the smallest of all. This process has been tried in a variety of places. I first became acquainted with it at Leicester, where it was tried under certain disadvantages perhaps, as the works were not originally constructed for it. There it was found not to give any good results as regards the purification of the sewage. The quantity of suspended matter was largely reduced, and the sewage, in consequence, looked very much clearer; but this is an *ad captandum* argument, because all is not pure water that is clear. The appearance of the liquid is a very small point indeed. When the sewage thus purified had been kept a day or two in a bottle, it underwent a process of fermentation, and again became highly turbid, and had a strong and disagreeable odour. I afterwards saw the process at Leamington, where, although the works were not constructed specially for it, they were much better adapted to it than those at Leicester, as they had been, to some extent, modified for the purpose. Here very similar results were obtained. There was a smaller quantity of mineral and organic matter, in comparison, after treatment, but the organic matter in solution was only to a small extent removed.

An older process than this, which was tried at Leicester, was known as the lime process. It consisted in simply adding lime to the sewage, and it also clarified it to a very considerable extent, and thus improved its appearance, but it scarcely removed any of the organic matter in solution. Another process, which was proposed and tried at Northampton, consisted in the consecutive addition of lime and chloride of iron, and this gives somewhat similar results. Another process, tried at Bradford, called Holden's process, consists in the employment of sulphate of iron, lime, and coal dust. Again, there was a process brought forward by Mr. Forbes, in which phosphate of alumina was introduced, and it was afterwards precipitated by lime. Another process has been used quite recently, called Whitthread's process, which has been tried at Enfield; it consists in the use of di-calcic phosphate and lime. The idea was to recover the whole of the phosphoric acid in the manure. The effluent water, however, contained more phosphoric acid than the filtered sewage, so that there was a positive loss in that respect.

The precipitate derived some phosphates from the suspended matter, which compensated for this loss and left a small nett gain. There was scarcely any decrease in the organic carbon, and only 16 per cent. in the organic nitrogen in solution. There is a curious circumstance about most of the processes in which the sewage is rendered finally alkaline. The effluent sewage very frequently contains in solution a larger quantity of organic nitrogen than it did before treatment. This, of course, is rather an objection, and at first sight is not very easy to understand, but it must arise from the alkali dissolving some of the organic matter which was previously in suspension. In the A B C method, in one case it was found that there was a considerable increase of ammonia also, which was to some extent due to the use of ammonia alum in the process of precipitation, and as ammonia is the most valuable constituent of manure, the process was in that respect wasteful.

All these methods of purification depend on the production in the sewage of a solid precipitate, which shall remove from solution the dissolved organic matter, and this, so far as it is done at all, is effected principally by surface action. That is to say, the solid matter produced by the precipitant holds on its surface some of the matters which would otherwise be in solution.

We will now turn from these processes of precipitation to another class which seem to me to give much better results, namely, processes of filtration. Filtration, *per se*, may be taken to be the passage of a liquid containing matter in suspension through a porous septum, either solid or consisting of loose particles lying close together. Its first action is purely mechanical, the suspended matter being intercepted in the pores of the filtering medium, and retained. With regard to substances in solution, it is known, as before stated, that solid matters have a powerful surface action, so that substances in solution passing through the filtering medium would be to some extent removed and retained on its surface. But this cannot continue; the pores of the filter must be choked, or the surface action satisfied, by the amount of matter brought to it, and the liquid passes over it without being acted upon further. This process has been tried on sewage at Ealing and one or two other places, but it was found after a time that the filter had

become clogged, and the process was not continuous. But if oxygen be dissolved in the liquid, we alter all the conditions. The surface has also a powerful attraction for oxygen, and condenses it, and thus concentrated it acts powerfully on the organic matter also on the same surface, and true combustion takes place. This may go on indefinitely, provided the quantity of oxygen in solution is sufficient. But this quantity is limited. Pure water only dissolves three volumes of oxygen per 100 volumes, or 100 parts by weight of water would only dissolve the $\frac{1}{2000}$th of a part by weight of oxygen, whereas the organic matter which may be in solution is almost unlimited. In this way it is perfectly easy to see that it might be largely in excess of the oxygen; and if sewage which contains little or no dissolved oxygen is passed through a filtering medium, a small proportion only of the organic matter will be burnt, the great proportion passing on much as if there was no oxygen at all, that is to say, it must pass through unchanged, or be stopped in the pores of the filter, which would be thus choked up. Experiments were tried some years ago on this question. A glass tube, fifteen feet long, placed vertically, was filled with sand, and sewage was passed upwards through it at a very slow rate. At first very good results were obtained, the effluent water was efficiently purified, and contained scarcely any organic matter. But soon it stopped altogether; the lower parts were choked by organic matter, and it was impossible to force any more liquid through. A pressure of something like 10 lbs. to the square inch was applied, but without effect. An attempt was then made to aërate the tube, but it was impossible to pass even air through it under very considerable pressure. Dr. Frankland then suggested that the filtration, instead of being continuous, should be intermittent, that is to say, that the tubes should receive a measured charge of sewage once in every twenty-four hours. The sewage remained on the surface a short time, but speedily sunk into the sand, drawing after it a quantity of air, the surface being exposed, and the interstices being filled with air instead of liquid, and this at once produced a great improvement. Each quantity of sewage passing through drew after it a quantity of air, just as the mercury draws the air after it in Dr. Sprengel's mercury-pump. The filtration, instead of stopping, was found to be perfectly continuous, a charge of sewage being added every day for many weeks without change in the efficiency of the purification. However, it was still subject to the same conditions. If a sufficient supply of oxygen were not introduced the process would stop, and as the charges of sewage were increased it remained longer on the surface, and thus prevented the entrance of oxygen, the tube being perfectly sealed as long as any liquid remained on the surface. The longer this continued the shorter was the time during which oxygen was introduced, and on gradually increasing the charges of sewage, a point was reached at which the organic matter and oxygen were balanced, and beyond this the quantity of sewage could not be increased without choking the filter. In this way experiments were continued for a period of from three to six months, and in all cases the efficiency of the filtration was found constant throughout, and was only stopped by the increase of the charge of sewage to such an extent that the oxygen supplied was not sufficient. As evidence that this was the true explanation of the action, it may be mentioned that several of the tubes were successfully unstopped by simply leaving them to drain slowly for some little time, adding occasionally small quantities of well aërated pure water to keep the surface wet. In a short time the obstructing organic matter was consumed by the oxygen thus introduced, and the tube was restored to perfect efficiency. This method of filtration has been adopted in several places, and it is found that in various soils as much as from 40 to 100,000 gallons of sewage per acre per day can thus be efficiently purified.

Sewage farms have been established at Norwood, Croydon, Bedford, Aldershot, and many other places, for the use of sewage in irrigation, which is of a somewhat analogous nature, only that much less quantities of sewage are used. Fortnightly analyses of the sewage and effluent water from Norwood and Croydon were made for one entire year, and the results were very satisfactory, the effluent water being frequently superior as regards organic matter to the Thames water supplied to London. I have here samples obtained from the Croydon farm yesterday.

The town of Merthyr Tydvil being ordered by the Court of Chancery to abate the nuisance caused by the discharge of its sewage into the river, Mr. Bailey Denton, C.E., was consulted, and acting upon the foregoing experiments, he prepared an area of twenty acres of porous soil, draining it from 5 to 7 feet deep. It is arranged in four parts, each of which receives the whole sewage of the town for six hours, and then is aërated for eighteen hours, the four beds taking the sewage of the twenty-four hours. At one time, while the beds were being constructed, as much as 80,000 gallons of sewage per acre per day were then cleansed, and this was done for a long time without any apparent diminution in efficiency. I have here samples of sewage and effluent water from Merthyr; it is much darker in colour than the Croydon sewage, and contains a much greater proportion of organic matter, but I think, as far as the colour is concerned, it has been even more efficiently purified. This, the effluent water, was obtained from beds which have now been constantly at work for more than four years; no nuisance or disease has been observed as caused by the filtration, and the water, which has been frequently analysed, has been found to have really a very strong resemblance, as regards organic matter, to the Thames water supplied to London; indeed it is, on the average, a little better than the latter as regards organic matter.

These results are shown on this diagram, and I think you will see the result obtained by the precipitation methods are not to be compared with those obtained by intermittent filtration. By the latter the sewage is, for all practical purposes, destroyed. It cannot be utilised to any great extent. Some crops are grown on the Merthyr Tydvil beds, which bring in a certain return, but not, of course, sufficient to pay the expenses. A sewage farm where land can be obtained at a sufficiently low rent, may be made remunerative, but I am of opinion that,

perhaps the best way of all would be a union of the two systems. A sewage farm does not always require sewage, and if it were arranged with intermittent filtering beds attached, where the sewage could be purified when not wanted for agricultural purposes, I think the efficiency of the whole would be much increased. This arrangement would also dispose, to a great extent, of the excess of sewage in wet weather, when it could be passed through the intermittent filter and the organic matter thus destroyed.

I believe, however, that the notion that sewage is a valuable property must be, to a great extent, abandoned, and that towns must be content in many cases to pay for getting rid of the nuisance. The importance of this question, perhaps, cannot be overrated. A great deal has been said about waste and loss of valuable material, but in most cases the important consideration is to get rid of the refuse on the cheapest, most expeditious, and least dangerous principle.

I have now given a hasty glance at a few of the most important kinds of pollution from which our streams are suffering, and at a few suggested remedies for them. The most effective remedy would be the enthusiasm of cleanliness to which I have referred, but I fear that while human nature remains as it is we cannot look for that. Let us hope that, since the health, and thus, in an important sense, the wealth of the country depends upon a speedy solution of this problem, the authorities, both central and local, will bestir themselves, and by wisely enforcing these or other efficient remedies, so far improve our rivers that, although they may not regain their natural purity, they may again fulfil their ancient function of supplying water for manufacturing and cleansing purposes, and no longer serve as channels for the dissemination of disease, or offend the eye or the nose. We may have to wait some time, but I hope we shall ultimately see this accomplished.

DISCUSSION.

Mr. R. Rawlinson, C.B., said the question of river pollution had naturally occupied a good deal of his attention. River pollution must necessarily be as old as civilisation, for mankind would naturally associate themselves to flowing waters, and any pollution would of course go down into the stream. So long as population was sparse, and water abundant, this was of very little consequence, but at the present time, our little island being as densely populated as any spot on the face of the globe, and also occupied by manufactories in a manner unprecedented in history, we had arrived at such a state from neglect that these manufactories produced a vast amount of pollution. In attempting to carry out remedial measures, two things must be considered. There was an old proverb that "you cannot eat your cake and have it," and no doubt the wealth of England was in a great degree bound up with river pollution, with the use and abuse of water. He did not say that they should rest satisfied with the frightful abuse to which rivers were subjected, but having been chairman of the first Rivers Pollution Commission, and having examined most of the seats of pollution in England, and having had to consider all the remedial measures suggested, he had been forced to the conclusion that they must be satisfied with something far short of that perfection which chemists would wish to attain to, as to attempt to carry out too stringent measures would lead to the annihilation of a considerable amount of trade, and for many reasons it would be impossible to enforce them. Some manufactures were carried on in situations where there was no space for purifying processes. It had been suggested that large conduits should be made to run parallel to the streams in manufacturing districts, to collect the foul water, and carry it down to some lower reaches or to the sea, but he believed the remedy would be worse than the disease, for, whilst manufacturers preferred pure water, they would rather have it polluted than not at all. He was quite prepared to say that an enormous amount of good might be done in a practical manner; for instance, the casting of any solids into streams might be forbidden at once; and if peremptorily forbidden, as he hoped it would be in the present session, he believed manufacturers would fairly and honourably carry out the law. The way in which some of these river were abused was almost past belief. Mr. Thorp had described the effects as shown in the laboratory, but he had seen their actual state, and when it was remembered that one-eighth of the coal consumed on the banks of rivers resulted in ashes, and that probably half of this had been tipped into the stream, some idea might be formed of the extent to which river beds had been choked, the result being, in times of flood, to lay under water thousands of acres of the adjoining land, and sometimes hundreds of acres of streets and town areas. When the Commission was sitting in the Aire and Calder valley, a flood occurred, which, it was calculated, produced a loss of £1,000,000; but if that money had been expended in improving and deepening the river such losses might have been entirely prevented. Going through some large mills in the upper reaches, the owner told him that he had had his basement flooded twenty times, and the machinery partly destroyed; but individuals were powerless to help themselves in these cases, and general legislation therefore was necessary. The first thing to do, in his opinion, would be to establish river conservancies over entire areas, which might be again subdivided; but there must be one general conservancy board, and there might be smaller boards governed locally by representative bodies. A rating power would be necessary, and in this country rating and representation must go together. Any legislation, to be effectual, must be such as would be willingly accepted, and this might be accomplished without much difficulty. For instance, there was one very prevalent class of pollution in the woollen and worsted districts, that of oil and soap waste, which was one of the most pernicious which could pass into a river. Some years ago, during his inquiries, he found that half the manufacturers in Yorkshire did recover this oil and soap waste so as to prevent pollution, though in a very rough manner. He asked one, who was making £300 a-year by this process, what he would say to it if a standard were set up, compliance with which would prevent his making anything by it. His reply was that he would gladly do it; and, in answer to a further question, he said that even if it cost him £300 a year to purify the effluent water to the required standard, he would gladly do so if it were a general thing throughout the trade. He did not want any legislation, however, which should not be of universal application, or which should give one man an advantage over another. All these mechanical pollutions might be remedied simply by depositing tanks. Miners, coal washers, and persons dealing with water in that way should be forbidden to send solid matter into the stream, and the waste pickle from tin works, and refuse water from copper and brass foundries, might be retained on the premises, and made to yield a paying product. Formerly no water was so foul as that coming from gas works, but that pollution had been prohibited for many years, and now it was found possible to make gas constantly without passing an ounce of polluting fluid or solid into any adjoining stream. He had no doubt the same result could be attained in alkali works and others of similar character. The great point would

be not to draw the rein too tight at the beginning. He would rather see a measure passed, which manufacturers might characterise as weak and imperfect, than one so stringent that it could not be enforced. Town sewage was another difficulty. A great deal of money had been wasted in vain endeavours to square the circle and invent perpetual motion, and also in the attempt to get a portable manure out of sewage, which should pay for the making, but it had not been done yet, and he doubted if ever it would. The reason chemical treatment failed was because you put grains of material into gallons, or hundreds of gallons; it was quite a homœopathic dose, and you could hardly expect the huge volume of sewage to be clarified. On the other hand, by the filtration process, you made the sewage itself the homœopathic dose, because a hundred tons of sewage spread over an acre of ground would only cover it an inch deep, and as there were only a few grains of solid matter in the gallon, the proportion of offensive matter to earth was about 1 to 3,000,000, and the water passed away at the bottom, leaving the solids in the ground. This was the explanation of the powerful purifying effect of filtration. Sewage in its crude state should not pass into rivers, but only when clarified up to the best known standard, and this, where practicable, filtered through land.

Mr. Jabez Hogg remarked that the question of the pollution of rivers was so large that it could hardly be treated in its entirety, and he really thought Mr. Thorp had in some respects under-estimated the amount of the pollution existing. For instance, he had spoken of the impurities arising from different manufactories as being comparatively simple, but the fact was that you often obtained in the same water a mixture of impurities from different sources, as for instance from iron works and lead works, which impurities were exceedingly prejudicial. With regard to the organic matter, also, he believed there were considerable quantities present which were beyond the power of the chemist to detect, but which gave rise to the growth of *bacteria*, and such low organisms, which were now supposed to be intimately connected with many forms of zymotic disease. Though the coarser particles of organic matter might be separated by filtration, the germs of these little animals would pass through, and in a short time they would be developed in large numbers. Considering the large population living on some of our rivers, as well as along their banks, it was evidently a matter of extreme difficulty to keep the rivers pure. The refuse from the tanneries of Bermondsey was still allowed to flow into the Thames, and was carried up the river by the action of the tide to a considerable distance. He had tested the Thames water from above Teddington-lock, and found organic matter to a considerable extent. This was the case with all the water supplied to London at present, and seeing that there was a large population on the banks above the intake of the water companies, all having a right to drain into the Thames, he feared it would be a long time before purification would be effected.

Major-General Scott, C.B., said his chief text-books on the subject had been the reports of the River Pollution Commissioners and those of their predecessors, the Commissioners on the Disposal of the Sewage of Towns. He agreed with Mr. Rawlinson that in the first instance Government should take but a gentle step; the next one probably would be somewhat more in advance, and finally he believed they might arrive at such a degree of purity in the effluent water from towns as would satisfy the most exacting of chemists. It was evident that much might be done by prohibiting the introduction of all solid matters, and he trusted that Government would insist that no more than a certain amount of solid matter per gallon should be cast into any stream. He did not think Mr. Thorp was quite correct in the view he took of the difficulty of gauging the volume of the stream, and probably some plan might be devised by which, in proportion as the river became larger, so a larger amount of solid matter might be admitted with the sewage. The next step—if it were impossible to combine it with the first, of which he was by no means sure—would be to insist that no water should be thrown upon land for irrigation until it had been defecated. He did not say this rule should be universal, but it should at any rate apply in the neighbourhood of all large towns. To effect this some kind of chemical treatment was necessary, and he thought there was no better plan than that pointed out some years ago by the Royal Commission on the Disposal of Sewage, viz., the precipitation of it by lime. Then came the third stage, that of the purification of the sewage, which could only be effected by passing the water through a large mass of earth. Proceeding by degrees, he believed it would be found that, although farmers might be unwilling to receive sewage water in its raw state, yet if it were deprived of the solid matter and chemically treated, they would be only too glad to have it. In the case of Birmingham, they had in the valley of Tame a large area of sloping ground, and he had no doubt it could be so arranged that the sewage water could be taken along in pipes parallel to the river, and delivered to the farmers, who would be glad to pay for it. As had been said by Mr. Rawlinson, they must not "draw the string" too tight at first, but, working by degrees in the way he had pointed out, he hoped much would be ultimately accomplished. He should like a little further explanation from Mr. Thorp on one remark which he did not quite understand, viz., that the effect of the addition of alkaline matter to the sewage was to increase the amount of organic nitrogen present. The tables on the wall showed that even mechanical precipitation removed a large proportion of the organic nitrogen from sewage water; either the A B C or the lime process would remove about 50 per cent. of the whole quantity. He knew Dr. Frankland was a great disbeliever in the effect produced by running water in causing its own purification, and in his presence he must speak with diffidence; but he had on more than one occasion been greatly surprised at the effect produced by water running a little distance. In one case he had seen men fishing in a lock containing clear water only a few miles below a part of the river which was almost as black as that exhibited on the table; and again at Birmingham, when, in conjunction with Mr. Hope, Professor Huxley, and others, he visited the river Tame, just above the Salford-bridge, expecting to find it very impure from the sewage of the towns above, it was, on the contrary, as bright and nice-looking a stream as he had ever seen.

Mr. Hope thought there were one or two points on which Mr. Thorpe was slightly in error. First as to the difficulty of enforcing the proposed standards of pollution from manufactories, on account of the difficulty of measuring the quantity of water in the river and that passing from the works, he must say, as an engineer, that it appeared to him that there was no difficulty whatever. It was only a question of expense, and that would not be great. With regard to the contrast which had been drawn between irrigation and intermittent filtration, he had often pointed out that irrigation ought never to be allowed as distinguished from intermittent filtration. In fact no irrigation could properly be adopted with any certainty of result which was not coupled with intermittent filtration, and it ought not to be allowed except on land thoroughly subsoil drained. Neither ought continuous irrigation, as practised in many places during the night, to be permitted. The moment you had a continuous flow of water through the land you lost the wonderful power which Dr. Frankland had pointed out as being exercised by the process which he termed intermittent filtration; and when you had a saturated soil and subsoil, and a continuous column of water reaching from the surface to the subsoil drains, if there were any, you ceased to have an oxidation and absorption of the manu-

rial matters by the elements of the soil. No doubt there were other agencies at work besides oxidation, for, as Professor Way had pointed out, ammonia was a solvent of silica, and that being so, the silica in the soil would naturally assist in the retention of the ammonia. But if the soil were continuously flooded night and day its natural action would be destroyed, and you could not expect anything but sewage to run from the drains, though it might look pretty clear to the eye; that, however, depended on the character of the soil. In numerous cases which he had investigated for the British Association he found such to be the case, in one case the effluent water being positively worse than the sewage, as it flowed on to the land; the explanation being that the weather was very hot, and a certain amount of evaporation had taken place. Where the sewage was passed simply over the surface of the land instead of through it into the subsoil drains, the process was much quicker, but you lost the benefit of the action of the soil and the air contained in its interstices, and were dependent entirely on the surface of the soil and the roots of the plants upon it. There was, therefore, no safety in irrigating land which was not at the same time carefully and thoroughly drained.

Dr. Frankland expressed his regret that he had not been in time to hear the paper, as Mr. Thorp had enjoyed a peculiarly favourable position for forming an impartial opinion on this subject. Mr. Thorp had not visited the localities where these investigations were carried out, and, consequently, had not come under the personal influence either of manufacturers or riparian owners, but simply looked at the matter through the results which his analytical work had brought before him during the nine or ten years he had been engaged in the laboratory of the Royal Commission. He possessed, therefore, an amount of experience in connection with these questions, which was probably not equalled by any one in the kingdom. He (Dr. Frankland) agreed with Mr. Rawlinson, that legislation, in the first instance, ought to be attempted with caution, and that much good might be done by prohibiting the introduction of solids into rivers; but he should like to see a little more than that done, at any rate in the case of sewage. After the solid matter had been removed you still had left, actually in solution, a quantity of material which had the effect of rendering unfit, for all domestic and other purposes, the stream into which it was allowed to flow. He would therefore plead that something ought to be done in the case of sewage, though it might be wise to wait a little before such legislation was applied to manufacturing refuse. More attention also had been paid to sewage than to the other pollutions which affected rivers. Two processes for the treatment of sewage, irrigation and intermittent filtration, were not difficult of application in any locality, and if land was easily obtainable, by adopting the former it might be possible to pay the expenses. If, however, the locality were one where land was costly, intermittent filtration should be resorted to, because, whereas for irrigation it required one acre of land for 100 people, with intermittent filtration an acre would suffice for 3,000, and surely 3,000 people could afford to pay for an acre of land to purify their sewage. He thought General Scott must have misunderstood what was said as to the effect of lime or an alkali on the amount of organic nitrogen in sewage. Of course there was no absolute increase of nitrogenous matter by the application of such a substance, but the addition of lime or any alkaline substance to such a liquid as sewage, was that a certain quantity of nitrogenous organic matter previously in suspension became dissolved, and probably that was what Mr. Thorp meant. He quite agreed with Mr. Hope as to the desirability or necessity of sewage passing through the land, and not merely over it; but what had fallen from Mr. Rawlinson had considerably shaken his opinion as to the possibility of enforcing such a thing by Act of Parliament. It had been found at Norwood and other places, that merely passing the sewage over the surface of the land was sufficient to cleanse it, and therefore he did not think it would be wise to enforce by Act of Parliament the better process. It was quite true that soil constantly soaked with sewage would not purify it; it must have a period of rest to recover itself and become aerated, in order to enable it to act. As to the alleged self-purification of rivers, there was no doubt the effect General Scott described was that most commonly observed; a quantity of refuse material was poured into the stream, but if you followed it down it gradually became clear, and from that it might be supposed that it had become purified; the fact was, the suspended matter became deposited, as was shown by the diagram on the wall, but on looking at the analytical results, it would be seen that the polluting matter remained substantially unaltered. Water might become clear and pellucid, and even very palatable to water drinkers, but yet be exceedingly dangerous; and as soon as a freshet or a flood happened in such a river it carried down the filth which had been deposited in the quiet reaches, and distributed it over the low-lying lands in the vicinity, causing much evil. Therefore not even the suspended matter was really got rid of by this process of self-purification, and as to the matters in solution, it had been shown by numerous experiments that there was no river in England long enough to purify sewage cast into it, even at its source.

Mr. Rawlinson observed that it would be unnecessary to enact that land used for sewage irrigation should be treated alternatively, because no sewage farm could be carried on if more than 5, or at most 10 per cent. was ever under irrigation at one time. Therefore with a farm of 100 acres 90 or 95 would always be at rest.

Mr. Thorp, in reply to the observations which had been made, said he would first mention one point which he had unwittingly omitted, viz., the question of purification by manufacturers, which had been indirectly touched upon by one or two speakers. It was said that it would be a great hardship to compel them to purify the water which they used, but as a matter of fact a good many manufacturers in these highly-polluted districts did purify the water they used, only they did so before they used it, and in so doing they were under great disadvantages, because, as Mr. Hogg had pointed out, they had a mixture to deal with, of which they could know very little, whereas if they had to purify water after they had used it they would to a great extent know what was in it, and consequently how to treat it. It often happened in the same factory that there would be a small quantity of water exceedingly polluted, and a much larger volume only slightly contaminated; the processes which might be necessary to cleanse the highly polluted water might be somewhat costly, but applied to a small quantity in a concentrated form they would not be expensive in the total, though if the two kinds of polluted water were mixed together, these costly processes would have to be applied to the whole. The same thing would apply to that same water if it went down to another manufacturer; he would have to apply these costly processes to all the water he used, and thus it would be found that probably very few manufacturers if any would be put to additional expense by getting their water in the first place ready to use, and then in purifying it afterwards, having to take out what they had put in. He had omitted to speak of the mixture of pollutions, for the same reason that he had omitted many other matters, simply because he had not time to go into them; he could have occupied six or eight evenings very easily with so large a subject. Both General Scott and Mr. Hope had slightly misunderstood him as to the guaging of rivers; he knew perfectly well that it was perfectly easy to gauge at any given time the quantity of water passing down, but the difficulty was to keep on gauging it as the river varied, in order to know how

such pollution a given manufacturer might be allowed to put into it. Probably if he saw anyone guaging the river he would take a little extra care not to pour so much impurity into it. He rather differed from General Scott as to the defecation of sewage by lime, perhaps because he looked at it as a chemist, whilst General Scott did so as an engineer. His experience in the laboratory tended to show that defecation by line was only temporary, because if the water so treated were kept for a short time, the process of putrefaction began, and it became very offensive. Dr. Frankland had already explained what he had intended to say, and what he believed he had said as to the effect of lime and alkaline substances upon the organic nitrogen, and of course it was obvious that by the addition of lime or any other non-nitrogenous substance, the organic nitrogen in the water could only be re-arranged—it could not be either increased or decreased. A mistake might, however, be made by depending on the diagram shown, because the upper red line did not represent organic nitrogen, but organic matter altogether, including nitrogen and carbon, therefore although a diminution in the organic matter was shown, it might be due entirely to a diminution in the carbon. He must entirely demur to the idea of 50 per cent. being removed by most of these chemical processes; in some few cases it might be so, but, speaking from recollection, he should think the average hardly exceeded 10 or 15 per cent. at the outside. The self-purification of rivers had been referred to by Dr. Frankland, but he thought General Scott had fallen into error by confusing clarification with purification. Water might be very clear and bright, and very nasty nevertheless. With regard to continuous irrigation, Mr. Hope was quite right; if you covered the surface of a field with sewage you effectually sealed it up against the admission of oxygen, and without this the destruction of organic matter was impossible. If enough oxygen were admitted any amount of organic matter was destroyed; that was the secret of the whole question.

The Chairman, in proposing a vote of thanks to Mr. Thorp for his clear, accurate, and practical paper, said it was remarkably complete considering the vastness of the subject and the shortness of the time allowed. As had been remarked by Dr. Frankland, Mr. Thorp occupied a unique position, and no one could be better qualified to give so full an account of this important subject. At the present moment, too, it derived additional importance from the fact that it had been put before the country in the speech from the Throne as one of those on which the Government intended to propose legislation. They had not yet done so, or even named a time for its introduction, but he hoped before long they would be pressed to introduce it, so that it might be a sufficient time before Parliament and the country to enable those qualified to give an opinion on the subject to express it freely, and also for those who were pecuniarily interested to state their views when the Bill came on for discussion. He entirely agreed with what had fallen from Mr. Rawlinson and Dr. Frankland—whose eminent position in connection with the last Royal Commission gave him a title to speak with authority—to the effect that it was not desirable to introduce any very stringent legislation just yet. It was a very difficult question, and one in which it would be advisable to proceed step by step; but after the exhaustive inquiries made by the two Commissions, and the work done in the laboratory with which Mr. Thorp was connected, which had been under the control of Dr. Frankland, and which he was sorry to hear was now to be closed, though he hoped not permanently, there seemed to be ample materials for a thorough consideration of the subject. But it would be necessary to form clear ideas of what should be done, and it was no use forming chimerical notions as to the amount of reform which might be attained. He did not himself believe they would ever succeed in rendering rivers fit to supply water for domestic purposes, but still much more might be done to remove the reproach at present existing, that our rivers, instead of being emblems of purity, were positive nuisances. There could be no doubt that the practice of tipping cinders, ashes, and such-like solid refuse into rivers should be absolutely prohibited; and he thought they might go a little further, and, although many of his friends were very much frightened at the long list of standards of impurity suggested in the Blue Books, it was not intended that they should be applied to rivers, but to the effluent waters from towns and manufactories, which, he thought, disposed of the argument that, if these standards were adopted, the first manufacturer would pollute the water as far as the standard permitted him, so that those below him would not be able to do so at all. He had been much interested in the discussion, which he hoped would yet produce valuable fruit.

The vote of thanks was carried unanimously.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 17th, 1875; P. LE NEVE FOSTER, M.A., Secretary of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Abbey, Richard, 48, Essex-street, Strand, W.C.
Adderley, Captain Mylles B., 27, Bedford-place, Russell-square, W.C.
Baines, Vincent T., 3, Storey's-gate, Westminster, S.W.
Barry, John G., 8, Old Jewry, E.C.
Bayes, William, M.D., 58, Brook-street, Grosvenor-square, W.
Bickerstaff, Lieut.-Col. Robert, Belgrave-mansions, S.W.
Bugg, F. J., Quay, Ipswich.
Chevalier, Nicholas, 5, Porchester-ter., Hyde-park, W.
Coulthurst, Edmund, 59, Strand, W.C.
Edwardes, Thomas Bulstrode, 64, Westbourne-park-road, W.
Elliott, Joseph, jun., 1, St. Andrew's-crescent, Cardiff.
Gilbertson, Edward, 8, Upper Phillimore-gardens, Kensington, W.
Harrison, Joseph Henry Hayward, Eagle Brewery, Arundel, Sussex.
Lewinton, Alexander Bellamy, 14, Cleveland-street, W.
Luckenbach, F. A., C.E., New York, United States.
Maxwell, Captain Sir John Heron, Bart., R.N., 64, Warwick-square, S.W.
McGregor, William, Willow-view, Ashburnham-road, Bedford.
Powell, Edwin, Messrs. Powell and Bishop, Hanley, Staffordshire.
Ramsden, Reynolds, "The Jerusalem," Cornhill, E.C. and Railway-arches, Blue Anchor-road, S.E.
Remington, Samuel, New York, United States.
Turner, George, Horton-grange, Bradford.
Ward, Thomas, F.C.S., Arnold-house, Blackpool.
Willink, William Williamson, 3, Hyde-park-street, W.
Wingfield, Lewis, 8, Maida-vale, W.

The following candidates were balloted for and duly elected members of the Society:—

Akroyd, Mrs. W., 2, St. Alban's-villas, Highgate-road, N.W.
Curtis, Frederick, 48, Baker-street, W.
Goodwin, George, 62, Cornwall-road, Bayswater, W.
Höglund, Fabian, 39, Drottninggaten, Stockholm.
Porter, Thomas, The Cottage, Dulwich-wood-park, S.E.
Riley, Edward, F.C.S., 14A, Finsbury-square, E.C.
Satrustegui, Señor Don Joaquin M. de, 21, Billiter-street, E.C.
Whitfield, John, F.C.S., Scarborough.
Wilmot, John Fletcher, Thames-street, Windsor.
Wright, W. Cort, F.C.S., 46, Morley-street, Manchester.

The paper read was—

MILK AND THE ADULTERATION ACT.

By Professor Wanklyn,

Corresponding Member of the Royal Bavarian Academy.

In selecting milk for the purpose of illustrating the need for an Adulteration Act, and of exemplifying the working of the Act, I have been influenced by a variety of considerations.

In the first place, milk analysis has been much developed of late years, and is now better kown and more certain in its indications than almost any other branch of the analysis of food. In the second place, the adulteration of milk is very largely practised in the milk trade, and is likely to be much diminished, if not altogether abolished, by the action of the Act.

The constancy which is observable in milk, regarded from one point of view, and its variety in richness, afford examples of different methods of treatment, and render the subject of milk a good typical example of what may be done under the Adulteration Act.

The process of milk analysis, which is now adopted by most public analysts, is very simple and easy to understand, and may be briefly explained as follows:—

Milk consists of an aqueous solution of caseine, milk-sugar, and certain mineral matters, and contains minute globules of fat, which are diffused through it. The average composition of cows' milk is the following:—

100 cubic centimetres contain—

	Grammes.	
Water	90·09	
Caseine	4·16	9·65
Milk-sugar	4·76	
Ash	0·73	
Fat	3·16	
	102·90	

In 100 centimetres of milk there are therefore 5·65 grammes of "solids not fat," and 3·16 grammes of fat. In order practically to ascertain how much solids exist in a given specimen of milk, a known quantity of milk (measured or weighed out) is exposed to a temperature of 212 degs. Fah. for a length of time. At this temperature the water of the milk evaporates off, whilst the solid constituents remain unaltered. It is usual to employ about 5 cubic centimetres of milk for this purpose, and to put it in the water-bath for three hours, at the expiration of which period the water is found to have completely evaporated, and the residual solids may be weighed.

One of the modern improvements has been the selection of a suitable quantity of milk for the purpose of taking the solid residue. Formerly far too much milk was used for the purpose, and loss of time and impairment of accuracy were the consequences. When five cubic centimetres are taken and exposed for three hours to a temperature of 212 deg. Fah. (rigidly maintained for the whole period), the milk residues may be obtained so constant in weight as not to vary by more than some 0·02 grammes per 100 cubic centimetres of milk. This is a degree of accuracy which rivals that of the very best processes of chemical analysis.

Having in this manner arrived at the quantity of total solid residue in milk, the next step is to expose that solid residue to the solvent action of ether, which dissolves the fat out of it, and leaves the "solid not fat," behind. The ethereal solution of the fat may be afterwards evaporated at a gentle heat, and the fat which remains after the ether is gone may then be weighed. Thus, we have the weight of the total milk solid and the weight of the fat yielded by 100 cubic centimetres of milk. If the latter be subtracted from the former, the weight of the "solids not fat" will be arrived at.

Generally speaking, the analysis is complete when this stage is reached; but if anything further be needed, another portion of the milk may be burnt, and the residue weighed, by which means the quantity of ash or mineral matter in the milk is arrived at. The milk-sugar may also be obtained and weighed by submitting the "solids not fat" to the solvent action of alcohol and water, which dissolves it, and leaves the caseine and the major part of the mineral matter in an insoluble condition. The solution of milk-sugar is to be evaporated to dryness at 212 deg. Fah., and the residue dried and weighed, a small correction being made for the common salt which passes into solution along with the milk-sugar. After the successive action of ether, alcohol, and water upon the total milk solids, there still remains an insoluble residue, consisting of caseine and phosphate of lime. The residue is dried at 212 degs. Fah., till it no longer loses in weight; it is then weighed. In order to correct for the amount of phosphate of lime, the mixed caseine and phosphate is burnt, and the weight of the residual ash subtracted from the total weight. Such is the complete and elaborate milk analysis; but, as has been said, it suffices in most cases to stop much short of this, and to determine only the total milk-solids and the fat. This is amply sufficient in all ordinary cases where only watering and skimming are suspected.

In order to understand how to employ the analytical data in calculating to what extent milk has been skimmed or watered, a little explanation will now be necessary. Let it be supposed that normal milk (*i.e.*, milk of the composition above described) be skimmed, and let us ask ourselves what change will take place in the composition of the milk? The reply is that it will be poorer in fat, but that the ratio between the water and the "solids not fat" will not be effected by the skimming; and if the skim-milk be analysed the ratio of water to "solids not fat" will be found to be 90·09 to 9·65.

If milk be wholly or partially skimmed, the fact is revealed by the analysis showing a deficiency of fat; but if no watering have taken place the ratio between water and "solids not fat" remains just as before.

When watering is practised, this ratio is altered, and the degree of alteration depends solely on the degree of watering, and not at all on the skimming. These propositions being understood, it will be seen that a simple arithmetical calculation will enable us to deduce the degree of skimming and watering from the amounts of fat and the amounts of "solids not fat," found by analysis.

When milk, set for the cream to rise, has thrown up all the cream, it is to be remarked that the layer of skim-milk is never quite devoid of fat; and, on the other hand, the layer of cream

…ver consists wholly of fat globules. Usually …lk throws up about one-tenth of its own volume …cream; and, as the whole amount of fat in the …lk is only 3 to 4 per cent., it must be obvious …t cream cannot be fat *per se*. Indeed, cream is …lk which is very rich in fat globules, and skim-…lk is poor in fat globules. And it is very in-…resting to observe that new milk, cream, and …m-milk, all of them, exhibit the same ratio …tween the water which they contain and the …olids not fat." This being thoroughly under-…od, the calculations for the ascertainment … skimming and watering will be quite intel-…ible.

…he degree of constancy in real milk of the ratio … water to "solids not fat" will obviously …vern the degree to which calculations of the …ent of watering are entitled to be trusted. … normal ratio, as has been said, is 90·09, … departures on the side of diminished "solids … fat" are almost unknown. In the other …ection, however, there is an occasional depar-…e to a limited extent. The practical result of … is that the public analyst may calculate … extent to which a specimen of milk has been …ered, and may be pretty sure of not erring to … extent of more than 5 per cent. above the real …ring; but that occasionally (in those cases … the original milk was of exceptional rich-…) he will be liable to underrate the watering …e extent of about 8 per cent.

…*imming*.—There is an inherent difficulty in …ing with this sophistication. As has been …, the usual proportion of fat in milk is a little … 3 per cent., occasionally, however, it falls to …er cent., and under exceptional feeding may … to somewhat over 4 per cent. When an …lyst finds only 2 per cent. of fat in a sample of …k, he cannot be absolutely certain that the …k has been skimmed. Ninety-nine times out …very hundred times that 2 per cent. of fat …ound by the analyst, the depression of the fat …wing to the practice of mixing the skim milk … the night with the whole milk of the next …ning, and offering the mixed milk for sale. … Switzerland, indeed, such milk is known and …ognised as "half-skim."

I make the suggestion that milk dealers in this …ntry should adopt the designation "half-skim" … milk containing about 2 per cent. of fat, made … mixing together equal volumes of skim-milk …d whole milk; and, under that designation, milk …hich is poor by nature might not unfairly be …ld.

Actual Extent of Adulteration in the Milk Trade. —It used to be said—and to be believed, too—that London milk, and the milk of towns and cities, …as often chalk and water, or a preparation of …lves' brains, &c. Investigation has, however, …mpletely discredited all notions of that sort, for …it is now generally recognised, both in this country …nd abroad, that the only kinds of adulteration to …met with are of what are called the harmless …scription, that is to say, commercial milk …s subject only to impoverishment by skimming …nd watering. The extent to which these prac-…tices have been carried is surprisingly great, as …may be gathered from the published reports of …chemists who have examined the milk of commerce.

It has been my lot, within the last five years, to examine into the question, and I will now describe my investigation to you.*

In the year 1871 and the early part of 1872, I examined something like a thousand samples of milk bought in London, the examinations being conducted under these circumstances. The editor of the *Milk Journal*, Mr. Gamgee, had samples bought generally by a boy or girl, and they were obtained from dealers who did not know that the milk was to be examined. The samples were brought to me, and I made the examination in the method I have described to you. The result was this, that 90 per cent. of all these milks was not genuine, that is to say, it was below the normal mark. I also made examinations of milk from the London hospitals, and with a similar result; and a very careful examination was made by me of the milk obtained by the Government from the London workhouses, and these last examinations were made with extreme care. In London there are 30 unions, and Mr. Rowsell, who was appointed to examine into the workhouse contracts a few years ago, obtained samples of milk from each of the workhouses, two samples at different times, and sent them to us for examination. One workhouse, that of Westminster, refused to give samples for examination, but samples from the other 29 were examined. The milk from nearly all was found to be very much watered or skimmed; and to give you an idea of what sometimes takes place, I will read the result obtained from the Stepney Workhouse. In one case I found that 100 parts of milk contained 47·3 parts of water, and in the other 46·5, or nearly half, so that you see that milk was mixed with nearly its own volume of water. Out of the whole 29 there were only two or three which yielded proper results.

In order to appreciate the significance of facts of this kind it should be mentioned that the milk is supplied to the London workhouses under contracts for the supply of genuine milk. The contract for Stepney says, "genuine new unskimmed milk, to produce 10 per cent of cream." Yet the analysis showed that the milk had been mixed to nearly its own volume of water, and the cream had been totally removed. To give you an idea of the importance of this matter, and the amount which was implied, I may tell you that the yearly amount expended in the London workhouses in milk is £13,130, and you may imagine that, if instead of supplying milk you supply half milk and half water, a good deal of money will be paid for that which is not supplied. The case of the workhouses is very important in many points of view. It is well known that the workhouse dietary is not very abundant, and if the authorities proportion a dietary in the belief that they are giving a certain quantity of milk when they are really giving only half that quantity, it is easy to see that the paupers might be half-starved. And this is the more important as the diet of the young and very old is to a great extent milk. It was the publication of a number of facts of this description, in the years 1871-72, which precipitated the passing of the Adulteration Act in 1872.

* *Vide Milk Journal*; "Report on the Milk supplied to London Hospitals;" "Mr. Rowsell's Report on the System of Supply of Provisions for the Workhouses of the Metropolis."

One of the points on which I particularly insist is that in these instances the purveyors of milk had contracted explicitly to supply milk of at least ordinary richness.

The general result of my investigations is th before the year 1872, nine-tenths of the milk sold new or whole milk was milk which had been eit skimmed or watered to a very palpable exte

MILK SUPPLY OF LONDON WORKHOUSES.

IN 100 GRAMMES OF SAMPLE OF MILK.				CALCULATED.			
		Grms. of Solids not Fat.	Grms. Fat.	Grms. of Genuine Milk.	Grms. of Fat removed.	Grms. of Cream Removed.	Grms. of Extra Wa
		a.	b.	$\frac{100}{9\cdot3}a$.	$\frac{3\cdot2}{9\cdot3}a-b$.		$100-\frac{100}{9\cdot3}a+\frac{3\cdot2}{9\cdot3}$
Bethnal-green (St. Matthew)	I.	9·04	1·22	97·2	1·89	9·45	4·7
" " "	II.	4·38	2·08	47·1	–0·57	–2·85	52·3
Camberwell (St. Giles)	I.	8·37	1·14	90·0	1·74	8·70	11·7
" "	II.	8·94	0·96	96.1	2·12	10·60	5·0
Chelsea (St. Luke)	I.	9·36	2·24	100.6	0·98	4·90	0·4
" "	II.	7·48	2·86	80.4	–0·28	–1·40	19·3
Fulham Union	I.	9·09	1·52	97·8	1·61	8·05	3·8
" "	II.	9·30	1·80	100·1	1·40	7·00	1·4
St. George's Union	I.	9·52	2·44	102·6	0·84	4·20	–1·8
" "	II.	9·08	2·82	97·6	0·31	1·55	2·7
St. George-in-the-East	I.	6·55	2·32	70·5	–0·06	–0·30	29·5
" "	II.	5·92	1·30	63·7	0·74	3·70	37·0
St. Giles-in-the-Fields and St. George, Bloomsbury	I.	9·13	1·50	98·2	1·65	8·25	3·4
	II.	7·17	1·96	77·1	0·51	2·55	23·4
Greenwich Union	I.	6·60	2·32	71·0	–0·05	–0·25	29·0
" "	II.	6·38	1·98	68·6	0·21	1·05	31·6
Hackney Union	I.	9·09	3·50	97·8	–0·47	–2·35	1·7
" "	II.	7·40	2·54	79·6	0·00	0·00	20·4
Hampstead (St. John)	I.	8·44	1·50	90·7	1·40	7·00	10·7
" "	II.	7·74	3·00	83·3	–0·34	–1·70	16·4
Holborn Union	I.	8·27	1·84	89·0	1·01	5·05	12·0
" "	II.	7·64	2·40	82·1	0·23	1·15	18·1
Islington (St. Mary)	I.	7·70	0·92	82·8	1·73	8·65	18·9
" "	II.	7·06	1·45	75·9	0·98	4·90	25·1
Kensington (St. Mary Abbott)	I.	0·04	0·60	86·0	2·17	10·85	16·2
" " "	II.	6·08	1·26	65·4	0·83	4·15	35·4
Lambeth (St. Mary)	I.	6·54	1·56	70·4	0·69	3·45	30·3
" "	II.	7·08	1·22	76·1	1·22	6·10	25·1
Lewisham Union	I.	6·42	0·96	58·3	0·90	4·50	42·6
" "	II.	5·95	1·30	64·0	0·75	3·75	36·7
London (City of) Union	I.	8·84	2·82	95·1	0·22	1·10	5·1
" "	II.	6·26	1·10	67.3	1·05	5·25	34·0
St. Marylebone	I.	7·84	1·14	84·3	1·56	7·80	17·3
"	II.	9·44	3·06	101·5	0·19	0·95	–1·3
Mile-end Old Town	I.	9·55	1·96	102·7	1·32	6·60	–1·4
" "	II.	8·70	1·80	93·6	1·19	5·95	7·6
St. Olave's Union	I.	7·17	1·86	77·1	0·61	3·05	23·5
" "	II.	7·70	1·86	82·8	0·79	3·95	18·0
Paddington	I.	7·22	1·44	77·7	1·04	5·20	23·3
"	II.	6·06	2·16	65·2	–0·07	–0·35	34·7
St. Pancras	I.	7·22	1·12	77.7	1·37	6·85	23·7
"	II.	4·94	1·64	53·1	0·09	0·45	47·0
Poplar Union	I.	7·40	0·76	79·6	1·79	8·95	22·2
" "	II.	5·96	0·90	64·1	1·06	5·30	37·0
St. Saviour's Union	I.	6·65	2.10	71·5	0·19	0·95	28·7
" "	II.	6·30	1·90	67·7	0·27	1·35	32·6
Shoreditch (St. Leonard)	I.	9·99	1·48	107·4	1·96	9·80	–5·4
" "	II.	9·44	2·36	101·5	0·89	4·45	–0·6
Stepney	I.	4·98	0·78	53·6	0·93	4·65	47·3
"	II.	5·09	0·58	54·7	1·17	5·85	46·5
Strand Union	I.	9·56	1·64	102·8	1.65	8·25	–1·2
" "	II.	9·16	2.46	98·5	0·69	3·45	2·2
Wandsworth and Clapham Union	I.	8·78	1·50	94·5	1·52	7·60	7·0
" " " "	II.	8·66	2·86	93·1	0·12	0·60	7·0
Whitechapel Union	I.	5·62	0·68	60·4	0·25	1·25	39.8
" "	II.	6·06	1·90	65·2	0.19	0·95	35.0

This state of matters called for legislative action, and accordingly the Adulteration Act was passed.

On the present occasion, pending the passing the new Adulteration Act, it may not be inappropriate to refer to the provisions of the Bill at present before Parliament. The leading features of the Bill, as likewise of the Act of 1872, are the enactment of heavy penalties for poisoning, and lighter penalties for the mere deterioration of provisions.

On examining minutely, there are unmistakable signs that the Bill has been drawn up by persons very imperfectly informed of the nature of the subject matter dealt with by the Bill. How, otherwise, can we account for the placing of the poisoning of drugs on much the same footing as the poisoning of food?

Some of the most valuable drugs are most powerful poisons—and what meaning, for instance, would be attached to the poisoning of morphia? Even the poisoning of food is not correctly dealt with by the Bill, which obviously proceeds on the false assumption that the addition of that which is poisonous *per se* is necessarily to render the article of food poisonous.

When food is flavoured with a small quantity of almond flavour, it is not rendered poisonous, although the almond flavour is a poison. There is a difficulty in defining a poison. Sulphuric acid in a concentrated condition is a poison, and it might be urged that putting any of it into vinegar was poisoning the vinegar. If the enactment be against the putting of an injurious material into food, I do not see why it could not be enforced against the use of sulphuric acid in vinegar; but the real evil to be guarded against is the rendering food poisonous; and though the distinction may seem trivial at first, I have very little doubt that, if the Bill passes in its present form, in the course of practice this very difficulty will arise. We all know that Acts of Parliament are construed literally, and that they have to be construed by people who have little knowledge of the subject-matter, so that such cases as that of sulphuric acid in vinegar would expose the manufacturer to the penalties imposed on the person who mixes a poisonous or injurious substance with articles of food.

There are a great many other objections to the form which the Bill has taken, but I will not enter into them minutely now. It seems to me a pity that the Act of 1872 should be meddled with at all at present, for I am sure it would be much better, and many persons agree with me, that it should be left for a while, until more experience has been had of its working. I am sure that further legislation is premature at present, and my very strong opinion is that the Bill at present before the House is much worse than the Act of 1872.

DISCUSSION.

Mr. Branson said that if there were anything which would cause the legislation going on at present to be modified, it was the uncertainties which traders had to deal with at the hands of those who were the only professional persons on the side of the prosecution—the public analysts. Their present position with regard to articles of food he considered very unsatisfactory, and, though the lecturer had very fairly described his mode of procedure, he did not think the hard and fast line he had laid down should be taken as a ground for procedure even under the present Act. The new Bill he considered one of the most wretched productions ever printed, and thought it might be entitled an Act for the assistance and perpetuation of adulteration, rather than for its prevention. The word "knowingly," and another phrase, "usages of trade," which were introduced, were terms which no magistrate would be able to get over. He was astonished that the President of the Local Government Board had allowed such a Bill to be introduced, and unless it were very carefully amended in detail, the state of things would be much worse under it than under the previous Act. That had undoubtedly done an immense deal of good, but at the same time many retailers had been exposed to persecution. To protect them the word "knowingly" had been introduced; but the great majority of retail tradesmen were very different now to what they were a generation ago, and knew scarcely anything about the articles in which they dealt; they bought things from the wholesale merchant in packages, the inside of which they never saw, and, if they did, they would not understand anything about the contents; and under such circumstances fraud could never be brought home to them. It had been stated that the Bill would contain a provision for transferring the prosecution from the retailer to the wholesale dealer who supplied him, but he could not find it. The Committee of the House of Commons had recommended that this power should be given to justices on the oath of the accused party, and if that could be secured it might be a great advantage, but on the other hand where the importer or wholesale dealer sold goods in bulk, there might be room for fraud upon him by the retailer. He should much like to see some of the wholesale adulterators attacked in their warehouses, rather than that the retailers in their little chandler's shops should be worried, but a very stringent clause ought to be inserted to impose a heavy penalty on anyone who endeavoured to make the wholesale dealer his scapegoat. This was altogether a most difficult question, but the present Bill seemed a very half-hearted measure, and if all the adulterators in the country had given the draftsman a retaining fee he could not have done much more for them. If the House of Commons awoke to its duty something might be done; but he thought while general principles were laid down, the Bill should contain schedules specifying what mixtures of certain articles were allowable. The word in the Bill was not "poisonous," but "injurious;" and though he was not a chemist, he thought the example referred to, of putting sulphuric acid into vinegar, one which ought not to be allowed; and he hoped it would not be sanctioned by any Bill which might be passed.

Mr. Holborn said he attended the whole of the protracted investigation into the working of the Adulteration Act last year, when Mr. Wanklyn and many other eminent chemists were examined, and it was somewhat remarkable that many of them differed entirely amongst themselves, and especially as to the qualifications of the other analysts. Mr. Wanklyn, for instance, said he would undertake to make a preparation of fats, which another of the analytical witnesses should mistake for a totally different article. They differed as to milk, more so as to butter, and still more as to the Adulteration Act; and under these circumstances he asked whether it was not a mistake to give up judging of the articles of food and drink as our forefathers had done, and treat them solely as articles of pharmacy. The public analyst of Sheffield stated before the committee that those engaged in the sale of these articles did not know their quality, but the reply was that practical men could agree in their definition of an article, within about two per cent. in nearly every case, whereas the public analysts under the Act of 1872 could not agree within twenty per cent. Some of the most eminent men who gave evidence said that capable public analysts of food did not exist—some said not six—others said not a dozen. No doubt the analysis of milk had been valuable, but the proposal to

substitute chemistry generally for an accurate knowledge of the article would, in his opinion, only end in confusion. The present Bill was much worse than the last Act. As a guardian of a large metropolitan parish he knew the value of chemical examination as a check, but he could not approve of the proposal to put the reputation of a tradesman entirely into the hands of one of these analytical chemists, whose qualifications had been so flatly denied by their more eminent brethren. Mr. Wanklyn had shown that a man who sold an article containing ¼ per cent. of a substance injurious to human life, was liable on the second offence to six months on the treadmill; and they had all heard probably of the high sheriff of his native county being fined for selling the finest article and the highest priced article ever produced. Then there was the great butter case at Liverpool, in which Dr. Brown said one thing, Dr. Marriott another, Dr. Bartlett another, and Professor Anderson something different again; and it cost the poor trader upwards of £500 to prove that he supplied the public with a pure article. Yet when he asked for his costs he was told by the magistrate in effect that he might consider himself very lucky to escape the clutches of the analyst. Clause 21 of the new Bill gave power to the magistrate, if exception were taken to an analysis, to refer to the analyst in the adjoining county, who might be equally incompetent, so that it was only an appeal from one fool to another; and when the blind led the blind, and both fell into the ditch, depend upon it the poor trader would go undermost. He considered the measure a great blot on English jurisprudence, as being grossly unfair, inasmuch as while it exposed the small trader to heavy penalties for ignorance, the man who professed to be an aalytical chemist, and received a large salary on account of his knowledge, when he was proved to be ignorant went scot free, though his ignorance might inflict the greatest hardship on his fellow citizens. No Act of Parliament had been passed within his memory which perpetrated so gross an injustice.

Mr. Wentworth L. Scott said the processes described so ably by Mr. Wanklyn had been used many years. He had himself more than fourteen years ago examined 100 promiscuous samples of London milk, representing about 8,000 specimens, when he found that 74 per cent. were sophisticated. As to the standards, he was opposed to laying down too hard and fast a line as generally applicable, because milk differed in different parts of the country, depending on the breed of cattle, the rules of feeding, and farm management. He thought it would be more satisfactory therefore, if any standards were adopted, to make them applicable to particular districts, after obtaining an average of the quality of milk there produced. He did not see how milkmen could be made to call poor milk "half-skim," because the case could not be proved in the event of a prosecution. The word "poisonous" did not occur in the old Act or in the new Bill, and therefore he regretted that so much stress had been laid upon it, and it seemed to him immaterial whether an article of food were rendered absolutely poisonous or merely injurious—both ought to be forbidden. If you admitted the principle that you might put copper on pickles to a small extent, and kill your man, not all at once, but by repeated doses, it would be very injurious both to public health and morals. He did not think, however, there was any chance of the present Bill being passed even in its amended form. Sulphuric acid was not used in vinegar to such an extent as persons might suppose from the remarks of a previous speaker, and by law one-thousandth part by weight was permitted; he hoped, however, that this permission would be withdrawn, since it was stated by some of the most eminent makers that vinegar would keep perfectly well without the addition of any sulphuric acid. With regard to milk, he would add that not long ago the analyst at Greenwich examined some which had not only been adulterated with water, but also by the addition of a large quantity of common salt, probably for the purpose of "running up the specific gravity," so that its detection by a rough test would not be quite so easy. Provision was made in the Bill for bringing home any adulteration to the real offenders, but he should have [illegible] deal more at length with these questions that [illegible] fortnight in his promised paper.

Dr. Bartlett, after referring to the little manual of milk analysis published by Mr. Wanklyn, which, he thought, was calculated to be of the greatest use not only to analysts, but to the public generally, and to the trade, said that in a strictly scientific point of view the method of analysis described was open to one remark, viz., that the common ether of commerce, which would be used for dissolving fat, would also take up 10 per cent. of water, and would also, therefore, take up the quantity of milk-sugar which that proportion of water would dissolve. This small margin of error would [illegible] interfere, however, with the commercial working of the process. His name having been mentioned in connection with a celebrated butter case, he would give the facts in relation to it. The butter was first submitted to the local analyst at Liverpool, who said it was adulterated; then to other parties, who said the reverse; then, after some time, to himself, when he stated that it was so far decomposed that he refused to certify with regard to it at all. It was then sent to Dr. Anderson, of Glasgow, than whom there was no man more capable in general chemistry, nor more incapable, according to his own showing, for that particular purpose. He stated that he had very little knowledge of the analysis of butter, and that he could obtain very little information either from his friends or in print, and in the result he certified that he could not say whether it was pure or impure. He would not go into the question whether 5, 10, or 15 per cent. of impurity in butter could be detected by analysts, but when the proportion became larger it was easily detected by the palate. He was not a public analyst, and never had been, but he would remark on the manner in which they were assailed in trade journals with such a tone of vituperation, as if they were the persons who harrassed the unfortunate trader. The analyist was only the servant of the Local Board, who were generally traders themselves, and selected the man who would least harrass their brethren. The solicitor to the Board conducted the prosecution and advised upon it, and the analyst had simply to testify as to the quality of a particular sample which had been submitted to him. It had been said that traders had no confidence in analysts, and allusion had been made to the analyst for Sheffield, with whom he was acquainted. He had heard that gentleman state that he had mixed with certain quantities of good tea 5, 10, and 15 per cent. of leaves which he had himself exhausted, and the sample being sent to a tea taster, he valued the one which had the largest quantity of exhausted leaves in it as better than that which contained none whatever. Such a fact as that must be set against some of the other statements which had been made. With regard to milk, he thought Mr. Wanklyn had taken rather a high estimate of the ash, [illegible] ·73 was higher than his own experience would lead him to, but the difference was very slight indeed. There was an adulteration of milk which had not been alluded to, but which was of some importance. Milk was sometimes sold in a state far worse than if it had merely 5 per cent. of water added to it, viz., when it contained a large amount of lactic acid, for any medical man would say that in that condition it was particularly unfit for the consumption of infants, and not very good for anyone, unless they liked sour milk. Now milk in this condition was adulterated with various alkaline substances to conceal the sourness or to prevent the acidity occurring; carbonate of soda and carbonate of potash had been used; he had been consulted as to the use of boracic acid, borate of soda, and even caustic potash. It was a matter of considerable moment, therefore, for analysts to be able to detect the presence of any of these alkalies,

as this depended on the amount of ash, it was important that the percentage should not be placed to high. His own analyses showed an average of ·65 to ·69 per cent. of ash, and as a very small proportion of alkali would neutralise a large amount of lactic acid, the importance of the question was manifest. He should like to see collected a general average of milk analyses throughout the country; but at any rate if there were more ash than ·73 or ·8 it would show that there had been the addition of alkali to neutralise sour milk. Without using the strong language he had heard, he considered the Bill at present before Parliament a very crude measure, and it was, therefore, of importance that it should be fully discussed, and every possible information furnished to the committee who had charge of it.

Mr. Flux, speaking as one of the general public, said Mr. Wanklyn had shown the necessity for an Adulteration Act, which necessity, he did not think, was likely to cease; and he would therefore advise those gentlemen who abused it so much to try and assist in passing a really useful measure rather than to aim at its abolition. He had had some opportunity of watching the operations of the Act, and was convinced it had been productive of great public benefit, though, as was the case with all novel legislation, there had been cases of individual hardship. These cases, however, had been discussed and commented on, and there would be less likelihood of their recurrence in future, as analysts and public bodies became more familiar with the duties imposed upon them. In his opinion, a great deal of the soreness which had been felt upon this matter arose from the fact of offences under the Act being tried at police-courts; and he believed that if, at any rate on the first occasion, such cases were tried in a civil court, reserving the criminal court for repeated or aggravated offences, much of the objection would be removed. As to permitting adulteration to run riot without a check, it was simply impossible; the public must have wholesome food, and must be protected by the laws of the country against those who would adulterate.

Mr. Wanklyn, in reply, said he had given no opinion as to the propriety of putting sulphuric acid in vinegar, but he did not consider a small quantity detrimental, though he knew by experience that it would keep without. What he objected to was a maker selling as vinegar free from sulphuric acid that in which it was contained; but he brought forward that instance to show that a person selling such an article would be liable not to the milder penalty, but to imprisonment for six months, with hard labour. The clause he referred to ought to prohibit food being rendered poisonous, not the putting of anything poisonous into food. The words "poisonous" and "injurious," he used as synonymous. With regard to butter, he held that in the present state of knowledge it was impossible to say that any given sample was really pure, the difficulty of distinguishing between the fats said to be introduced and butter itself being very great, and therefore he thought public analysts ought at present to refuse to deal with it. It was their duty to perform such analyses as the present stage of analytical knowledge permitted, but it was of the utmost importance that they should confess that there were questions which at present they were unable to solve. If Mr. Bond had examined 8,000 samples of milk, he feared he must have done so rather imperfectly; but with regard to the case of half-skimmed milk, his belief was, that in 99 cases out of 100, milk which contained only 2 per cent. of fat had been skimmed or watered, and in the interest of the public he thought the milk dealer who sold poor milk must be treated much in the same way as the one who sold skimmed milk for new. He did not advocate heavy penalties under the Adulteration Act, or that when enforced it should be necessarily assumed that the offender was dishonest. To be sure, it ought to punish a tradesman simply for his negligence in not knowing his business, or not taking the necessary trouble to supply the public with pure articles. A good deal would be gained if the assumption were tacitly made that all cases arose from mere negligence, and if the penalties inflicted were light but certain. With regard to the proportion of milk ash, his figure of ·73 represented grammes per 100 cubic centimetres, which if reduced to a percentage, would be ·70, thus differing very slightly indeed from Dr. Bartlett's figures, ·65 to ·69. At the present moment his assistant, Mr. Nisbett, and himself, were engaged in making investigations on the ash of milk—which, so far as they could ascertain at present, occasionally rose to ·81, and sometimes fell a little below the figures he had given—with a view to ascertain whether the phosphoric acid, the lime, or the chlorine, in the total ash was the more constant. This investigation was of importance, because when milk was decayed the only data of any use were those obtained from the ash, which did not decay in common with the organic matter. In these determinations it was necessary to deal with a larger quantity, say 50 cubic centimetres, because, as every chemist knew, there was this difficulty in dealing with it. If you burned the ash until it was white, you volatilised a little of the chloride of sodium, and if you stopped short of whiteness you left a trace of organic matter. By taking 50 centimetres, however, you might expect a degree of accuracy in which the variation would not exceed ·02. He had not laid down any hard and fast line, for he had said that when milk showed, on analysis, 20 per cent. of water, it might only have had 15 per cent. added, or, in exceptional cases, it might contain 28 per cent.; and, for purposes of prosecution, accuracy within 5 per cent. was ample, though the idea of attaining such perfection would have been deemed absurd a few years ago. When the constancy of "solids not fat" in milk was so great that you could detect the addition of little more than 5 per cent. of water, he thought that knowledge ought to be taken advantage of. As he had said, the fat would sometimes be as low as ·2, sometimes as high as ·4, but in the immense majority of genuine samples it would be a little over ·3. The case of skimmed milk could only be dealt with by a convention, and in any schedule in which milk was mentioned there should be some provision to deal with it. He thought the Adulteration Act would be of very little use if you could not punish a man for selling milk which was very much impoverished, or skimmed milk under the name of new. He thought there should be two provisions in the Act; one to punish severely those who poisoned the public, whether quickly or slowly, and another inflicting a milder penalty on traders who sold articles under designations which did not fairly represent them. If it did that, and little else, it would be effective. He regarded the present complicated Bill as an attempt to do much more, which would, in all probability, be abortive.

The Chairman then proposed a vote of thanks to Mr. Wanklyn for his able paper, which was carried unanimously.

Mr. Henry Blackburn intends to reproduce in the form of a lecture, the paper recently read by him before the Society on "The Art of Popular Illustration." The lecture will be delivered in Lancashire and Yorkshire during April, and will be illustrated with diagrams, specimens of various reproductive processes, &c. Any institutions desiring to avail themselves of Mr Blackburn's services may communicate with him at the Garrick Club.

Mr. Hopkins describes an experiment, which consists in passing a charge of electricity through a very fine thread of platinum, or other metallic foil, the thread being kept in place between sides of microscope glass. The effect of the heat from the electric discharge is to vaporise the metal, which is instantly condensed in a transparent layer upon the cold glass, and it can then be studied by the microscope, and can be used in various ways to determine the character of the metal and the peculiarities of the discharge.

MISCELLANEOUS.

THE AMENDED PATENT BILL.

The alterations introduced into the Lord Chancellor's Patent Bill during its passage through committee are not very numerous, but are of sufficient importance to justify a short abstract. None of them, it will be noticed, touch the principles of the Bill, and the verbal alterations are exceedingly few. The Bill as originally brought in provided that the number of examiners should not be less than two, nor more than four, but it is now proposed to appoint two only. The examiners are to be assisted by "two or more, but not exceeding four," assistant examiners, who are to be nominated by the Lord Chancellor in the same manner as the examiners, and are to be "specially qualified for the office by legal or scientific knowledge." An alteration has also been made in the status of the referees, who are to be appointed by the Commissioners of Patents alone, without the intervention of the Board of Trade, as was at first proposed, and the functions are somewhat limited under the Amended Bill. The applications are now to be intrusted to an examiner alone, instead of to an examiner and a referee jointly, but in special cases one or two referees will be associated with the examiner. Some changes have been made in the clause which deals with the points to which the examiners' attention shall be directed. Under the Amended Bill they are ordered to report as to "whether the invention appears open to objection on the ground of want of novelty," whilst the original measure directed them to inquire simply "whether the invention is new." Sub-section *f* of the same clause empowered the examiners to report "whether by reason of the frivolous character of the invention, *or for any other reason*, it is not worthy of a patent." The words in italics are now omitted. It appears from these changes that the preliminary examination will not be of that rigorous character which was at first intended. By a modification of clause 13 of the amended Bill, power is given to the law officers to hear appeals by applicants, and oppositions on the part of those who have given notice of the same, at a much earlier stage than under the original Bill, which indeed only provided for the hearing of appeals and oppositions by the Lord Chancellor after notice to proceed had been given. That part of clause 17 by which a patent might be made to extend to any of the colonies, "except one, in which it would be invalid by the law in force therein for the time being," has been abandoned, probably because all the important colonies have Patent-laws of their own. Foreign inventors will no longer be prevented from obtaining a patent in the United Kingdom by reason of "the circulation or republication of the foreign patent, or of any specification or document referred to therein or connected therewith," in this country, but (as provided in the original Bill) application must be made here within six months after the date of the foreign patent. That part of the clause relating to amendments by which "any amendment for which leave is given shall be indicated on the specification" is struck out, and an application for leave to amend will no longer be treated "in all respects as an original application for a patent," but, "where the request is made pending the application it shall be proceeded on and dealt with as prescribed." When, however, leave to amend is sought, *after the patent has been completed*, the amended Bill provides that it shall then be dealt with as an application. The schedule of stamp duties payable remains unaltered, except in the mode of arrangement. Under the original Bill the fees in the first three years are lowered by £5, as compared with the scale of the Act of 1852, and if no amendment be made in the schedule, a three years' patent will only cost £20.

The amended Bill contains 61 clauses (the same number as that in the original Bill), but they have been re-arranged, and the numbers do not always correspond.

VIENNA EXHIBITION REPORTS.

(*Continued from page 354.*)

Continuing the brief epitome of these reports, commenced and carried on in former numbers of this *Journal* the next in order is that of the Rev. J. G. C. Fussell, on "Educational Appliances." The subject dealt with by Mr. Fussell is, as he remarks at the commencement of his report, not one capable of thorough illustration in an exhibition, where only appliances and instruments can be shown, and there is obviously no means of illustrating accomplished results. This is, indeed, less true of matters connected with primary education than of the higher branches, since dealing, as elementary teaching does, to a very large extent with practical objects and illustrations, there is more material which can actually be brought before the eye in a tangible shape. It was, in consequence, chiefly primary education which was treated at Vienna, and it is to this department of his subject that Mr. Fussell devotes the more important portion of his report.

The "Kindergärten" system originated by Froebel was largely illustrated at Vienna, especially by Austria Hungary, Germany, Switzerland, and Sweden. School buildings and fittings for primary schools of various descriptions were also illustrated by numerous examples from the United States, Austria, Sweden, Hungary, France, Bavaria, Saxony, Belgium, and Switzerland. Great Britain was hardly represented at all, a matter on which the reporter dwells with some expressions of regret. The fittings of the Swedish school-rooms are highly praised by Mr. Fussell, the separate "school-bench," with its adjustable desk and the little "well" in front, opened or closed to suit the length of the small scholar's legs, being referred to as a highly commendable feature. Some of the models sent by America, Austria, and Germany are also noticed in terms of praise. Among the contributions from France was an elaborate model of a depôt recently established in Paris for the supply of school furniture and material to the various primary schools throughout all the arrondissements. This institution, it is stated, was subjected to a very severe trial after the war, when much that had been destroyed had to be replaced at somewhat short notice. It, however, successfully withstood the strain upon it.

The recent development of educational institutions in Hungary afforded the reporter much material for consideration, and an account is given of the measures recently adopted in that country for the promotion of instruction. The great chemical laboratory of the University of Pesth, now recently completed, is described as as example of what such an institution should be. It is fitted up with every appliance that the most advanced chemical science can suggest; there are laboratories for beginners and for advanced students, and separate laboratories in which special researches can be conducted without the apparatus being disturbed from day to day.

Among the objects intended for purposes of higher instruction, especially noticeable were the exhibits under the heading of geography, maps, atlases, globes, and plans in relief, though here, again, no reference is made to any British contributions.

Among the principal matters exhibited in the British Section, Mr. Fussell notes several collections by Mr. P. L. Simmonds—1. Industrial varieties of cotton. 2. Starches. 3. Waste substances. Also a series of specimens of artistic mosaic work by convicts at Woking under Major Du Cane, and three inventions by Mr. Adams, intended to embody abstract mathematical conceptions and relations in a vivid and tangible form. These are the "Problem of Pythagoras," illustrative of Euclid I. 47; the "Mensurator," which illustrates ma

problems of geometry, arithmetic, algebra, &c.; and the Coelometer, which exhibits in a concrete form all the conceptions which are necessary for nautical astronomy. In treating of our Indian and Colonial Departments, Mr. Fussell speaks at some length of the collection shown by Dr. Leitner.

The next paper in order is that by Mr. Vizetelly, on the wines tasted, followed by a much shorter one by the same gentleman, on the beers exhibited. The elaborate and exhaustive character of Mr. Vizetelly's remarks on the wines renders it impossible to attempt to do justice to them without occupying an unreasonable amount of space.' It must suffice just to notice the conclusions with which he ends his report. He expresses a strong disapproval of the recognition accorded by the jury to certain imitation wines, thinking that chemistry always does quite enough mischief in the wine trade without further encouragement. Though many of the processes for transforming one wine into another are harmless enough, it is yet "difficult to determine exactly where the harmlessness ends and the deleteriousness begins." The broad impression left on the mind of the reporter was, that the sources of wine supply are daily multiplying, and that there is a steady, if slow, improvement, both in viticulture and vinification, even in regions where, until quite recently, the most primitive practices prevailed. The people of wine-growing countries are more easily satisfied, both as regards quality and appearance, than nations who are only consumers, and it is not until wine becomes an important article of commerce that very much is devoted to the processes of its production. The taste for natural as opposed to fortified wine is, in the opinion of the reporter, growing, and only needs encouragement to result in the abandonment of the custom of adding alcohol to wine on the pretence that its presence is necessary to enable the wine to travel well and to continue sound. As a rule, fortified wines are never consumed by the inhabitants of the country where they are produced.

The existing differential duties on wines are, Mr. Vizetelly urges, of great advantage in encouraging the importation of a class of wines adapted for drinking freely at meals, instead of "those which contribute to a species of disguised dram drinking." Instead of the suggested equalisation of the duty, he would prefer to reduce by one-half the existing impost on wines containing no more than 26 degrees of proof-spirit, "or, better still, to abolish it altogether, when we should have wholesome common wine as cheap as beer, and excellent table wine, such as one drinks regularly in France, at 10d. per bottle." A few statistics are brought forward to show the difference between France and England in this respect. In 1872, the 1,851,792 inhabitants of Paris drank 85,849,304 gallons of wine, equal to 40½ gallons per head. In the same year, the 31,628,338 inhabitants of Great Britain and Ireland drank only 16,878,169 gallons, or less than a fifth of the quantity consumed by Paris alone, and only a little over half a gallon per head.

Of beer there were few English exhibitors, but the deficiency was amply made up by Austria, Germany, and other countries. Amongst the exhibits, it is noted that some came even from China, the Brazils, and New Zealand. Circumstances were somewhat adverse to a comparison between the English and German beers, as the latter were stored in an ice cellar, whereas the former were exposed in the Exhibition building, but with due allowance made for this, the comparison seems to have resulted sufficiently well for our representatives.

(*To be continued.*)

The number of persons killed in American railroad accidents in 1874 was 204, the number injured being 971. In the previous year the number of persons killed was 2?8, while 1,283 were injured. Collision and faulty permanent way generally do the most mischief on American lines.

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the month of February, 1875. When they are counted by sight the words "by sight" are used, when by turnstile the word "machine":—

	Voted in 1874.	Number of Visitors. Jan. How counted.
1. British Museum	£102,442	return refused.
2. National Gallery	6,346	58,532 (by sight).
3. Kew Gardens and Museum	17,862	5,645 (by sight).
4. South Kensington Museum	38,024	50,028 (by machine).
5. Bethnal-green	5,810	34,935 (by machine).
6. National Portrait Gallery	1,748	No return.
7. Geological Museum, Jermyn-street	8,998	6,114 (by machine).
8. Patent Office Museum	1,490	16,810 (by machine).
9. Edinburgh National Gallery	2,100	7,003 (by machine).
10. Edinburgh Museum of Antiquities	—	5,219 (by machine).
11. Edinburgh Museum of Science and Art	9,824	39,438 (by machine).
12. Edinburgh Botanic Gardens	1,750	No return
13. Royal Dublin Society	1,823	"
14. Dublin Museum of Natural History	1,672	No return (by machine).
15. Glasneven Botanic Gardens and Museum	2,148	No return (by machine).
16. Dublin National Gallery	2,380	No return.
17. Geological Society, Dublin	00	"
18. Museum of Royal Irish Academy, Dublin	2,084	"
19. Zoological Gardens, Dublin	...	"
20. Tower of London	2,236	" (by sight).
21. Royal Naval College, including Greenwich Painted Hall	1,416	" (by sight)
22. Royal Naval Museum, Greenwich	...	2,162 (by sight).

GENERAL NOTES.

Paris Exhibition, 1875.—The exhibition of matters connected with marine and river industries, as already announced in the *Journal*, will be held in Paris, from July to November next. The building selected is the well-known Palais de l'Industrie, in the Champs Elysées, where the Exhibition of 1855 took place. The Lord Mayor has accepted the presidency of the London committee for promoting the representation of the United Kingdom at the exhibition. The first meeting of this committee will shortly be held at the Mansion-house. The committee includes the Right Hon. the Lord Mayor (chairman); Mr. Alderman and Sheriff Ellis; Mr. Sheriff Shaw; Professor T. C. Archer; Sir Frederick Arrow; Sir Thomas Bazley, M.P.; H. Bessemer, Esq.; H. W. Bolckow, Esq., M.P.; Sir Antonio Brady; Alexander Brogden, Esq., M.P.; Frank Buckland, Esq., M.A.; Charles Cameron, Esq., M.P.; Hyde Clarke, Esq., D.C.L.; Sir Thomas Dakin; H. W. Eaton, Esq., M.P.; Alderman Sir Thomas Gabriel, Bart.; Sir Daniel Gooch, Bart., M.P.; R. Hudson, Esq., F.R.S.; E. Jenkins, Esq., M.P.; E. P. Linthillac, Esq.; Sir Louis Mallet, C.B.; Hugh Mason, Esq.; A. J. Mundella, Esq., M.P.; John Pender, Esq., M.P.; Right Hon. Lyon Playfair, M.P., C.B.; Sir Charles Reed; Rev. Arthur Rigg; Gilbert Sanders, Esq.; J. Forbes Watson, Esq., M.A., M.D.; J. Yeaman, Esq., M.P.; the Right Rev. Bishop Claughton, D.D.; the Right Hon. the Lord Provost of Edinburgh, C. T. Richie, Esq., M.P.; J. D'A. Samuda, Esq., M.P.; Ed. Johnson, Esq., hon. sec.

Philadelphia Exhibition.—The American Executive having requested that a representative of the British Commission might be stationed at Philadelphia, the Lord President of the Council has appointed as official delegate Colonel Herbert Sandford, R.A., who was employed in the Exhibition of 1862. It is stated that 200,000 dols. have been appropriated by the Japanese Government for expenditure in connection with the Philadelphia Centennial:—For the expenses of the commissioners to examine industries and report, 100,000 dols.; for the exhibition of Japanese articles, 80,000 dols.; for transportation, 20,000 dols.

Preservation of Food.—A new mode of preserving fish and other food has been brought before the notice of the Society. The process is the invention of M. Gorges, and consists in treating the substance to be preserved with a certain solution, the nature of which is kept secret. On Tuesday last a luncheon was given at the house of Mr. Frank Buckland, at which a variety of different sorts of fish, treated as above, were served. The fish had been kept in an ordinary hamper for six days, and most of it had been some four days or so previously packed in ice in the usual manner. The general opinion of those present was that the fish had retained all their natural flavour and freshness.

The Bessemer Saloon Steamer.—Mr. Bessemer's Channel steamer in now docked at Milwall, where she arrived after a trial trip from Hull. The trial is stated to have been fairly successful. She had previously made two private trips from the Humber, but this was her first real experience of a rough sea. On a Wednesday afternoon she steamed out of the Albert Dock, at Hull, under the command of Captain Littock, with a very few passengers, including Lord Henry Lennox, the First Commissioner of Works, and her builder, Mr. Reed. Having been swung in the river and had her compasses adjusted, she proceeded on her trip, and in a couple of hours had cleared the Humber. The trial of the saloon was not commenced till the Thursday, when it took place in a very high sea, and with satisfactory results. The vessel is said to have behaved admirably in the high wind and heavy seas, rolling very moderately and easily, and pitching scarcely at all. The Bessemer saloon was tried for an hour off Orfordness, the machinery being found to have it in perfect command. The man who worked it was not entirely successful in reversing or neutralising the rolling motions of the ship, but this arose only from some defect in the operating levers, and from inexperience, as this was the first trial of the saloon at sea. Those aboard were satisfied that the machinery was fully capable of controlling the saloon. It is expected that before Easter she will be running between Dover and Calais.

Currency of the World.—An American paper gives a statement of the value (in United States currency) in pure metal of the standard coins of the various nations of the world, as estimated by the director of the United States Mint. The pound sterling of the United Kingdom is of the value of 4 dols. 86·65 cents; the mark of the German Empire, 23·82 cents; the franc of France, Belgium, Switzerland, the drachm of Greece, the lira of Italy, and the peseta (of 100 centimes) of Spain, 19·30 cents; the Austrian florin, 47·60 cents; the Russian rouble (of 100 copecs), 77·17 cents; the crown of Denmark, Sweden, and Norway, 26·80 cents; the Netherlands florin, 40·50 cents; the Portuguese milreis (of 1,000 reis), 1 dol. 8·47 cents; the Turkish piastre, 4·39 cents; the Egyptian dollar (of 20 piastres), 1 dol. 0·39 cents; the rupee (of 16 annas) of India, 45·84 cents; the dollar of Central America, 96·50 cents; the Brazilian milreis, 54·56 cents; the silver tael of China, 1 dol. 61 cents; and the golden yen of Japan, 99·70 cents.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

March 24.—*No Meeting.*

March 31.—"Food Adulteration and the Legislative Enactments Relating Thereto." By Wentworth Lascelles Scott, Esq. On this occasion Dr. W. B. Carpenter, F.R.S., &c., will preside.

April 7.—"Captain Liernur's Improved System of Town Drainage." By Adam Scott, Esq. On this evening Thomas Hawksley, Esq., will preside.

April 14.—"On the Best Method of making Field Experiments practically useful to Agriculturists." By Professor John Wrightson.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

March 30.—"Civilisation and Progress on the Gold Coast of Africa, as affected by European Contact with the Native Inhabitants." By Andrew Swanzy, Esq.

April 13.—"On the Probable Influence of Railway Construction in Natal upon the Trade, and upon the Civilisation of the Native Races, of the Colony and adjacent Territory." By A. Browning, Esq.

Indian Section.

Friday evenings at eight o'clock, the following arrangements have been made:—

April 2.—"Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India," by Robert H. Elliot, Esq., Author of "Experiences of a Planter," &c.

April 23.—"The Preparation and Uses of Rhea Fibre," by Dr. J. Forbes Watson.

April 30.—"Indian Manufactures," by Elias Helm, Esq., of Manchester.

May 14.—"The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East," by the Rev. James Long.

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

April 16.—"Recent Advances in Photographic Science," by J. Spiller, Esq., Vice-President of the Photographic Society. Warren De La Rue, Esq., D.C.L., F.R.S., will preside.

May 7.—"Alum Shale and its Application," by Sydney Rich, Esq.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, University of London, Burlington-gardens, S.W., 8½ p.m. Mr. J. Coryton, "Trade Routes, viâ British Burma, to Western China."
Medical, 11, Chandos-street, W., 8 p.m.
Birkbeck Scientific Society, Southampton-buildings, W.C. Mr. E. G. Clayton, "Sulphur and the Sulphides."

Tues. ...Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Sir William Wright, "The Hull Docks." 2. Mr. John Clarke Hawkshaw, "The Construction of the Albert Dock at Kingston-upon-Hull."
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Col. Lane Fox, "Note on Chest Measurement of Recruits." 2. Rev. Dunbar I. Heath, "Molecules and Potential Life." 3. Mr. G. H. Kinahan, "A Prehistoric Road in Antrim." 4. Mr. Chas. C. Abbott, "Stone Implements found in New Jersey, U.S." 5. Mr. E. H. Howarth, "The Sarmatæ."

Wed. ...Geological, Burlington House, W., 8 p.m. 1. Mr. Henry Hicks, "The Occurrence of Phosphates in the Cambrian Rocks." 2. Mr. M. Hawkins Johnson, "Note on the Structure of the Phosphatic Nodules from the top of the Bala Limestone in North Wales." 3. Professor H. G. Seeley, "The Maxilliary Bone of a new Dinosaur (*Priodontognathus Phillipsii*, Seeley) in the Woodwardian Museum." 4. Mr. R. Etheridge, jun., "Description of a new species of the genus *Hemipatagus*, Desor, from the Tertiary Rocks of Victoria, Australia; with Notes on some previously described species from South Australia."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Sir Gardner Wilkinson, "On the Listening Slave and the Flaying of Marsyas."
Archæological Association, 32, Sackville-street, W., 8 p.m.
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Sat. .....Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,166. VOL. XXIII.

FRIDAY, MARCH 26, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society :—

	£	s.	d.
G. T. Saul	5	0	0
(Second donation)	2	2	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
(Second donation)	10	10	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter C. Trevelyan, Bart.	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	0
Jonah S. Wells	10	10	0
Charles Downes	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0
John Peckover	5	5	0
Frederick Braby	2	2	0
Decimus Burton, F.R.S.	5	5	0
Percy Rowlands	2	2	0
The Right Hon. Lord Hatherley	20	0	0
Colonel John Thomas Smith, R.E.	2	2	0
Ardaseer Cursetjee, F.R.S.	5	0	0
H. V.	25	0	0
J. S. Lapraik	1	1	0
Alexander Gordon	3	3	0
Wentworth L. Scott	1	1	0
Charles Telford	5	0	0
William Middlemore	5	5	0
J. H. Anderdon	10	10	0
Sir Titus Salt, Bart.	50	0	0
William Young	2	2	0
John Bloomer	5	5	0
Henry Brooks	1	1	0
Griffiths Smith, F.R.G.S.	1	1	0
John Rutson	3	3	0
Alfred W. Miles	3	3	0
Charles White	1	1	0
Arthur Trevelyan	5	0	0
Mrs. Alexander Kerr	5	0	0
Francis Bennoch	3	0	0
W. A. Gilbee	1	1	0
W. Sparks	1	1	0

The Council will be glad to receive further contributions to this fund. Members can obtain information as to its nature and objects on application to the Secretary.

SCHOOL DRILL.

A meeting of this Committee was held on Thursday, the 18th inst. Present—HENRY COLE, C.B. (in the chair), Lieut.-Col. Du Cane, Capt. O'Hea, Capt. Phipps, R.N., and E. Carleton Tufnell.

REVOLUTION INDICATOR.

A meeting of this Committee was held on Friday, the 19th inst. Present—Vice-Admiral ERASMUS OMMANNEY, C.B., F.R.S. (in the chair), W. Froude, F.R.S., Capt. Nisbet, and J. R. Ravenhill.

MERCHANT SHIPPING BILL.

A meeting of this Committee was held on Monday, the 22nd inst. Present — J. SCOTT RUSSELL, F.R.S. (in the chair), R. Greaves, Dr. Sandford, Captain B. Sharpe, R.N., Rev. R. J. Simpson, and Capt. H. Toynbee.

TECHNOLOGICAL EXAMINATIONS, 1875.—NOTICE TO INSTITUTIONS.

Candidates intending to enter for these examinations should make early application to the Secretary of the Society of Arts, Adelphi, London, for forms for making a return of age, address, &c., as these particulars must be forwarded to the Society not later than the 31st instant.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1875, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in

"recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufacturers, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to C. W. Siemens, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

The Queen has conferred upon Mr. Henry Cole, C.B., the distinction of a Commandership of the Bath, in recognition of his eminent public services.

The imports of paper for printing and writing into the United Kingdom in the year 1861 amounted only to 6,106 cwts., while in the following year the amount was 115,927 cwts., and in 1873, 195,193 cwts. The amount of the imports of esparto and other paper-making materials was, in the year 1860, in round numbers, 160,000 tons, whereas in the year 1873 it had augmented to 130,500 tons. In 1861 the imports of paper into this country represented a value of £171,500, while in 1873 the total value was estimated at £563,000, an increase of over £400,000. The value of the imports of esparto was computed to amount, in the year 1860, to the sum of £323,000; but in 1874 this had increased to £971,446.—*Printers' Register.*

The casting of the statue of the late Prince Consort, to be placed under the dome of the Albert Memorial, in Hyde-park, has been completed. The figure is seated in a chair of State, and is of colossal size, being 15 feet in height from the base to the crown of the head. The artist, the late Mr. J. H. Foley, R.A., fortunately completed the model before his death. The statue would have been completed some months since but for an unfortunate accident. It now only requires the final chasing before being fixed in its resting-place.

A shaft has recently been sunk at Lawton, in Cheshire, for the purpose of pumping up brine, to be conveyed by means of pipes to the coke ovens in connection with a colliery in North Staffordshire, a distance of two or three miles, there to be converted into salt by means of the waste heat from the ovens.

MISCELLANEOUS.

THE "BESSEMER."

The *Bessemer*, which, after her trial trip from the Humber to Gravesend, has been brought up into the Thames, and is now lying in Millwall Docks, is, it must be admitted, no beauty to look at. It is, indeed, fortunate that her internal advantages are not to be gauged by her external appearance, for an uglier vessel—that is, among vessels designed for the workings of peace, not for war—has perhaps never yet floated on the water. A landsman surveying her from the shore might possibly opine she was some vast turret ship, heavily armed in defence of the passengers she was evidently destined to carry, and would certainly shake his head over the too probable sufferings in store for those unhappy souls. To all who go down to the sea in ships is reserved a certain amount of misery, but a mere outward and casual inspection of the *Bessemer* would almost warrant one in supposing that in her case the misery would be even beyond what we have hitherto known. The first step on deck will go far to dispel all such gloomy forebodings. The more contrast between what is to be seen there and what, as our memory will but too faithfully tell us, is to be seen on those miserable little cockle-shells in which the passage of what is poetically, but most inappropriately, called the "silver streak" has hitherto been always made, is enough. Surely Mr. Bessemer and Mr. Reed, above all other living men, deserve the thanks of their fellows for their efforts to alleviate what Sir Spencer Robinson has not inaptly styled "one of the greatest evils that can afflict humanity."

The first thing on which the general public will be anxious to satisfy themselves will undoubtedly be the great saloon—the swinging saloon—which is to hand down the name of Bessemer to a grateful posterity. As the ship herself and all her wonders have been already so fully and so scientifically explained at the time of the launch in September last, and again were but a few days back so ably treated by Lord Henry Lennox in the light of his own personal experience, it is unnecessary now to enter into any minute details or to dilate on an already well-told tale. But about this saloon a few words will not be out of place. In the first place it more resembles the smoking-room of a Club, where the comfort of the members is especially studied, with a view to long sittings and much conversation, than the saloon of a steamer which is to run backwards and forwards across a channel some twenty-six miles wide. It is surrounded with comfortable lounging seats, and rows of the same are in the centre, raised on a sort of dais. The walls are decorated with frescoes, pleasant to look upon, and painted in warm lively tones. The wood-work is of oak, well polished and handsomely carved. The only feature of the room which would attract the curious eye is a small enclosure, more like a pew than anything else, in the centre among the raised seats. Within this is an odd-looking arrangement of polished steel, which certainly looks out of place among all the other surroundings. But this is, it may be said, the very *genius loci*. It is by this and through this that the comfortable seats will be found comfortable, the pictures admired as they should be, and the oaken fittings not mere hard and unnecessary excresences, playing into the hands of heavy seas, to be execrated by all men. This is, in short, what makes this saloon the Bessemer saloon. Within this pew-shaped enclosure stands, or will stand, a man, whose sole business it will be to regulate the motion of the saloon, so that whatever may be the war outside there may be peace within. This regulation is effected by an arrangement of levers, spirit-levels, and a small, heavy disc-wheel, but the passengers that are to be will be glad to learn that the

working of this machinery, so far as the regulation of the saloon's motion is concerned, will not depend alone on this man's judgment. All he will have to do will be to keep the wheel motionless, as indicated by the spirit-level, by doing which the slight motion of the saloon floor will of itself turn on and off the water pressure—which is the real motive, or rather restraining, power of the whole—from the pistons in the exact proportion that is necessary to maintain the floor of the saloon in a horizontal position.

Then, besides this general reception room, there are private cabins both for ladies and gentlemen, smoking-rooms, buffets, lavatories, and many other means and appliances for comfort, it may even be said luxury, and all solid, substantial, and in good taste. Great attention, too, has been paid to ventilation—a very necessary item in the sum total of a passenger's comfort, as every traveller can tell. Arrangements have been made for forcing 3,000 cubic feet of air per hour and per passenger into the saloon, by which the air, which in winter can be warmed, enters below and passes out through the windows above. In the other rooms the arrangement is reversed, the air not being forced in, but exhausted from them. At least, then, we shall have pure air and comfortable seats if we must stay below. If this is all, at least it is a great deal. If this Bessemer saloon—unquestionably perfect as it would seem to be in theory—should after all turn out but naught in practice, and we are still destined to misery, at least, to make use of something of a bull, we may be miserable in comfort—may enjoy, as it were, an "ecstasy of woe."

But Lord Henry Lennox holds us out promise of a far better state of things. Through a "wild night," a heavy cross-sea, and an E.N.E. wind, the *Bessemer* on her first voyage was found to behave remarkably well. She pitched hardly at all, and rolled but little. Then she was by no means so perfect in her machinery as she will be when she goes down to her appointed station. Some few trifling adjustments of her machinery, it is said, will keep her at Millwall, and then there would seem to be every likelihood of her realising the great expectations that have been formed of her, not only by her promoters but by the public, and of the sea-wave being, by her aid, in a considerable degree relieved of its typical motion.

Mr. E. J. Reed, M.P., occupied the attention of the Institute of Naval Architects on Saturday, Lord Hampton presiding, with a full technical description of the vessel. There was a very large company present, among them being the Earl of Lauderdale, Lord Henry Lennox, Admiral Sir Spencer Robinson, Mr. Merrifield, and many other gentlemen interested in questions relating to sea-going vessels. Mr. Reed commenced by excusing himself for not having prepared a written paper, saying that his time had been so entirely occupied by Parliamentary and other duties that he had found himself unable to devote the time necessary to do so. He stated that Mr. Bessemer himself was indisposed, or he would have been present at the meeting, and the speaker then went on to describe by means of sectional drawings the peculiarities of the invention. He expressed himself as completely satisfied that she would fulfil her purpose, but took occasion to reiterate his dislike of low ends, such as the *Bessemer* had. He remarked that the vessel was in herself so steady that the worked saloon was unnecessary, and while the principle of the saloon was good, and even in the early days of its suggestion he had conceived that it would answer, contrary to the opinions of many men, yet he believed that Mr. Bessemer had still to find the guiding apparatus, some means by which the eye and hand of the operator had to be guided. This principle of a saloon hung so as to counteract the roll of the waves would come to be, he thought, applicable to smaller cabins. Admiral Sir Spencer Robinson said he entirely concurred in the favourable opinions of Mr. Reed on this very great invention, for it was nothing else. It was with great satisfaction that he had listened to Mr. Reed and heard him express his complete belief of the power of the ship to counteract the motion of the waves and his suggestion that the principle could be applied to other vessels. If the horrors of the middle passage could be lessened the world would travel more. He would not presume to offer an opinion in opposition to an able naval architect like Mr. Reed, but there was one point upon which Mr. Reed cast some little doubt, upon which he (Sir Spencer) entertained none, and that was the subject of the low ends. As he had been instrumental, more or less, in bringing about the use of low ends in the Royal Navy, he put in a sort of protest against the rather disparaging view taken by Mr. Reed of the low ends of the *Bessemer*, for Mr. Reed could not but have seen the ship's remarkable freedom in heavy seas, and her remarkable absence of pitching—qualities which were in no small degree due to low ends, and he believed that the low ends of the *Bessemer* would contribute to her freedom from pitching. Mr. Reed explained that his remarks about low ends must have been misunderstood, for he did not desire to say more than that he was not an admirer of low ends, but he quite agreed with Sir Spencer that the low ends of the *Bessemer* had contributed to her longitudinal steadiness. The Earl of Lauderdale described himself as one of the "old school" who did not like low ends, but he did not regard them as being out of place in the *Bessemer*. There was one danger about them, however, and that was that some persons might be tempted to get on them while the ship was travelling. If they did they would never be seen again.—*Times*.

FURNITURE.

A special Exhibition of Furniture has just been opened by the Right Honourable the Viscount Sandon, M.P., at the City and Spitalfields School of Art, Skinner-street, Bishopsgate. Contributions of ancient furniture have been sent from the Kensington Museum, and these are supplemented by specimens lent by some well-known London furniture makers and others. The inaugural ceremony took place on Monday evening, the 22nd inst., Lord Sandon in the chair, when the following paper upon the "Contrasts between Ancient and Modern Furniture," was read by Mr. Alan Cole, of the Science and Art Department:—

The work of tracing the history of furniture manufacture, and of bringing forward the contrasts which exist between the productions of various epochs, has already occupied the time and attention of many authors, whose numerous volumes sufficiently prove how comprehensive a subject is furniture. Very recently a large octavo book, containing 241 pages of introduction, and over 400 pages of descriptive matter, has been written by Mr. J. H. Pollen, and published by the Science and Art Department; and this volume refers to the collection of furniture at the South Kensington Museum. It would take me many hours to read this volume to you, and when I had finished I should have been only informing you about a limited section of furniture. You may therefore readily imagine that the notes which I propose now to submit to you, and which are intended to apply to furniture generally, must necessarily be of a brief character, and occupy but comparatively few minutes in delivery.

To find the origin of the first furniture ever produced would involve the consideration of profound ethnological questions, and even then the result might not be satisfactory or sufficient to justify the research. As I am in no way prepared to propound or to answer questions on ethnology, I will commence by asking you to take for granted, as an obvious fact, that from the very earliest times furniture of some kind, whether it may have been a rude stool or table, has been made by man to conduce to his comfort.

The oldest nations of which we have traditions or

records used furniture. The Egyptians, some thousands of years before Christ, were a people practising many of the arts in common use with us now. They had chairs and couches, of which the forms have been used in the manufacture of furniture from their time to this. That the oldest Hindu races were acquainted with furniture, such as cushioned seats, is evident from the Bhuddist bas-reliefs, in which indications of such articles appear. On the Sanchi Tope Gateway, of which there is a reproduction in the South Kensington Museum, may be seen representations of the customs and articles of dress and use which were common to the Bhuddists. And although this interesting monument of Bhuddist art dates from the commencement of the Christian era, there can be no doubt that the representations carved upon it, which I have just mentioned, are those not merely of what was in vogue at the time of the actual carving and erection of the gateway, but are records of customs which existed many hundreds of years previously. The Bible records the skill of the Hebrews in producing all kinds of artistic works, and there is notably mention of one man, Bezaleel, the son of Uri, whose mission it was "to devise cunning works, to work in gold and in silver and in brass, and in cutting of stones to set them, and in carving of timber to work in all manner of workmanship."—(31st chap. Exodus, 2 to 11 verse.) He and Aholiab produced the magnificent works which are minutely described in Exodus, for the service of the sanctuary. These works are spoken of as the "furniture of the tabernacle," and the date ascribed to them is nearly 1,500 B.C. Later on, about 800 years before Christ, we find, in the 10th verse of the 4th chapter of the 2nd Book of Kings, a detailed account of furniture, consisting of a "bed and a table, and a stool and a candlestick," all of which were provided by the Shunammite woman for Elisha.

Of the furniture made some two or three hundred years later, we have at the present time specimens which are deposited in the British Museum. I refer to the representations of Greek chairs, which Mr. Pollen states to have been made of wood. About the fourth or fifth century B.C., it would appear that the Grecians produced a variety of furniture. The pedestals upon which the table tops were placed were constructed generally of metal and were so contrived as to fold up. The Romans followed in the footsteps of the Greeks. Costly materials were used, such as gold and silver, and other metals, ivory, and all kinds of wood, marbles, rich embroideries, and furs.

Many of you are well aware that the domestic arrangements of Roman houses differed from those of houses of the present day. The Roman rooms were spacious and few. Instead of suites of drawing-rooms, dining-rooms, libraries, morning-rooms, such as are to be found in the majority of houses now used by the richer classes, the Roman householder had one large room, in which he chiefly lived. At his meals he lay upon a kind of triple couch, carved in stone or marble, and covered with rich embroideries and soft textile fabrics. These triple couches were used in a hall or room called the *triclinium*, and this term is sometimes applied to these triple couches. They were arranged around a pedestal, which was, like the Grecian prototypes, generally of a portable character. Upon this pedestal was placed a slab, or *abacus*, which was already spread with the food and necessary eating utensils. The different courses of a meal were served upon different slabs or *abaci*, and when the meal was finished the pedestal was removed, and the guests remained reclining upon their *triclinia*, whilst the entertainment which succeeded the meal might follow. Thus this style of life is exactly the reverse of what now takes place. As soon as a meal is finished the occupants of the eating-room are glad to leave it, and go into another altogether. By removing themselves they get rid of the necessity of removing, as the Romans did, the furniture. Here, then, I think a fairly strong contrast may be traced between ancient furniture and modern furniture. Our furniture is made for special use in the room in which it is placed, and for which there are particular purposes. The ancient furniture was more or less portable, and drawing-room and dining-room and bed-room furniture were all used in one room. The fashion to have a great number of small and special rooms for special purposes is of comparatively late date. Up to Mediæval times the influence of those customs, which the Romans introduced into the northern countries of Europe, still remained. The houses consisted of a far less number of individual rooms than at present. The furniture to be used in such circumstances was, as I have already pointed out, of a portable character. The mode of manufacture and style of ornament differed from those of the Romans, and with the advancement of civilisation, the habits of nations and the articles of their domestic use gradually changed.

To return, however, to the classical period. As an example of the design and finish of early Roman furniture, a *fac-simile* copy of a magisterial chair or bisellium is exhibited. The original was discovered in the course of the Pompeian excavations, and with many other articles of antique furniture is preserved in the Museo Borbonico, at Naples. By permission of the authorities, Signor Castellani has produced reproductions of these interesting objects. Students of Roman history, and, indeed, all who are interested in the history and art of the foremost nation of ancient times, have now the means, without making a long journey, of studying Roman furniture in a more complete manner than previously. Such reproductions, with the fine collection of utensils, articles of domestic use, &c., at the British Museum, form an encyclopædia of information more attractive, and I venture to think more instructive, than pages of letter-press and engravings.

After the work of the classical period comes Byzantine work, but of this not very much is known. Certain carved ivory slabs give us indications of chairs which appear to have been made after patterns of the Roman antecedents with the elements of both Greek and Egyptian ornamentation. Many rich articles of use and furniture were made for Charlemagne, who welcomed Byzantine artists to his towns on the Rhine. Hence it is that we find many traces of this kind of art at towns like Strasbourg, Mayence, Cologne, and Aix-la-Chapelle, at which latter place there are many relics of this mighty sovereign.

Near the Pompeian reproduction you will find a cross-legged or *curule* chair, which is a copy of a chair said to have belonged to King Dagobert of France. The original is now in the Bibliothèque Nationale, and by the permission of the late Emperor Napoleon the reproduction now exhibited was made. Dagobert reigned in the seventh century. There is a complete account of this chair by Monsieur Lenormant, in a French work entitled "Mélanges d'Archéologie," who shows that the chair is one of two made, under special circumstances, for Clotaire II., the father of Dagobert. It appears that about the commencement of the seventh century there lived a clever metal-worker and designer, who before he was canonised and became St. Eloi was known as Eligius. In the course of his career he came to Paris, and through the King's Chamberlain brought himself to the notice of King Clotaire. Clotaire desired to have a fine throne of State, and pleased with the accounts of St. Eloi's ability, he commanded him to undertake the making of a gold chair inlaid with precious stones. A large supply of gold was given to St. Eloi for the purpose, and the chair was commenced. But St. Eloi found it necessary to mix an alloy with the gold, and so obtain a material more convenient to work than pure and soft gold. The consequence was that his store of gold was more than sufficient for one chair. Accordingly, when his first commission was executed, he made a second chair, in order to use up the whole of the gold supplied to him. At the appointed time he took his jewelled chair to the King, who was overcome with

pleasure and admiration at the sight of so magnificent a work. St. Eloi explained how he had made it, and show that the gold which the King had given to him had been more than sufficient for the purpose, adding, "in order not to waste what remained of the gold I used to make this second chair," which he then uncovered and displayed to the King. The chair was of bronze, richly gilt with the overplus of gold. Now, this second chair is that which at present exists in the Bibliothèque Nationale in Paris. It was used by Dagobert when he ascended to the throne of France. Later on it was preserved in the Treasury of St. Denis, near Paris, and in the twelfth century the Abbé Suger, who was renowned for his decorative works in the Abbey of St. Denis, restored certain portions of the chair, the back and upper portions of it. The incident of St. Eloi's economical use of the stock of gold confided to him may possibly be of interest to workmen of the present time. As a link in the history of furniture the chair of Dagobert is undoubtedly of much value.

The Bayeux tapestry, of which you may see a full-sized coloured photographic copy in the South Kensington Museum, has many examples worked into it of various articles of furniture used at the time of the Norman conquest, all of which are interesting records of the adoption in pattern of antecedent furniture. Very richly decorative chairs, tables, and couches were made in the fourteenth century for the use of rich nobles, and I may perhaps mention a table, which was probably made in Spain. It was brought by Don Pedro, of Castile, to Angoulême, and there presented to Edward the Black Prince. Of so great splendour was this table that a troubadour sang its glories in a poem in which it is described as being of gold ornamented with precious stones and pearls from the East. In the centre was a carbuncle so brilliant that it turned the night into day. But even so magnificent a table as this was not quite unique, for a reference to books on furniture will show that it was the custom to produce in the richest manner special works for special personages, just as much as it is now the fashion for patrons of art to stimulate skilled and artistic workmen to devote their talents to the manufacture of beautiful inlaid cabinets and chairs, &c.

Before the influence of the Italian *renaissance* of art had reached England, we possessed a talent for making handsome furniture, although it could not compete with the more costly work of the French and Spanish nations. Portable furniture, similar in idea to the Roman furniture, was in use. Above the seats in big houses, was placed a species of canopy which was connected with the seat itself by a high back. These seats and their canopies were profusely enriched with carvings, as we may easily know by the elaborate stalls and seats which we find in our cathedrals. This kind of pro-[illegible] seat was used in large dining-halls, and was made to accommodate two, three, four, and more persons. From it, there can be no doubt, came the settle, examples of which are extant, and are frequently found in old houses and inns.

The tables of the Mediæval age consisted of removable slabs placed upon folding tressels, very different to the solid tables of the present time. And in the folding tressels and removable top we can recognise a likeness to the antique Greek and Roman tables to which I have referred. Of Gothic furniture we have here one or two specimens from Germany.

About the fifteenth century, Venetian and Italian artists were constantly engaged in designing and making rich furniture. Of this class we have a few specimens, such as carved Venetian and Italian chairs, a pair of bellows, richly decorated with carving; all of which date about 1560. It was not easy to bring here examples of the cumbersome coffers used by Italian ladies to stow away their possessions; I would, therefore, merely mention them as special examples of the 16th century Italian furniture, and refer you to South Kensington, where there are specimens of marriage coffers, or *cassone*, painted, carved, and gilt. There can be no question that artistic work in all its branches was better known and more generally encouraged in Italy than elsewhere. Foreign countries, particularly Italy, certainly seem to have enjoyed an instinctive appreciation of work which was artistic and decorative, and it is not surprising to find that distinguished Italian and Flemish artists were tempted to England to execute commissions for the Sovereign and the rich classes. Henry VII. employed Torregiano, an Italian decorative artist, to make magnificent furniture, and the fashion once set, imitations followed as speedily as circumstances permitted. Torregiano established a kind of *atelier*, and trained students and workmen, who became, more or less, known as proficient carvers, metal workers, and so forth. But this encouragement of foreign art was not sufficient to supersede homely art. At Holyrood there are awkward, but picturesque chairs, which were made for the palace; these contrast curiously with the luxurious folding-arm chairs which abounded in the palaces of the Italian nobles, and of which specimens are exhibited. From Flanders, England imported artistic furniture and invited artists. A fine cabinet, said to be the work of Holbein, is exhibited in the South Kensington Museum, and is well worthy of study, both for its characteristic and picturesque style of design and for its careful workmanship.

The Great Bed of Ware, which was made in Queen Elizabeth's reign, is a remarkable piece of old English wood-carved furniture. At right angles to the head of it a curiously-carved back rises, and above it is a heavy canopy, supported at one end by the back and at the other by two massive pillars which rest on a four-column pedestal; the surfaces of almost all these parts are enriched with carving.

In Spain much fine and characteristic work was produced, and wood-carvers, who, however, paid more attention to ecclesiastical furniture than to domestic furniture, became celebrated; such men, for instance, as Berruguete, Alonso Cano, and others. As an example of the sixteenth-century rough inlaid Spanish furniture, a small cabinet is exhibited. Not far from it is another Spanish cabinet, with pierced iron-work ornaments on the outside. Inside, the work consists of raised ornaments of ivory, panelled in the Moresque style, coloured and gilt after the manner known as "Vargueño," from the village of Varga, in the province of Toledo. The Arabic table, which stands near this Spanish cabinet, is not entirely a genuine work; it is made up of fragments, which were probably used for wall panelling; the legs and framework are modern French. As authentic specimens of 14th century inlaid work, these panels claim attention. The ingenuity of the Moorish and Mohammedan artists in making intricate and effective geometric patterns is well-known.

The Italian carved wood mirror-frame of the 16th century, which you will find in the collection here, is a remarkable specimen. The excellent style of the ornament, and the effective manner in which it is distributed and balanced, cannot fail to strike you. Moreover, the workmanship displays a freedom which strongly contrasts with the mechanical appearance of the wood carving of the present time.

About the 16th century the changes in the use of furniture became more apparent; the articles for use were more numerous, and the rooms in the houses were smaller and more or less appropriated for fixed purposes, as is now the custom.

In France during the succeeding century the taste for artistic articles in furniture was strongly developed, and furniture artists, whose names still live, were numerous in the reigns of Louis XIII. and Louis XIV. One of the foremost is André Boule, who made works of inlaid tortoise-shell and brass, and his cabinets are much prized. Specimens of them, lent by Sir Richard Wallace, can be seen at the Bethnal-green Museum as well as at the

South Kensington Museum. One example of his work, a coffer or box, is here exhibited.

But the man who, more than others, did most to develop art in France is certainly the Minister of Louis XIV., Colbert. To him is due the establishment of all kinds of centres whence issued fine art works. He hired art workmen from Venice, and gave them the means of forming *ateliers*. The influence of their skill soon spread, and a school of decorators, such as Gouthiére, and Reisener, and Martin arose. All these artists were noted for their skill in certain divisions of art applied to furniture, such as delicately-carved metal mouldings, inlaid work, and painted varnished work.

You are all well acquainted with the name of Grinling Gibbons, the wood-carver. About the end of the 17th and commencement of the 18th centuries, he produced many excellent and freely-carved wood works used for household purposes.

In England, in the eighteenth century, painted furniture came into vogue, and artists like Cipriani and Angelica Kauffman painted tables, cabinets, chests of drawers, and such like, examples of which are lent for exhibition by Messrs. Wright and Mansfield. Contemporary with this kind of work were light and dexterously-carved mahogany chairs and tables. These were made, to a large extent by a furniture maker, named Chippendale; he seems to have received much inspiration from Chinese art. Almost all his furniture has some trace of Oriental art, especially in the pierced work with which he used to decorate the legs of his tables and chairs. With the revival of taste for elegant and quaint furniture, the works of Chippendale are much sought after at the present time, and of his work we have one or two specimens, also contributed by Messrs. Wright and Mansfield. Sheraton was another English furniture maker of note, of later date than Chippendale. Specimens of his work, and of carving done by Adam, are shown. Adam revived at the commencement of the present century the taste for classical forms.

The Universal Exhibitions of 1851, 1862, and 1867 have done much good to elevate the taste of people generally. For all these special occasions artistic workmen have striven to produce some works of high character. Some of the more important of these productions have now a home in the South Kensington Museum. And I must apologise for again repeating that those interested in this subject will find advantage in going there. They will then be able to study the handsome sideboard made by Barbetti, of Sienna, for the first Universal Exhibition, namely, that held in 1851, and the wonderfully carved and inlaid cabinet made by Fourdinois for the last French Universal Exhibition, held in Paris in 1867. Without specially mentioning the recent Vienna Exhibition of 1873, you probably know that since 1867 there has been a series of International Exhibitions at South Kensington. They came to a conclusion in 1874. One of the features of them was the allotment of a space, in the galleries devoted to fine art, for the display of works of miscellaneous art. This broad category included everything which had a distinct connection with decorative art. Hence much of the space was occupied by furniture. Some of the specimens of the furniture then shown is lent for exhibition here, and specimens like Messrs. Collinson and Lock's black and red painted buffet cabinet, Messrs. Gillow's, Messrs. Cox's, Messrs. Walker's, and Messrs. Gregory's ornamental furniture sufficiently exemplify the taste and skill which modern furniture-makers find it expedient to devote to making articles for general domestic use. These works bear, indeed, a strong contrast with the comparatively fragile work of Chippendale, with the heavy and richly carved Italian Renaissance chairs and cabinets, with the extinct, but well-authenticated Roman and Grecian furniture. And yet it is a remarkable fact that, while so great a variety of form and proportion and decoration exists when these kind of works are considered side by side, the chair of the present time retains all the essential features not only of the chair of the Greeks but also of that of the Egyptians.

Examples of chairs, tables, &c., made in this district of Spitalfields, will have an especial interest on the present occasion. From Spitalfields comes much of the be[illegible] furniture manufactured, and used not only in London b[illegible] also throughout England. It has been suggested tha[illegible] exhibitions like the present might be recurrent and re-presentative of the manufactures of the district. Th[illegible] present collection should perhaps be regarded as in-augural of a series of displays where articles of loca[illegible] production should predominate. To the manufacturer[illegible] and students of the School of Arts such exhibitions woul[illegible] undoubtedly be useful.

At the commencement of my paper I asked leave t[illegible] point out the difficulty which I think exists of doin[illegible] justice in a brief time to so large a subject as furnitur[illegible] and I trust that you will quite agree with me that I di[illegible] not overrate that difficulty. Considered from vario[illegible] aspects, the subject would supply matter for numero[illegible] lectures, and I must plead my inability to attempt [illegible] cope with it other than in the most superficial a[illegible] general manner. I am well aware that I have not touche[illegible] upon the technical and mechanical sides of the subje[illegible] These are questions which involve a wide acquaint-ance with the methods of manipulating all kinds [illegible] material, such as woods, metals, marbles, precio[illegible] stones, satins, silks, and embroidered stuffs, all of whic[illegible] are suitable for use in the production of furniture. Th[illegible] there are questions relating to styles of art, whether [illegible] should be Egyptian, Classical, Byzantine, Mediæva[illegible] Renaissance, Rococo, or adaptions of Oriental ide[illegible] Hence it will be seen how extensive must be the infor-mation and acquirements of anyone who professes [illegible] be well acquainted with the subject of furniture. [illegible] must, therefore, ask you to regard the notes I hav[illegible] had the honour of reading to you as a mere outli[illegible] sketch of a few points in the history of furnitu[illegible] making, and if they become the means of adding [illegible] interest to the display of the objects arranged around th[illegible] room, I shall feel more than rewarded for the hazardo[illegible] task which, at the invitation of the Chairman of th[illegible] School of Art, I ventured to attempt.

INSTITUTION OF NAVAL ARCHITECTS.

The annual session of this institution was held [illegible] Thursday, Friday, and Saturday last, at the House of th[illegible] Society of Arts. The following were the papers read:—

Thursday.—Morning meeting:—1. Mr. John Sco[illegible] Russell, F.R.S., "Imperial Legislation as it affects Nav[illegible] Construction and the English Merchant Navy." 2. M[illegible] W. W. Rundell, "The Load-draught of Steamers." [illegible] Mr. C. Davidson, F.R.S., "Freeboard." 4. Mr. C. W[illegible] Merrifield, F.R.S., "The Telegraph Ship *Faraday*[illegible] Evening Meeting:—1. Mr. W. W. Rundell, "A Mo[illegible] of Obtaining the Outlines of Sea Waves in Deep Water[illegible] 2. Mr. W. Froude, F.R.S., "The Graphic Integrati[illegible] of the Equation of a Ship's Rolling, including the Effe[illegible] of Resistance." 3. Mr. B. Tower, "A Method of obtain-ing Motive Power from Wave Motion." 4. Mr. Joh[illegible] McFarlane Gray, "Notes on Polar Diagrams of Stability[illegible] &c." 5. Mr. R. Sennett, "Compound Engines."

Friday.—Morning Meeting:—1. Mr. John Scott Russell, F.R.S., "The Duties, Qualities, and Structure of the Modern Man-of-War." 2. Mr. Nathaniel Barnaby, "Iron and Steel for Shipbuilding Purposes[illegible] 3. Mr. John Scott Russell, F.R.S., "The Requisites [illegible] New Naval Guns and Gun Carriages." 4. Mr. A[illegible] Sedgwick Woolley, "Torpedo Steam Launches." [illegible] Right Hon. Viscount Bury, "A New Binnacle Indica-tor." 6. Mr. W. Fleming, "The Rig of Ships." [illegible] Mr. W. Forbes, "The Rig of Ships." Evening Meet-ing:—1. Mr. W. M. Fenning, "The Proper Relatio[illegible] which should exist between Ship-builders, Ship-owner[illegible]

and Ship Insurers." 2. Mr. B. Charles Stephenson, "Seaworthiness and Insurance." 3. Mr. J. Wigham Richardson, "The Strains and Strengths of Ships."

Saturday.—Morning Meeting:—1. Mr. E. J. Reed, "The *Bessemer* Steamship." 2. Mr. F. C. Coxhead, "Hydraulic Gear for Watertight doors." 3. Mr. G. W. Sly, "Apparatus for Cleaning Bilge Pumps." 4. Mr. Charles Hemje, "A New Centre-board Yacht." 5. Mr. Edward Jackson, "A New Base for the Form of Vessels." 6. Mr. A. B. Cruikshank, "Safety Cleats." Mr. F. Sammerson, "An Improved Water Gauge Fitting for Marine Boilers."

TUSSAH SILK-WORM.

The most important and most widely-distributed of the wild silk-producers of India is the tussah. This insect is found in the sub-Himalayan tracts, almost throughout the extent of the range; through the hills, from Assam to Chittagong; in the Soonderbuns; everywhere in the great belt of hill and forest inhabited by the sontal, the kol, the khond, and the gond; in the Western ghats; and in portions of the Madras Presidency. In Upper Assam and the Punjab the tussah is found, but not utilised as a fibre producer. In the former province it is known as the katkuri. In the Punjab, the cocoons, from their extreme toughness, are cut into strips, and used to bind the stocks of match-locks. In Bombay and Madras, though found, the tussah does not seem to be utilised, except in the jungles of Ganjam.

The fullest account of the method of rearing the worms is given by Captain Brooke, Deputy-Commissioner of Chota Nagpore. In this locality, he states, the nucleus of no inconsiderable trade now exists, and only awaits the stimulus of high prices. The primary question, whether the product is or may become of such value as to occasion a large demand, is one that more nearly concerns traders than Indian administrations; still, so convinced is the Deputy-Commissioner of the value and beauty of the fabric that can be woven from well-reeled tussah, that he ventures to urge strongly upon the Government the advantage of introducing it to the markets of Europe. In the months of May and June, wood-cutters and graziers find the wild cocoons on the leaves of the saj, lendeya, and *dhoura* trees. These they collect and sell to the rearers at the rate of four cowries for a small, and eight or ten cowries for each large cocoon. The small cocoons nearly always yield male moths, the larger female; the rule, however, is not without exception, although it generally holds good. When the moths have cut their way through the cocoons, the males and females are placed together, and allowed to remain so for nine or ten hours. They are then separated, and the wings of the female broken off. Accepting this process as a hint that she is not to leave the place, she begins at once to deposit her ova, the larger and healthier insects continuing to lay for about twelve hours. The eggs are then tied up in pieces of cloth, which are carefully opened on the same day in the ensuing week. The rearers have ready little sacks made from one or two leaves of the *tendoo*, which are apparently chosen for their toughness. In each of these packets, as soon as the worms begin to appear, which happens usually on the ninth day, from 80 to 100 eggs are placed, and the tendoo-leaf sacks are then fastened to *lendeya* trees, upon the leaves of which the insects begin at once to feed. In a few days they are removed to *saj* trees, and are changed about according as they require fresh food. During the feeding time the greatest care is necessary to preserve the worms from being destroyed by birds and ants.

The rearing of the worms is attended by many ceremonial observances, which begin when the insect leaves the egg, and are not discontinued until the cocoons are gathered and taken to the rearer's house. During the feeding of the worms, the Dhéemurs—the principal caste engaged—lead lives of the strictest abstinence. None of the female sex are allowed within a considerable distance of the trees upon which the worms are feeding; and if by chance a woman or impure man passes the feeding grounds, the trees and worms are sprinkled, in the name of the god Togni, with water taken, if procurable, from a running stream, and in which tulsi leaves have been steeped. During the same period the Dhéemurs carefully abstain from flesh, fish, or haldi as their food, nor do they cut their hair or shave, and carefully deny themselves all ablution. When the cocoons are all formed, they are collected into a heap, and a goat, pig, or fowl is sacrificed to Togni, the blood is sprinkled over the cocoons, and they are after this taken home. On the third day following, the Dhéemurs shave and resume their normal condition. When the crop is gathered, the members of the weaving caste visit the villages and buy the cocoons from the rearers. They are then, as soon as practicable, boiled in a lye made from the ashes of fungi stalks, a plant grown for the oil expressed from its seed. This process effectually kills the chrysalis, at the same time dissolving the mucilage of the cocoon. The cocoons are then stored for use.

The method of reeling is primitive in the extreme, and to its imperfections may be attributed the scant attention this valuable and very beautiful silk has hitherto received. The description given of the process is as follows:—The spinner, always a woman, sits on the ground; on her left is an earthen vessel, with a thickish rim, about six inches in diameter and three deep. The saucer is three parts filled with a mixture of potash and ashes, patted down to a level surface, and kept damp with water. Upon this the cocoons to be spun are placed, the outer portion, of inferior and nearly useless silk, having been first removed. The thread in ordinary use among the weavers is spun from seven cocoons; these are all placed at the same time in an earthern saucer, a filament is then taken up from each cocoon, and these are brought together and rolled between the hand and left thigh of the spinner, which are kept damp by an acid solution of tamarind and water. Here the first imperfection creeps in, the spinners not being careful to prevent an unequal number of fibres coming off the same kernel, and the result is an uneven spinning, which greatly detracts from the beauty of the silk. In the right hand is the *natwa*, a small roughly made triangle of wood, with a thin handle passing from the apex through the hypothenuse. The silk passing from the left thigh of the spinner is wound round the arrow head of the *natwa*. When a thousand cocoons are reeled off, the silk, now known as tussah, is slipped off the point of the *natwa* and placed on the *parti*. This is simply a rod with two cross pieces of wood, the extremities of the cross pieces and the upright being connected by stays of soft wood. When on the *natwa*, the silk is in a state of tension, but in the *parti* it is relaxed and easily wound off. When on the *parti*, the silk is known as *ori*. From the *parti* the *ori* is passed by a *punera*, or hollow stick about 2½ inches long, the object of which is to prevent the silk being injured by the hand, on to the *jatir* to prepare it for the loom; the process now differs in no way from ordinary weaving. In the mixed fabrics of cotton and tussah manufacture in the district, the silk always forms the *puria*, *i.e.*, warp of the piece, the *binari*, woof or breadth, being cotton. The warp and woof are also known as *tana* and *bana*. When in the loom, the silk again changes its name from *ori* to *nar*.

The method of reeling, though extremely simple, is ill-calculated to bring out the latent gloss and beauty of the fibre. The natural colour of the silk is a light brown, and often, notwithstanding its imperfect treatment, it exhibits a richness and depth of colour quite its own. The outer covering of the cocoon, consisting of inferior silk, removed by the weavers, before spinning of the true tussah, is not lost, but sold to another class of weavers. The silk bracelets and armlets

worn by all classes among the Hindoos in the month of Sawan, at the feast of *rakhi bundun*, are made from this refuse. Its value, however, is very small, being sold for one rupee per seer. It is mentioned as an interesting fact that the perforated cocoons of the tussah that is, the cocoons from which the moths have escaped—are quite capable of being reeled off, and a large loss of silk is thus obviated. No weaver rejects a cocoon simply because the moth has eaten its way through it. It sometimes, though rarely, happens that the perforated cocoon will reel off without a break, but, as a rule, the filament has to be joined several times. If the junction is neatly effected, and confined to a single fibre, it can hardly be detected, and judging from the appearance of reeled silk, its value would not be seriously effected even in a European market.

THE CULTIVATION OF OPIUM AND CINCHONA IN INDIA.

A great deal of valuable information on the products of India is contained in a recent report on the progress and condition of our Eastern Empire. The importance of opium as a source of revenue has long been an acknowledged fact. Cinchona barks, on the other hand, have, until a comparatively recent period, been only an experiment, though at the present time the cultivation of these trees has got far beyond this stage. So much has been said by different writers on the culture, preparation, and value of opium that it would seem as if nothing more could be said; nevertheless, there are many interesting facts contained in this report which are worth a wider diffusion than that usually accorded to a Government blue-book. The gross revenue upon Bengal opium for the year 1872-73 amounted to £6,069,793. The number of chests sold in that year was 42,675. Government exercises a strict supervision over the poppy cultivation, no one being allowed to grow the plant except on Government account, and the manufacture is conducted at two separate agencies, Patna for Bahar, and Ghazepoor for the North-West Provinces and Oudh. For the Bahar agency 330,925 acres are under poppy cultivation, and 229,430 for Benares. The poppy requires a high state of cultivation, the land has to be specially attended to and carefully manured; nevertheless, of late years the plants have suffered from blight. For the purpose of observing the conditions of this blight, Mr. Scott, the curator of the Calcutta Botanic Garden, was deputed, soon after its outbreak, to proceed to the localities where it had appeared, to work two seed gardens of his own, and watch the blight through all its phases, and he has also under his charge several small experimental gardens at the sub-agencies. Successful trials have been made of the effect of interchanges of seeds between the sister agencies of Bahar and Benares; but the trials of Persian and Malwa seeds have resulted in failure.

With regard to Malwa opium, which is free grown, and has consequently a heavy duty imposed upon it to bring it on an equality with the produce of Bahar and Benares, it is stated that the quantity exported from Bombay, which is its sole legal port of export, amounted during the official year 1872-73 to 42,401 chests.

Turning to cinchona we find a good deal of matter already familiar to us; but when we remember that it is only within the last fifteen years that the cinchona plants have been known at all in India, it is surprising to see the facts of their numbers and distribution as here recorded, and the facts are more surprising when we consider that the plants had never before been in a state of cultivation. It was an experiment in the truest sense of the word; the result, however, has been highly satisfactory, and the total expenditure it is stated "has been under £70,000." In the Government plantations on the Neilgherries alone there are at the present time some 2,645,373 plants, covering an area of 350 acres. A private plantation at Balmadies, consisting in 1866, when it was first formed, of 31 acres, was extended in 1868 to 60 acres, and has now a fine crop of splendid trees. A large crop of fine bark was procured from them last year, which was sent to London, and realised good prices. Two other plantations, covering together some 1,000 acres, are reported as being in a thriving condition, besides which are many other smaller ones, in all of which the plants are thriving. At Mercara, in Coorg, there is a small plantation which is about to be extended, and on the Barbabuden hills, in Mysore, there is another plantation containing 24,000 trees. At the well-known plantations at Rungbee, 2,000 acres are under cinchona cultivation. Bark from this plantation has been seen in the London market, and has realised prices ranging to 1s. 3d. per lb. Besides these various plantations the cinchonas have also been taken into British Burmah, and planted at an elevation of about 3,700 feet above the sea; in one plantation between 300 and 400 plants are now fairly established. The well-known trees are said to "cover the slopes of the mountains which overhang Wynaad, and line the hill-sides almost to the peak of Dodabetta. The tallest tree is now 36 feet high, and 28 inches round the stem. The amount of green bark supplied to the quinine manufactory on the plantations during 1873 was 91,773 lbs., from which Mr. Broughton, the quinologist, manufactures a febrifuge alkaloid at 1½ rupees per ounce, which is supplied to the medical stores. Thousands of fever patients are thus annually cured. In November 1873, the sale of 25,000 lbs. of Neilgherry cinchona bark belonging to the Government took place in the London market, and realized £3,490, the average price secured being 2s. 10d. per lb.; while one parcel was sold at the very unusual price of 5s. 9d. per lb. If this average is applied to the 91,773 lbs. used in the manufactory in India, it will place its value at £13,000. This makes the annual income of the plantations about £16,500, which will increase in future years."

Mr. Wood, who it will be remembered was appointed to the post of quinologist in 1873, has, it is stated, already manufactured a cheap form of the alkaloid, taking his supply of alkali from the ashes of the *Artemisia*, which grows in abundance on the Sikkim mountains, and is very rich in potash. The great problem to solve is said to be the discovery of "the cheapest form in which an efficient febrifuge can be manufactured from the bark; and there is every reason to expect that valuable results may be announced from Mr. Wood's labours."—*Pharmaceutical Journal.*

The marine tonnage of the several cities of the United States is given by the reports just published at Washington, as follows:—New York, 1,012,745; Philadelphia, 363,542; Boston, 274,941; Bath, 125,915; San Francisco, 124,065; Buffalo, 100,819; St. Louis, 121,[illegible]; Baltimore, 121,187; Oswego, 112,875; Pittsburgh, 103,8[illegible]; Chicago, 85,971; Waldoboro, 100,643. The tonnage of the lakes is 758,838, and that of the western rivers 373,464.

The fruit trade from the Azores to Great Britain continues to be steadily prosecuted. The value of the exports will be considerably augmented in a few years, by the large number of pine-apples shipped to England, as the cultivation of this fruit has been much developed during the last two or three years. The attention of proprietors has also been turned to bananas, which are now being exported on a larger scale.

Packing-papers and paste-boards up to three-fourths of an inch in thickness are manufactured from a description of moss (*sphagnum*) of which there is a bed four square German miles in extent, at Zehlaubruch, near Konigsberg, in East Prussia. The paper is reported to be strong, and to be well adapted for packing, for bookbinding, &c.

The Japanese are about to do something with the petroleum in their country, and a delegation accompanied by interpreters have been making a tour of inspection among the Pennsylvania oil wells. They have purchased an outfit of boilers, engines, &c., for sinking, to be shipped to Japan.

WOOD INDUSTRIES IN SWITZERLAND.

Amongst the replies to an inquiry made by Earl Derby respecting the forests and timber productions of different countries, appear some observations by Mr. Jenner upon the wood-carving of the Bernese Oberland. This industry, which does not date further back than 1816, now furnishes remunerative employment for upwards of 2,000 workmen, and within the last few years the sales have risen from £40,000 to nearly double that amount. These are not, absolutely speaking, large sums, but still they have sufficed to spread ease over districts the inhabitants of which, before the introduction of this industry, were pinched by want, and that, too, by supplying work of such a nature that it does not interfere with many other avocations. The cowherd and the shepherd tending their flocks in the Alpine pasturages, the charcoal-burner watching his fires, and the peasant families sitting round their stools during the long winter evenings, can, at the expense of but little physical exertion, add greatly to their store of comforts by means of some little skill in carving. A very large proportion of the cheaper articles are actually produced in this manner. Almost every variety of timber may be utilised; for lime, walnut, oak, pear, and apple trees have all their special applications, and of late years the most renowned makers have taken to carve "palissandre," or rosewood, mahogany, cedar, &c.

The peculiar characteristic of the Swiss carving is undoubtedly that it aims at combining, on all occasions, the useful with the agreeable. Nearly every object is meant to serve the double purpose of an ornament and an article of furniture. At the Vienna Exhibition great progress was especially observed in the branch of wood-carving which is concerned with the representation of Alpine animals, both wild and domestic, whilst, on the other hand, the figures of men and women exhibited their usual uncouth stiffness and grotesque attitudes. Side by side with the wood-carving industry, but greatly surpassing it in pecuniary results, is the manufactory of parquets, which is of still more recent introduction. This trade is carried on in eighteen out of the twenty-two cantons of Switzerland, and is now in the most flourishing condition. It may fairly be said that hardly a Swiss house, with any pretensions to comfort, is now built without a parquet in one at least of its rooms. In respect to neatness, durability, solidity, elegance, and cheapness, the use of machinery has certainly enabled the makers to achieve wonders. The favourite woods are walnut, pear, plum, cherry, maple, lime, and fir, and fine foreign woods are gradually being introduced. The diversity in the patterns is something really astonishing when the low rates obtaining are taken into consideration. The largest factory is that at Interlaken, which was founded in 1851, and has employed upwards of 100 workmen for the last fifteen years. It is fitted up with every kind of machinery, and is capable of turning out about 15,000 square feet of parquets per diem, or between 5,000,000 and 6,000,000 square feet per annum.

The occupation of wood-carving is of considerable value as affording training for other trades. The Oberland child, brought up in the midst of an unceasing school of modelling and design, acquires special qualifications for making a first-rate carpenter, locksmith, engraver, stone-cutter, decorative painter, architect, &c. For this reason Mr. Jenner suggests that the introduction of wood-carving into the Board schools of London might not be unattended with beneficial effects, and that none the less because the extra expense incurred for the instruction of the children ought to be repaid by their earnings after the system has been a few years in existence. The intuitive love of every Anglo-Saxon boy for cutting up wood with a knife, which usually takes the form of boat-making in England, he thinks might be easily turned to account in imparting the elements of the art. As wood-carving on a large scale is greatly facilitated by the use of various kinds of machinery, it might be possible, when the system had reached a riper development, to add a certain amount of mechanical knowledge to the other acquirements of the frequenters of public schools. As a branch of foreign labour wood-carving would appear to be quite unexceptionable, economically speaking, in England. It need encroach upon no existing industry, and would have little to fear from competition for some years to come, thus being secure of two of the first essentials for the labour of criminals, non-interference with honest labour, and a free field for a sufficient time to make the system work in regular routine. The country might thus by degrees be endowed with a new branch of industry, for which, owing to our great mechanical skill, and the especial facilities we possess for procuring the most beautiful and the rarest woods at comparatively low rates, Great Britain would appear to be peculiarly fitted. It is hardly too much to say that what the zeal of one man, Christian Fischer, of Brianz, was able to achieve for the benefit of his fellow citizens of the Oberland in 1816, is not beyond the powers of the thousands of highly-qualified gentlemen who are striving to advance the cause of education in England. At all events, as Mr. Jenner observes, there would be but little harm in trying the experiment in one of the reformatories or prisons.

CORRESPONDENCE.

ENDOWMENT FUND.

SIR,—It must be gratifying to the Council to find that the members are responding to its request for contributions to an Endowment Fund for our Society. I have read the list published in the last *Journal*, and write to ask if it would not be possible to form a committee from among the members at large to aid the carrying out of so desirable and urgent an object. It appears to me that the work of the Society, instituted by the Council and carried out by its officers, may well challenge comparison in point of extent, varied character, and public utility, with that of any existing Society either in England or throughout Europe. The Council ask for increased support to enable it to carry to completion what it it has so ably begun, and I cannot doubt that many members would be found willing to aid the Council in collecting the funds necessary to meet the heavy and greatly increased expenditure which the present action of the Society must necessitate.

A personal canvass of the members, and a few words of explanation given to some of our merchant princes, would, I feel sure, result in large contributions to the fund, and possibly a Sir Joseph Whitworth might be found among the long list of members, who would be willing to come forward and place our Society in a position of permanence, and thus earn for himself the name of benefactor. The work originated in the Society is daily attracting more and more attention. Endowments are being asked for, and in several instances have been obtained by other institutions for the carrying out of the work inaugurated by the Society of Arts; but the parent Society is still left to struggle on, dependent for its existence upon annual subscriptions alone. Without such a fund as is asked for the first commercial crisis may deprive it of its means of usefulness. America has just established a Society of Arts in New York, Australia has institutions with like objects to ours, and many of the Societies existing, both at home and in the British possessions, owe their existence to work done in years past within the Society itself. Surely the present institution, which has been, and still is, the instrument of so much good, should not be allowed to stand in jeopardy for want of a sufficient fund at its back to insure permanent

and vigorous action under the most adverse circumstances.

Hoping that the above suggestion may be thought worthy of consideration, and that members will be willing to come forward and co-operate in so good a cause,—I am, &c., T. W. S.

THE ROMAN v. THE INDIAN ALPHABETS.

SIR,—It is with the greatest pleasure that I take up the challenge addressed to me by Mr. Drew, though not so much with the view of combating his opinions as in order to throw light on the merits and defects of his scheme. Everything connected with Indian reforms requires ventilation, and so far encouragement, but nowhere is the hasty adoption or rejection of a proposal more to be deprecated than in connection with a country, whose highest authorities have the most divergent views even regarding the premisses of every political, educational, or commercial Indian question. Both Mr. Drew and myself wish to bring enlightenment to the masses, but whereas he considers the introduction of the Roman alphabet as the most effective means, I attach little importance to it, but find the panacea for the existing evil of ignorance in the development of the vernaculars through their legitimate sources, the Persian, Arabic, and Sanskrit, and in the co-operation of those very classes whose Oriental learning and consequent influence has been ignored under our present system.

In the province (the Punjab), with which I am connected, about 62,000 pupils read in Government Institutions, and about 18,000 in schools more or less aided by Government. Altogether, about 10,000 read English, and the rest the vernaculars. The population of the Punjab is nearly 18 millions. About one in 200 is under that kind of instruction of which our educational department takes any cognisance. On these 90,000 pupils about £1,000,000 is expended per annum.

Whilst, however, less than 100,000 are known to come under instruction, there are many hundred thousands whom our system ignores. These learn, if Mohammedans, Arabic and Persian, and, if Hindus, Sanskrit, for religious purposes. Besides these, there are the traders, shawl-weavers, bankers, and others, who learn a peculiar kind of cyphering traditional to their occupation. The Sikhs learn Gurmukhi, the character in which their sacred books are written, but Mr. Drew overrates the extent to which this character is known, and underrates the spread of the Perso-Arabic character. Of ten persons who can read and write, one may be able to write English, one Gurmukhi, Kaeti, or any of the less important alphabets referred to by Mr. Drew, three Hindi or Sanskrit, and five Perso-Arabic, whilst of the remaining half, a large percentage knows the Persian character in addition to its own.

If it be asked, how it is that in spite of our expensive machinery we do not reach the masses, it is because the masses have their own views of education, in which they are strengthened by the priesthood, and the native nobility. Unless, therefore, the wishes and even prejudices of the natural leaders of the people are taken into co-operation, no foreign reform can ever succeed, and our department of "Popular Education" must remain a misnomer.

Supposing, now, that we introduce the Roman character into our schools; there will be every avidity to learn it, because it will be presumed to be a step towards the acquisition of *English*. This desire we shall not be able to satisfy, as we have not enough teachers of English. The result will be the spread of discontent into the villages, which is now chiefly confined to towns. Indeed, as it is, every boy that goes to a Government school, does not do so for the sake of education, for that he believes he gets elsewhere, but because he thinks that he has laid the authorities under some obligation to provide him with an appointment. The class of clerks is already getting too numerous, and whereas a *sufeyd-posh*, or one who has to dress as a gentleman, "in white clothes," can be got for fourteen shillings a month, as a vernacular clerk, as much as £4 has had to be paid recently for a fair carpenter at Lahore.

If, however, the Roman character is to be learnt in conjunction with the vernacular, I would suggest the plan should be tried without much flourish of trumpets, for the slightest accident may give rise to misrepresentation, and class it among the insidious attempts to subvert their religion, with which the natives already credit us. I do not suppose that the Roman character will ever rise to the dignity of the "greased cartridges," but it may fairly inspire the dread of the census, or of the last *tikkus*, the Indianised form for the word "tax," on which, I hope, Sir Charles Trevelyan does not congratulate his followers. As a means of education, the Roman character for the vernacular will simply be laughed at, for there is nothing to read in it. It has hitherto existed in consequence of the books that were written in it being circulated gratuitously, and thus it may continue to retain a limited public. But no one will ever read *Miskin* in the Roman character or even glance at the *Bagh-o-bahár* in it, excepting when teaching Hindustani to an Englishman. Urdu and Hindi will continue to be written in their own character as hitherto. The transliteration of the *Bhagvat* into the Persian characters had not the faintest influence on Hindu literature, or the transmutation of the Nagari character in favour of the characters of Mohammedan conquerors. On the other hand the adaptation of the *Hitopadesa* to Shemitic readers makes the *Kalila-o-Dimna* almost an Arabic classic, thus proving that you must neither translate foreign ideas nor transliterate foreign alphabets, but that, if you wish to succeed, you must adapt all that is of universal application in your own religion, morality, philosophy, and literature, to the native standpoint. Otherwise you only court failure. The Roman character for the Urdu and Hindi will be learnt as a Pigeon-Urdu and Pigeon-Hindi, favoured by the English rulers, but no native will take credit to himself in it either as a scholar or as wishing to influence his countrymen by writing in it. If, however, the Roman character is to be introduced, let it be accompanied by the publication of handbooks enjoining obedience to parents, cleanliness of habits, &c., so as to give something to read in that character that the people can appreciate. Above all, let there be publications in it telling the people how to till their fields, the best times for sowing, &c., and let there be an end of the present useless instruction as to the latitude of Timbuctoo, the politics of the Jews, or the sport with Amaryllis in the shade.

The most practical feature of Mr. Drew's proposal is its recommendation to courts and suitors. It would curb the presumption of scribes, who now know that their depositions cannot be read, as a rule, by their European superiors, but it will not get rid of that class. Nor is that necessary. That class should be utilised as an agency for good, and not be peremptorily put aside, when there is no other to fill its place. Besides, it has its root in the traditions of the people.

The range of the alphabets referred to by Mr. Drew is too wide to be dealt with within the space of a few columns. Having shown that in the province of which he speaks Hindustani is far more universal than he suspects, and that the other characters are strictly limited, I will confine my objections at present to the flaws in his system as regards that vernacular. I am glad to perceive that he not only admits, but invites, the probability of improvements in his system of transliteration. I think that his scheme should be seriously and minutely examined by a sub-committee of the Society, before which also the remarkably ingenious alphabet of his Excellency the Persian Minister may be brought. What we all want is to bring knowledge within the reach of the masses of India—no sensible proposal towards that end should be discouraged—and

Though, as I have already said, I think little of Romanisation, except as a system of transliteration of Indian words for the use of Européans, I think enough of it, respectfully, but earnestly, to urge the consideration of the following proposal:

I think that the Society of Arts would be quite justified, after carefully examining the present faulty system of transliteration and arriving at an authoritative conclusion, to urge, first, the adoption of a proper system by the Indian Government as regards its own publications; and, secondly, the introduction of the Roman character in the vernacular schools in India by the side of the native alphabet, the preparation of useful handbooks in the Roman character and in the vernacular language, and the permission to write petitions and proceedings in law-courts in that character. This will give a fair trial to the view for which Mr. Drew and Sir Charles Trevelyan contend, and would be a practical conclusion of a not unimportant discussion.

It must not be thought that Romanisation has achieved unanimity even in the school of European transliterators. I, for one, consider the rendering of the letter *ain* by an apostrophe as simply absurd. Ain is a consonant which may be read with all the vowels, whilst to represent it with an apostrophe would be tantamount to not reading it at all, or reading it only in one way. The word "Zila" is, *e.g.*, now written by the Romanisers as "Zil," which an ordinary reader will rhyme with "drill," whilst the apostrophe will certainly not render the various vowels in the first syllable of "a'bûr, u'br, and i'brat,", which, by Mr. Drew's system, would be transliterated by "'br, 'br, and 'bret." Nor does Mr. Drew make any provision for the sounds of "ö, ü, eu, oi," which occur in some of the Oriental languages. I do not remember what he gives for the letters "jim," pronounced as in "journal," or for "j," as pronounced in French. All I can say is, that in spite of dots an English reader will read a dotted d, t, r, and s precisely as an undotted one, whilst big and small "Kaf" will be pronounced by him without any guttural distinction. Mr. Drew's gravest fault, however, is that he confounds the accent, as in French, which marks the stress of the voice, with the miserable accents which we have adopted in our system, and which merely show a more open or close pronunciation of the words, whilst their tendency is to confound both quantity and intonation with the inherent nature of the vowel. Accent, however, is not quantity, nor does quantity change the nature of a sound.

When I said that the masses in India revere the Perso-Arabic and the Sanskrit characters, I did not mean that Hindus revered the Arabic and Mohammedans the Sanskrit characters. On the contrary, I repeatedly kept these two antagonistic elements in view, and it was perhaps scarcely fair for Mr. Drew to charge me with the suppression of the whole truth, simply because, for the sake of brevity, I compressed an introductory statement, on which I subsequently enlarged. Everybody knows that Arabic is revered by Mohammedans and Sanskrit by Hindus, and I think I might have been trusted with the possession of that information.

After all, alphabets are conventional renderings of sounds, liable to various pronunciations, even when the same signs are used, as is the case in most countries of Europe, with different nationalities, classes, or periods of literature. No school of transliterators will ever be able to impose their pronunciation on a nation, even when their objects are advanced by that generous gratuitous circulation, to which I have alluded and which has hitherto ensured a limited public for the Romanised publications in India during the last thirty years. Of course, should Government support the system, it will have a certain success, one of whose most pleasant features will be that the "Romanised" natives will write English, the language of their rulers, on the same phonetic plan, to our great consternation, and may return the compliment, which we now pay them, by urging us to "Romanise" English.

The fact is that Persian and Urdu are practically ideological rather than phonetic in their spelling. This also is the case with English. It is by dint of practice that we read "light" as *laït*, just as by practice one reads "Muhammad" in the Persian character, and not "Mihmadu." The *tout-ensemble* of a word recalls its pronunciation to Englishmen as well as to readers of Hindustani. If our officers practised the Shikasta more they would find it just as easy to read as the scrawls of some of their colleagues and superiors.

I wonder why the Romanisers, who have exerted so much ingenuity on their dots, have not thought of the far more easy method of reversing the Roman character whenever they wanted a second value for a sound. Our printers could have at once used the present type for the new purpose without difficulty whatever, whilst a reversed "s" or "r" would have arrested the attention of the reader. Still, all these schemes, like that of using numbers for a universal language, are a waste of talent, for they leave the main points unsettled, which are—"What are the causes of the present state of things? In what precise respect is it desirable to introduce reforms, and will these reforms effect their object?"

The reason why the Roman, Greek, Russian, German, Armenian, and other characters are read with comparative ease, is not because there is any inherent excellence in them, but simply and solely because the letters are *separate*. This allows of the introduction of vowels in the body of the word, and of a variety of artifices in printing calculated to arrest attention. It is thus, that one of the poorest alphabets, the Roman, has become one of the most useful, whilst it is the artistic combination and not the nature of the letters in the far more expressive Persian that has been in the way of the universal spread of knowledge in the countries where that character is used. Lithography will do much for Mohammedan East, but a Perso-Arabic type, such as His Excellency the Persian Ambassador has devised, will develop indigenous and introduce foreign literature in an acceptable and cheap form. Do what we may, our reforms, including the Roman character, will be considered by the masses as an insidious attempt to upset their religion. Learn to consult the natives, and you will strike a mine of intellect and a desire for reform, of whose existence the half-trained European does not dream, when he forces his crude notions on races that have long discussed and dismissed innovations in every branch of human thought and activity, because they had not the mechanical appliances for putting them into practice. Now, as 3,000 years ago, the East is the home of mental discipline, culture, and repose, where genius is as universal as it is ignored, in consequence chiefly of the want of publicity and of easy communication. Without these advantages we should now be behind the Orientals whom we despise. The one intelligent European among a thousand of his dull brethren is able to pass off his views and inventions as the embodiment of the civilisation of his continent. When the East will have a cheap press and railways—provided always it does not seek to slavishly imitate the West in its reforms—it must resume the position which it once held, owing to the native genius of its peoples. To do this, it must give up considering writing as an end, but must merely look on it as a means, of learning. An indigenous alphabet, separate in its letters, will be the first step, and will be the foundation, as His Excellency expects, of a great indigenous civilisation.—I am, &c., G. W. LEITNER.

Principal, Government College, Lahore.

22, Aberdeen-place, N.W.

SIR,—I perfectly agree with Mr. Frederick Drew in his opinion that it is both desirable and practicable *

apply the Roman character to the languages of India—aye, and to all other languages too—but on one condition only, and were that condition satisfied, Dr. Leitner's strictures, many of which are, under existing circumstances, perfectly justifiable, would fall to the ground. That condition is that the Roman alphabet should fit itself for the work. But while it consists of only 26 letters to represent the 48 elementary sounds of the human voice, it is obviously incapable of representing correctly even the languages of Europe, for which it was expressly formed. It must be extended, either by awkward diacritical marks and inconvenient accents, or, according to Mr. Pitman's plan, by the addition of new letters, so that each distinct articulate sound may have one invariable sign to represent it, and one only. Thus extended, it would become a true international alphabet, from which each nation would draw its own special alphabet, only adopting the characters which it required, and rejecting those which represented sounds not existing in its language. Thus the English alphabet would consist of 39 letters, the remaining 9 being excluded; the French would consist of 35, the German of 32, the Italian of 29, &c.

Each nation would, moreover, be enabled to represent accurately even its dialects or vernaculars, as it would still find in the international alphabet the character required, *e.g.*, the Devonshire *u*, the Scotch *ch*, &c.

With such an enriched Roman alphabet, Dr. Leitner, though naturally dissatisfied with our present "poor" one, so inadequate to the work proposed for it, would himself find no difficulty in Romanising not only Hindustani proper, but all the vernaculars likewise.

If Mr. Drew will therefore have the courage to propose an extension of his favourite alphabet, so that it shall contain all that is necessary for the accurate and unmistakable representation of spoken sounds, clearing it at the same time of all redundant forms, such as *c*, *ch*, *ck*, *qu*, *gh* for *k*, he may have a good chance of success. But while he has only an imperfect, anomalous alphabet, both deficient and redundant, to substitute for the time-honoured alphabet of India, I fear the opponents of a most desirable reform will long have the best of the argument.

Should a precedent be required for this extension of the alphabet we can, without going back to the old Greeks, who did not hesitate to add to theirs the new letters they required, or to the Romans who themselves added what were in reality new characters, *æ*, *œ*, we can find a precedent, I say, in the introduction of the letter w. With a precedent even Conservatives can move on.

I have treated this question more fully in the second chapter of the "Essay on the Analogies of Language," *Phonetic Journal* for 1864.—I am, &c.,

Tito Pagliordini.

March 6, 1875.

THE WEST COAST OF AFRICA.

Sir,—My attention has just been drawn to a letter from Mr. David Chinery, jun., in the *Journal of the Society of Arts*, of the 26th ult.

I regret that in my description of the oil rivers I have disappointed him and his friends, who demur to my having given no reliable statistics in support of my statements and opinions.

I reply, that an experience of about seventeen years on that part of the coast, entitles me to make statements and to give opinions; and, further, I have the "temerity" to challenge the whole body of African merchants and agents of experience to deny the facts stated, or to disagree materially with such opinions as I have deduced from them.

In giving a general sketch of the trade, it was impossible to dwell at length upon details of it in any place.

In reply to the accusation that I adopted the descriptions of others, &c., I say that in my preamble I stated that where my own personal experience failed I availed myself of authorities I knew to be authentic. Passing by Mr. Chinery's allusion to "most erroneous statements," on my part, respecting the "constitution and politics" of the republic as irrelevant, no statement upon those points having been made, I will just remark with regard to the "trade," that I am glad to hear that it is improved, and that, if the figures submitted to Mr. Chinery are an approximation to the truth, that Liberian bondholders have reason to congratulate themselves.

My other remarks respecting Liberia are not gathered with assiduous labour from "the hackneyed notions of theoretical and sentimental writers," but from my own observations, and from conversation with some of the best educated and ablest men in the colony, and I maintain that they are substantially correct.

I sincerely hope, with Mr. Chinery, that the "African Section" will succeed in sifting the wheat from the chaff—facts from the expositions of theorists.—I am, &c.,

W. Babington.

8th March, 1875.

INSURANCE.—HAZARDOUS RATES.

Sir,—Will you permit me, through the aid of your valuable *Journal*, to direct the attention of your numerous readers to the important subject of fire insurance, but more particularly to the rate of premiums charged on hazardous trades in this country compared with similar risks abroad. I more particularly allude to the advanced rate levied on pianoforte manufacturers and branches connected therewith, who are seeking a remedy by which they can best obtain full security against fire on economical terms. Some years ago I paid only 5s. per cent. on a portion of my stock and utensils in trade, which rate has been increased in proportion as my business extended, until last year it reached 63s. per cent., since reduced to 52s. 6d., through a considerable outlay to diminish the risk. The same property is insured in other offices at 42s. per cent., which I consider an unreasonable demand, as compared with 8s. per cent. charged in Paris on similar risks. Therefore, London manufacturers, whose average rates are so much higher, naturally inquire why they should be so heavily taxed. The answer is simply this. The London offices are a rich and influential body, most of whom hold their periodical meetings, and have the power to determine whatever rates they please, subject to the reports of their respective surveyors, who naturally make themselves as valuable to their employers as possible, and report unfavourably, on which the offices not unfrequently fix on arbitrary rates "by an arrangement among themselves," deemed by the insured much in excess of what the risk justifies. Hence the growing dissatisfaction expressed by many in the trade, and felt by others who are silent from fear of becoming conspicuous as discontents, and thereby causing displeasure to those who insure them. From my intimate connection with the trade, I know this to be the case, and feel that a more independent expression should be given to a co-operative endeavour to effect a modification of the premiums now charged by the respective offices, and which forms so heavy a dead-weight on this important business. Large fires sometimes occur, by which the insurers sustain heavy losses; but when the premiums paid for many years, previous to the fires, are calculated with interest thereon, the amount has sometimes been found to be in excess of the sum claimed from the offices. The responsibility of renewal notices is another important matter, deserving the fullest consideration, and I should feel obliged if any of your readers will kindly enlighten me as to the responsibility of an office issuing a renewal notice through their agent in the usual form.

The facts are as follows. In September last, I received a renewal notice as usual on two policies; one

for £2,000 at 52s. 6d., £52 10s.; another for £1,000, £26 5s., on stock, &c., in one of my manufactories. I availed myself, as on former occasions, of the fifteen days' grace; meantime the surveyor from the office viewed the premises, and found the alterations I had previously promised to make had been made, but omitting to report to the office these facts up to the 13th of October, I became anxious as to whether I should be allowed a reduction on the 52s. 6d. or not; consequently, at noon on the 13th I conferred with the manager, who kindly consented to accept a deposit of £5 on each policy to hold me secure for fourteen days, "thereby giving me, as an old client, time to effect an insurance elsewhere, in the event of our inability to agree as to rate, after he had received the surveyor's report." For these receipts I left my cheques, which were duly paid by my bankers, and it was not unreasonable for me to express my surprise at receiving on the following morning a letter, dated the 13th, informing me of the surveyor's report, admitting that all the necessary alterations had been made, but at the same time informing me they declined renewing the policy, and that the office would not hold me insured after four o'clock the next day, viz., the 14th instant, the manager also saying I could have my £10 back on returning the receipts given me only an hour or two before. This, I think, was a most discourteous proceeding, the legality of which is questionable.

Pianoforte manufacturers have, for many years past, been alive to a diminution of risk, and at considerable expense reduced the danger of fire, but without any corresponding benefit to themselves, and it is proverbial that the offices always take the benefit thereof, and the stereotyped reply to the insured is, "that they ought to be thankful that a higher premium had not been previously demanded."

Without wishing to trespass too much on your valuable space, I hesitate to conclude before making an inquiry as to compulsory claims in leases, to insure in an office therein mentioned. I have recently found such very oppressive, having had the premium nearly doubled where I have reduced the risk more than half. This is an arbitrary proceeding in my opinion, and one requiring redress, otherwise the offices can "by an arrangement among themselves," on that as on other things, determine on any rate they please, for at present they refuse to allow the insured to seek redress from another office, who might probably view the risk through a more favourable medium. I shall feel obliged if some of your readers will suggest a remedy for these things, which press heavily on trade generally, feeling assured that a continuance of such assessments so disproportionate to the risk, and so inconsistent with the charges made by foreign offices to foreign insurees, which they refuse to extend to English firms, being themselves members of the Fire Insurance Committee, by which combination London pianoforte manufacturers are over-weighted, and less able to compete with foreigners; and it becomes a serious matter whether a combination of such wealthy offices have not already too much influence over the manufacturing industries of this country, and should be viewed as exercising a power beyond the prerogative of a "fire insurance body," having the welfare of their clients in view as well as their own.

I think a disinterested surveyor might be appointed to fix the rate of premium on hazardous risks, who should be paid a percentage on the amounts insured. This, if adopted, would be more equitable and consistent than leaving it solely with the offices, as at present. If [illegible] per cent., with a few centimes for neighbours' risks, is found remunerative in Paris, why should it not be in London? I would suggest that the offices be memorialised through their committee for an immediate reduction in the rates. If they decline, they ought to publish statistics to prove their inability. If unwilling to do either, I would suggest the advisability of the Council of your Society having the whole subject of hazardous risks ventilated by discussion at the earliest opportunity, when I have little doubt important facts will be elicited to redress grievances such as I have endeavoured to prove worthy of your full consideration.—I am, &c., H. BROOKS.

138, Hampstead-road, London, N.W., 10th March, 1875.

CACAO CULTIVATION IN INDIA.

SIR,—Since my letter in the *Journal* of Feb. 19th, I have learned that a few seedlings of Theobroma cacao were planted in the Yerai nearly two years ago. They were sent out from Kew, and hopes are entertained of their success. As benefit would result from such an addition to the resources of the country, may I again ask for a few lines?

The instances of the introduction of cinchona and tea, which have proved great successes, are to the purpose. The former, it is well known, was introduced direct from South America, nor was either sent out from Kew. So much will be found to depend on the choice of the first seedlings, that it appears to me the success that may reasonably be expected will be jeopardised, if it is taken for granted that the cacao seedings from Kew are necessarily of excellent character.

It seems remarkable that in all the colonies which supply this market, the cacao has been introduced from its original habitat (with an important exception—Trinidad), and only the commoner varieties have been grown. In consequence, the cacaos only of Caraccas and Trinidad command good prices, and there is but a limited supply of fine cacao, by no means equal to the demand.

Even in these countries, there is a growing tendency to replace the better by inferior kinds, the "Creole" by the "Forastero." The latter includes some few kinds better than the rest, although none equal to the former. The "Forastero" produces at an earlier age, with less labour, and more productively than the "Creole," but is mostly the inferior, so it is the more desirable to select the better growths only for introduction into India, and not the first that may offer irrespective of quality. The variety to be particularly avoided is the "Calabacillo," which produces the inferior cacao, but as the trees yield a great deal more than the other qualities, many proprietors plant it. It is this "Calabacillo" that persons in London think is unripe cacao, because the beans are hard. You may cure it as long as you like, but the inside always remains hard, though the pods may have been picked perfectly ripe.

Were the Directors of the Botanical Gardens in Bengal to obtain seedlings direct, and choose either the "Creole" or the better kinds of "Forastero" that might be specified, I feel convinced that many would avail themselves of the opportunity of giving cacao culture a fair trial. There may also be inducements, that either the Indian Government or this Society can offer, that would stimulate them to achieve such an important addition to the staples of India.—I am, &c.,

HAHNEMANN EPPS.

Hampstead, March 20th, 1875.

A HINT TO BUILDERS.

SIR,—It is probable that the houses occupied by the middle classes in this country are in no respect so deficient as in the want of box-room and space for the stowage of dry goods. It is equally probable that there is no such source of dust and dirt to be found in our houses as that which accumulates, in the course of years, under the slate roofs of London houses. I venture to think that the defect in construction may be greatly remedied, and the evils arising from dirt be got rid of, if the Sand-blast Company would place in the market a supply of flat-rolled plate-glass of sufficient size and strength to permit of its being used, by either landlords

or tenants, in substitution for broken slates. This could be done if the glass was perforated so as to admit of its being united, as our slates are at present. All that is required is that the holes shall be sufficiently large to admit of expansion and contraction, and as these can be cut rapidly and cheaply by means of the sand-blast, we should then get light in the dark places, and, while the dirt would disappear, we should gain the additional space which would be so eminently useful.—I am, &c.,

F. D.

GENERAL NOTES.

Exhibition of the Sugar Trade at Trieste.—The sugar-boilers of the Austro-Hungarian Empire are organising an exhibition at Trieste for the month of May next, on account of the increased importation of sugar to Italy. This exhibition will present a comprehensive view of the sugar trade in Austria-Hungary. The railway companies have granted reduced rates for the carriage of the exhibits.

Steam as a Fire Extinguisher.—It is well known that numerous experiments have lately been made as to the value of steam for extinguishing fires. Opinions at present vary a good deal on the subject, but there is no doubt that the power of steam to penetrate and reach places inaccessible to a stream of water gives it certain advantages. An apparatus for turning on steam automatically when the heat in a building becomes sufficient to produce electrical contact by acting on a thermometer, and thence through suitable electrical arrangements, has been lately patented by Messrs. Sanderson and Proctor. It is stated that recent experiments with it at Huddersfield have shown it to work with success.

Mohair.—Mohair, or Angora goats' hair, is produced solely in the vilayets of Angora and Kastambol, in Asia Minor. The clip of these districts is estimated at about 30,000 bales, of 1½ cwts. each. An inferior class of goats' hair is grown in Konia, which province yields 2,500 bales of the same weight. Another low class of goats' hair is also produced in the district of Van, where the entire crop is quoted as being 4,000 bales. It is only the superior quality that is sent hither to be classed and shipped to England, its only market. The quantity exported in 1871 was 5,880,000 lbs. weight; in 1872, 4,960,000 lbs.; and in 1873, 5,120,000 lbs.; and the average price obtained in 1873, in England, was 2s. 10d. per lb. The native dealers in this staple are in the habit of wetting the hair to increase its weight before bringing it to market, and this deteriorates it to a considerable extent. Many a time have efforts been made by the merchants to put a stop to this practice, and the Government has also frequently prohibited the custom, but the law has been allowed to remain a dead letter, and the protests of the merchants are unheeded. The mohair would be more valuable to our spinners could it be obtained unwetted, for it would then retain its lustre, and it is the brightness of the staple that enhances its value as a substitute for silk.—*Journal of Applied Science.*

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 31.—"Food Adulteration and the Legislative Enactments Relating Thereto." By WENTWORTH LASCELLES SCOTT, Esq. On this occasion Dr. W. B. CARPENTER, F.R.S., &c., will preside.

APRIL 7.—"Captain Liernur's Improved System of Town Drainage." By ADAM SCOTT, Esq. On this evening THOMAS HAWKSLEY, Esq., will preside.

APRIL 14.—"The Best Method of making Field Experiments practically useful to Agriculturists." By Professor JOHN WRIGHTSON.

APRIL 21.—"The India Museum Question." By Dr. FORBES WATSON.

APRIL 28.—"Horse-shoes and Horse-shoeing." By GEORGE FLEMING, Esq., Veterinary Surgeon, Royal Engineers.

MAY 5.—"The Protection of Buildings from Lightning." By R. J. MANN, Esq., M.D., President of the Meteorological Society.

AFRICAN SECTION.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 30.—"Civilisation and Progress on the Gold Coast of Africa, as affected by European Contact with the Native Inhabitants." By ANDREW SWANZY, Esq.

APRIL 13.—"On the Probable Influence of Railway Construction in Natal upon the Trade, and upon the Civilisation of the Native Races, of the Colony and adjacent Territory." By A. BROWNING, Esq.

INDIAN SECTION.

Friday evenings at eight o'clock, the following arrangements have been made:—

APRIL 2.—"Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India," by ROBERT H. ELLIOT, Esq., Author of "Experiences of a Planter," &c.

APRIL 23.—"The Preparation and Uses of Fibre," by Dr. J. FORBES WATSON.

APRIL 30.—"Indian Manufactures," by E... HELM, Esq., of Manchester.

MAY 14.—"The Russian Advance in Central Asia ... its Commercial, Literary, and Social aspects towards India and the East," by the Rev. JAMES LONG.

CHEMICAL SECTION.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

APRIL 16.—"Recent Advances in Photographic Science," by J. SPILLER, Esq., Vice-President of the Photographic Society. WARREN DE LA RUE, Esq., D.C.L., F.R.S., will preside.

MAY 7.—"Alum Shale and its Application," by SYDNEY RICH, Esq.

MEETINGS FOR THE ENSUING WEEK.

MON. ...Institute of Actuaries, Quadrangle, King's College, W.C.
Birkbeck Scientific Society, Southampton-buildings, W.C., 8 p.m. Mr. R. J. Dawson, "Wood-working Machinery."

TUES. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (African Section.) Mr. Swanzy, "Civilisation and Progress on the Gold Coast of Africa, as Affected by European Contact with the Native Inhabitants."
Chemical, Burlington House, W., 8 p.m. Annual Meeting.

WED. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. L. Scott, "Food Adulteration and the Legislative Enactments Relating thereto."

THURS...Linnean, Burlington House, W., 8 p.m. 1. Dr. ... "The Connection of Vegetable Organisms with Small-pox." 2. Mr. Francis H. Welch, "The Anatomy of two Parasitic Forms of the Family *Tetrarhynchidæ*."
London Institution, Finsbury-circus, E.C., 7 p.m. Dr. Freeman, "History and Use of the English Language."
Chemical, Burlington House, W., 8 p.m. Dr. Gladstone and Alfred Tribe, "The Action of the Copper Zinc Couple on Organic Bodies." No. VIII. "Chloroform, Bromoform, and Iodoform."

FRI. ......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. Robert H. Elliot, "Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India."
Geologists' Association, University College, W.C., 8 p.m.
Archæological Institution, 16, New Burlington-street, W., 4 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,167. Vol. XXIII.

FRIDAY, APRIL 2, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1875, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B. (now Sir Henry Cole, K.C.B.), "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufacturers, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to C. W. Siemens, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

The Council invite members of the Society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

AFRICAN SECTION.

A meeting of this section was held on Tuesday, March 30, Mr. Hyde Clarke in the chair.

The Chairman said—Ladies and Gentlemen, no reference is necessary in any Society where gentlemen are present who are connected with West Africa in order to introduce the name of Mr. Swanzy. Upon us he has certainly strong claims, because from the first existence he has been a willing and zealous supporter of this Section. I now call upon Mr. Swanzy to read his paper.

The paper read was:—

CIVILISATION AND PROGRESS ON THE GOLD COAST OF AFRICA, AS AFFECTED BY EUROPEAN CONTACT WITH THE NATIVE INHABITANTS.

By Andrew Swanzy.

Opinions as to the character and capacity of the Negro races have greatly varied at different periods; for ages they were regarded as fit only for the most servile occupations among strangers, and accordingly we find them borne away from their country by land and sea, to dig and plant that others might reap; the earliest monuments and traditions of the human race bear witness to the duration of their degraded condition, which is even now but partially improved. England may fairly claim the initiative in the change which has, since the commencement of the present century, been effected in this contemptuous notion and its disastrous consequences; and, indeed, vivid sense of past injustice led to senseless partiality in the minds of some of our countrymen; but this feeling has again toned down to a reasonable estimate of the position of the African among mankind.

Even now, able and conscientious men disagree greatly on this subject, for while some consider the African as differing only in education from the European, others hold that the difference between the two is not merely one of acquisitiveness but of development, and that the barrier between them is insurmountable; nor, indeed, do these extreme opinions appear at first sight groundless. From the long intercourse of the African native with the nations of Europe we would expect from him some progress in European arts, and industry and wealth seem naturally to follow commerce, but yet these happy results have not been attained.

I propose to consider this evening the nature of the relations, past and present, of the two races,

and I cannot select, for the scene of this inquiry, a more suitable locality than the Gold Coast, because it was among the parts of tropical Africa first visited, and it has ever since been constantly inhabited by Europeans; the number of forts, nearly twenty, formerly occupied in considerable strength, attest its past importance, while the future of the Gold Coast looks brighter than that of any other district inhabited by the Negro race.

The earliest records of commerce between Europeans and the inhabitants of the Gold Coast date from the latter half of the 14th century. In the year 1366 a company was formed at Rouen with the object of trading in West Africa, and for several years its operations were confined to the coast between Cape Verd and the River Sestos, but in the year 1380 one of the company's vessels, the *Notre Dame de bon Voyage*, reached the coast beyond Cape Three Points, and returned to Dieppe, after an absence of nine months, with a considerable amount of gold, besides other valuable merchandise.

In the year 1382 three vessels left Dieppe for the Gold Coast, and one of them, the *St. Nicholas*, anchored at La Mine, the present Elmina, so called from the quantity of gold procured there. On the return of this vessel, after an absence of ten months, the Rouen Company determined to establish their trade on a firm footing at that place, and in 1383 three more ships were dispatched by them, with materials for building a blockhouse; trade increased, and it became necessary to increase the accommodation for carrying it on, so large magazines and stores were erected, with towers and batteries to protect them, and a church, in part remaining to the present day, replaced the small chapel originally built. The enterprise of the Rouen Company so prosperously begun, dwindled, and finally broke down under the influence of the civil wars which devastated France in the reigns of Charles VI. and Charles VII.; their trade gradually diminished, and died out about the years 1460-70. It is very generally supposed that the Portuguese were the first to discover and to trade with the Gold Coast, and this supposition is supported by many well-known facts, among others, the introduction of many words of Portuguese origin into the language of the natives; and such names as Elmina, Cabo Corso, now Cape Coast, not to speak of more important places to the south of these, sufficiently prove that Portugal was among the earliest and most prominent of nations to come in contact with West Africa; but I can find no record of any expedition to the Gold Coast undertaken by the Portuguese before the year 1465, although I am aware that their great navigators discovered Madeira and the Cape Verd Islands, with the part of Africa adjacent, early in the 15th century. A large vessel sailed from Lisbon in August of that year (1465); arriving on the coast the crew suffered so severely from fever that they lost many of their men; their numbers being thus reduced, they were unable to manage the vessel, and were carried by strong easterly currents to St. Thomas. Here they built two caravels with part of their ship's timbers, dispatching one to Lisbon with intelligence of their disaster, while the other, after discovering Prince's Island and Fernando Po, proceeded westwards as far as Accra. The officer in command finding gold in abundance, decided to return to St. Thomas, and report his discoveries to his superiors. The caravel was laden with such trade goods as were supposed most suitable, and dispatched to Accra. Their success was such, that about the year 1480 the Portuguese regularly established themselves there; three years afterwards they found Elmina Fort had been abandoned by the French, and in the year 1484 an expedition left Lisbon to take possession of it. On the 23rd of April of the same year they landed and settled themselves in the castle, naming it St. George d'Elmina, in honour of the saint to whom that day (the 23rd of April) was dedicated. Stronger fortifications were added to the old building, enlarging it in fact to its present dimensions. A company was then formed at Lisbon, under the king's patronage, and, as was usual in those days, a monopoly of all trade between Western Africa and Lisbon was conceded to it. Its agents built the fort of St. Anthony Axim, west of Cape Three Points, and established a factory at Chama, and for more than a century they exercised an influence amounting almost to sovereignty over the natives of the Gold Coast, and succeeded in maintaining the whole trade in their own hands, their armed ships driving away or capturing the ships of other nations. Towards the end of the 16th century the French made an attempt to re-establish themselves, but their ships were attacked and themselves imprisoned and ill-treated. Henry III., their king at the time, being powerless to help them, fully occupied as he was by his own internal troubles. Thus were the French again compelled to abandon the coast, retaining only their position on the Senegal, which they still hold. From this time forward the Portuguese remained for a great length of time sole masters of the Gold Coast, and, indeed, of nearly the whole coast line of Western Africa, and the remains of vast cities bear witness in our day to their energy and enterprise. But these great qualities were dimmed by cruelty and injustice, which at length became insupportable to the natives. The Accras assembled, under some specious pretext, a number of men, surprised the fort, and massacred all the Portuguese, and when the General in command of Elmina sent a considerable body of troops to avenge his countrymen, the natives successfully expelled them. From that day to this they have never recovered their position at Accra.

The Dutch now appear on the scene. In 1595, they, for the first time, reached the Gold Coast, and were eagerly welcomed by the natives, who implored them to establish themselves, offering them the choice of a site. The Dutch selected Cape Coast, where they constructed a fort; they were not allowed, however, to trade in peace, the Portuguese using their utmost endeavours to drive them away. At length the Dutch Government fitted out nine ships well supplied with munitions of war, which arrived on the coast in July, 1637; 800 soldiers, 500 seamen, and a number of Commendah natives were landed near the castle, and after a contest with the natives of Elmina, the Dutch took possession of the hill of St. Jago; here they placed cannon to command the castle of St. George. The Portuguese on this, finding themselves powerless, surrendered, thus giving up their princi-

pal stronghold. Shortly afterwards they retired to St. Thomas, leaving the coast altogether, while the Dutch, by conquest or occupation, obtained possession of many important points along the coast, most of which they retained till the year 1868, when the Eastern forts were exchanged for some of our Western ones, and in 1871 they ceded all their Gold Coast possessions to the English.

I am unable to fix the exact date of the opening of English trade on the Gold Coast; it was, however, commenced in the middle of the 16th century by independent adventurers, probably from Bristol, and certainly without any support from the government of that day. Later on James I. encouraged the enterprise, and in the year 1662, the Royal Company of Adventurers was founded, under the patronage of the Duke of York, for the purpose of prosecuting the trade. Shortly afterwards a war broke out between England and the Netherlands; the English attacked and captured Fort Witsen, Secondee, and Cape Coast Castle, and took possession of some places of minor importance; but they were not long permitted to retain these stations, as the celebrated Dutch Admiral, De Ruyter, appeared on the scene with a powerful fleet, and speedily obtained possession of all of them except Cape Coast Castle, which successfully resisted all his efforts to take it.

These losses led to the dissolution of the company in 1667. In 1672, a new company, entitled the Royal African Company, established themselves firmly at intervals along the coast, extending from Dixcove to Accra, building forts to enable their agents to contend successfully with the Dutch, with whom they were frequently at war. In 1750 their charter was taken from them, and their stations handed over to the African Company of Merchants; the rivalry with the Dutch continued, the latter suffering far greater losses than the British, who captured five of their forts. However, peace being restored in the year 1782, the captured places were restored, and both nations retained possession of their respective stations from that time to the year of the transfer already alluded to, 1868.

I am unable to trace the history of the occupation by the Danes of certain positions on the coast, but for nearly two centuries they held Christiansborg Castle at Accra, and the fort of Quittah, which they sold to the English in 1850.

Up to a recent period the seaboard of the Gold Coast, with an undefined jurisdiction inland, was divided between the English and Dutch, bordered on the westward by the French settlements of Assinee and Grand Bassam, and on the east by independent native tribes. Now the British Colony of the Gold Coast extends from Newtown, near the Assinee river, to Quittah, a distance of about 320 miles.

Thus we see that Europeans have been in contact with, and have resided without intermission among the inhabitants of the Gold Coast for at least 400 years, nay, if the history of the first French occupation is authentic, 500 years.

Let us now consult the oldest writers, who have described the character of the natives. John Leo, the famous Moor, who travelled over a large part of Africa, thus writes of the Africans in general:—

"Likewise, the inhabitants live a brutish kind of life, who, neglecting all kindes of good arts and sciences, doe wholy apply their mindes unto theft and violence. Never as yet had they any religion, any laws, or any good kind of living, but alwaies had, and ever will have, a most miserable and distressed life. There cannot any trechery or villanie be invented so damnable which for lucre's sake they dare not attempt. They spend all their time either in most lewd practices or in hunting, or else in warfare; neither weare they any shoes or garments. The Negros likewise leade a beastly kinde of life, being utterly destitute of use of reason, of dexteritie, of wit, and of all artes. Yea, they so behave themselves as if they had continually lived in a forest among wilde beasts."

Later on, in the year 1700, we find Bosman, in treating, as he says, of the natural temper of the natives of the Gold Coast, writing thus:—

"The Negros are all, without exception, crafty, villanous and fraudulent, and very seldom to be trusted, being sure to slip no opportunity of cheating an European, nor, indeed, one another. A man of integrity is as rare among them as a white falcon; they seem, indeed, to be born and bred villains, all sorts of baseness having got such sure footing in them, that it is impossible to be concealed. The degenerate vices are accompanied by their sisters—Sloth and Idleness—to which they are so prone, that nothing but the utmost necessity can force them to labour."

Le Pere Rabat writes in a similar strain, praising only the maternal love of the poor Negress; nor, indeed, has any traveller in Central Africa differed materially from Leo and Bosman. Inhuman cruelty in many parts heightened by cannibalism, base and grovelling superstition leading to the wholesale sacrifice of human life, extending over immense districts in Africa; we find even Livingstone, the Negro's friend, bearing unwilling witness to the degraded condition of the people among whom he travelled. It is not astonishing then that the inhabitants of the Gold Coast presented to their first European visitors a highly-coloured picture of all the evils of barbarism without one redeeming feature.

Though this picture of the natives of the Gold Coast is bad, nay, absolutely distressing to the beholder, yet we find them at an early period engaged in certain industrial pursuits; their houses were then as now neatly built of clay, carefully mixed, and well thatched; indeed, they were sufficiently advanced in the art of building to erect houses two stories in height.

Such clothing as was at that time worn was chiefly of native make, the warp and weft being spun by the women, and the narrow looms, with a reed only three or four inches long, worked by the men, the principal seats of this manufacture being about Assinee on the west, and Popo on the east; while the natives of Axim and the neighbourhood grew a great deal of rice, which they exported or exchanged for other articles. But little or no encouragement was given by European traders for the production of these articles. Palm-oil was in use among the natives as early as the year 1600, and probably centuries before, for I find the following paragraph in an edition of Leo's travels published in that year:—

"Here also is made of the oil and the ashes of the palme-tree a kind of sope which hath double the force of ours, for which cause it is forbidden by the Portugals."

Exactly the same kind of soap is in use at the present time, and is a very severe test of the durability of colours in cotton manufactures. But palm-oil only became an export commodity in the early part of the present century.

The produce of the country being so limited, we

are led to inquire into the attractions which tempted so many European adventurers to the Gold Coast in the 14th and 15th centuries. The fact was, that gold and spices were to be had in considerable quantities. A near and direct route to the countries producing spices and silk was the object of most of the adventurous navigators of past ages, and although the peppers of West Africa are now of little or no value when compared with the products of India and the Eastern Archipelago, they were deemed of considerable importance four or five hundred years ago. In the work just quoted the writer says:—

"This countrie aboundeth with long pepper, called by the Portugals 'pimento de'l rabo,' which is as much as to say pepper with a tayle. This tailed or long pepper so far excelleth the pepper of the East Indies, that an ounce thereof is of more force than half a pound of that other, for which cause the kings of Portugale have done what lay in their power to keep it from being brought into these parts of Europe, lest it should too much abase the estimation and price of their Indian pepper."

And then the writer adds that great quantities were, nevertheless, introduced by the various European traders. This passage undoubtedly refers to the common Chili pepper, of which our cayenne pepper is made, and which still forms a small and unimportant branch of the African trade. Guinea grains, then called grains of Paradise, were also among the exports from West Africa, but their value was of minor importance.

The fact that gold was obtainable in exchange for articles of infinitely less value was, no doubt, the chief inducement which led European adventurers to Western Africa; long before the opening of the slave trade companies were formed and forts built with the object of carrying on and, indeed, of monopolising the gold trade, and as the precious metal was only found between Assinee and Cape St. Paul, the Gold Coast speedily rose to importance in the estimation of Europeans. I am unable to state the quantity of gold exported annually before 1700, but I believe it to have greatly exceeded present exports, as the various establishments along the coast must have entailed very great expense, and a number of vessels were engaged in the trade. But Bosman, who is justly considered one of our most reliable writers on Africa, and who wrote about the year 1700, estimates the annual export of gold in peaceable times at 7,000 marks, or over £200,000, three or four times the amount at present exported. I am led to believe that the French and Portuguese, on their first arrival on the Coast, found large quantities of the precious metal, the accumulation of many years, in the hands of the natives, that its value was comparatively unknown to the latter, and that they readily parted with all they could procure, as in all probability gold was not then, as it is now, the medium of exchange and the representative of wealth. I have no doubt that a large proportion of the gold now found is retained by the inhabitants.

From what I have stated it will appear that during the first century, or 150 years, of their stay on the Gold Coast, the different European communities were too much engaged in contending with each other to pay any attention to the improvement of the people, even if they felt any desire to do so. War existed between the French and Portuguese, Dutch and English on the Coast; when at home they were quite at peace. To make matters worse it was customary to subsidise native tribes, to assist them in driving away their competitors. Nay, at a much later period, this practice, and that of bribing one tribe to destroy another, was common among Europeans. In 1694 the Dutch paid the Fantees £900 to extirpate the people of Commendah, who were then and have generally been inimical to the Dutch, but the English prevailed on the Fantees by the payment of a similar sum to remain neutral, and as Bosman says, "to one who knoweth how common and trivial a crime perjury is amongst the negros, 'twill not appear incredible that they should rather stand still for £1,800 than fight for £900."

Having thus briefly considered the circumstances attending the first period of European contact with the Gold Coast natives, we need feel no surprise that they made little or no progress in the arts of civilised life, nor could we expect any advance in morality or religion on their part. We have no authentic means of comparing their social condition at the end of this period with that in which their first white visitors find them, but we may conclude that but little good had been effected.

The next page in the history of the Gold Coast is stained with the blood and tears of its people; the middle of the 17th century marked the opening of the slave trade, a traffic now justly held as the most disgraceful occupation in which man can engage, and fraught with misery and disaster to Africa. The exportation of slaves existed on the coast between Senegal and Sierra Leone some years before it was extended to the districts under consideration, but in a very short time the slave trade attained gigantic proportions between Cape Coast Castle and Whydah, and at the latter place it was no uncommon thing to see six or seven ships at anchor waiting for their living freight. Coromantine also became notorious for the numbers and quality of the slaves exported thence. It is useless to contemplate the painful scenes enacted during the 100 years which terminated in 1807, when this inhuman traffic was declared illegal. Its entire suppression required some time even on the Gold Coast, and it has only been completely extinguished at Whydah within the last 15 years.

Casual readers on the subject, wholly engrossed by the horrors attending the capture and shipment of slaves, are apt to forget the minor evils attending this traffic, although, in truth, they have had a very disastrous effect on the progress of civilisation in Africa. It is a well-known fact that the Negro is more, I may almost say only, industrious where the population is dense; for instance, the populous district of Yoruba produces a considerable quantity of cotton, which requires steady, continuous labour; now, the export of thousands of able-bodied men and women, not to speak of slaughter entailed by the slave forays, must have considerably diminished the population of the Gold Coast, and thus greatly lessened the supply of productive labour. Moreover, the slaves were exchanged for the much-coveted goods of Europe, and thus the only incentive to labour was removed, no inducement remaining to the natives to cultivate the soil, or even to collect the produce indigenous to the country; the slave trade once suppressed, and peace restored to the suffering people, see how

quickly a substitute was found, and how rapidly the palm-tree supplanted the slave hunt, and supplied Africa with the objects of its desire, and Europe with a most valuable addition to its imports. I may here say that the value of the produce of the palm imported by my firm alone, in 1874, exceeded £130,000.

Although not strictly within my subject, you may wish to learn the prices paid for slaves. The price of a man slave was, in 1700, 180lbs. cowries; 40 to 45 iron bars, 7 ft. 2¼ in., or 50 pieces common cottons; 20 gross common pipes, or 12 or 16 pieces India cottons.

The year 1807 may justly be held as the year of salvation for Africa in general, but to the people of the Gold Coast it proved the most disastrous year in their history. It was the first year of the Ashantee invasion, and it was followed by what, in my day, was called by the Fantees "the time of trouble."

Sai Tootoo Quamina, the King of Ashantee, and sovereign over all the interior tribes from Assinee to the Volta, naturally felt a desire to extend his dominions to the sea, and in 1807 an excuse was afforded him for invading the coast districts. Two of his tributary chiefs, Cheboo and Apontaz, of Assin, having incurred the King's displeasure, took refuge in Fantee. Sai Tootoo demanded that his vassals should be given up to him, and on receiving a refusal he invaded the Fantee country, destroyed its towns, and massacred thousands of the inhabitants. The Ashantees proceeded to attack the Fort of Annamaboe, in which a number of defenceless women and children had taken refuge, but the garrison, consisting of five officers and twenty-seven men, successfully resisted the entire Ashantee army, although the garrison was finally reduced to eight.

From 1807 to 1824 the King of Ashantee was the nominal sovereign on the coast as well as in the interior, but frequent outbreaks of the Fantees led to fresh invasions, until at length the country was nearly depopulated, and roofless ruins alone remained to mark the site of prosperous towns and villages. At length the English, threatened by Ashantee, identified themselves with the cause of the Fantee tribes. Unsuccessful at Assamacow, where Sir Charles Macarthy and his small force were overwhelmed by numbers, the British, assisted by a large force of Akims, who fought bravely, completely defeated the Ashantees on the 26th of August, 1824. The slaughter of the enemy was so great that the King returned to Commassie, and, although on several subsequent occasions the Ashantees crossed the Prah, they never succeeded in inflicting serious injury until the year 1873, for which injury they received condign punishment from Sir Garnet Wolseley and his small but gallant force. Thus the coast tribes have been twice delivered from the hands of their cruel foe by British courage, services sufficient to compensate them for years of ill-treatment, and partially to cancel the debt we owe them, arising from our participation in the slave trade.

It is clear that, under such circumstances as occurred between the years 1807 and 1824, all improvement in the condition of the unfortunate Fantees was hopeless, and indeed the same remark may be applied to the whole period of 400 years the history of which I have briefly traced.

I turn with infinite satisfaction to brighter scenes and happier prospects, to peace and prosperity, brought about by the zeal, tact, and firmness of one able man, whose name is deservedly respected by all, Europeans and natives alike, who are acquainted with his true character and work; I allude to Mr. Maclean. My old friend Mr. Cruickshank has thus described the state of the protectorate on Mr. Maclean's arrival:—

"With our intercourse with the interior cut off, our trade annihilated, our allies fighting and squabbling with each other, and an authority so limited as scarcely to be any protection to the oppressed, the contemplation of his (Mr. Maclean's) arduous duty was sufficient to stagger an ordinary mind."

I can myself bear personal testimony to the change wrought by Mr. Maclean during the twenty years of his government. Peace with Ashantee had been uninterrupted, and internal peace secured, and when, as happened in one instance only, the King of Appolonia ventured to dispute Mr. Maclean's authority, he was defeated by his brother chiefs, and imprisoned in Cape Coast Castle. Trade was protected, and flourished; and even that much-abused system of credit not merely existed, but was, in fact, the basis of all commerce, Mr. Maclean being far too wise to tempt wavering honesty with facilities for evading its duties. British influence was gradually extended till it included within its friendly grasp vast districts, hitherto left to the greedy caboceer or the cruel fetishman; inhuman and obscene customs were suppressed, and education encouraged; and all this was effected without any apparent effort, but simply by the kindly genius and unswerving justice of one man. Moreover, it was during Maclean's time that the first serious efforts at improvement were made, but I shall refer to these in greater detail. But few of Mr. Maclean's successors were suited, either by constitution or ability, to the office to which they were appointed, nor, indeed, can efficient administration be expected from men who do not remain at their post long enough to acquire a knowledge of the wants and an interest in the welfare of those over whom they rule. Confident that her Majesty's Government will choose and retain able men to direct the destinies of their new colony, I refrain from any further reference to past failures.

Let us now consider whether any and what means have been resorted to by European nations to extend civilisation and religion to the Gold Coast. And, first, referring to the latter, we shall find that the attempt to establish missions was repeatedly tried, but, until quite recently, proved unsuccessful.

In 1853 a fellow passenger on board one of the African steamers kindly allowed me to examine a number of manuscript maps entrusted to his care. They were drawn up by Jesuit and other missionaries in the sixteenth and seventeenth centuries, to illustrate their travels in West Africa, and they proved beyond doubt that these zealous and able teachers had repeatedly visited that coast, and endeavoured to extend their religion in that direction. The particulars of the first mission to the Gold Coast with which I am acquainted are as follows:—In the year 1687 six Jacobite Monks left La Rochelle, under the auspices of the Guinea Company of France, with the object of founding an Apostolic Mission in Africa. They landed

there, and were well received by the then King, Zena, who gave them a house and land, and also six slaves as attendants. Moreover, the King sent his son, Aniaba, and another youth to France, in charge of one of the fathers. Of the remaining five two stayed at Assinee, and three established themselves at Whydah. Father Rabat, from whose work I derived these particulars, says they worked hard at both places without making a single convert, and adds they went nearly all together to a better world to be recompensed for their labours, not without the suspicion that they died from poison.

In 1700, Aniaba, who had been carefully educated under the King's care, was sent back to Assinee, in company with a devoted Jacobite Father, and the occasion was justly deemed as favourable to the spread of Christianity. Unfortunately, Zena was dead, and as nephews on the sisters' side and not sons, succeed to property and title in that part of Africa, Aniaba's influence was gone. Father Loyer was, however, well cared for by the natives, and a small station was established on the tongue of sand east of Assinee River, where he, with a few companions, remained neglected by their countrymen till 1705, when a vessel was sent to bring them away, and the station was given up, and it was said the good father did not leave a single convert behind him.

In the year 1751, the Rev. Thomas Thompson, a clergyman of the English Church, proceeded to Cape Coast with the view of evangelising the people; he remained there four years, and on his return to England he was accompanied by one Philip Quaive, a native, who was educated at Oxford, was ordained, and filled the office of chaplain at Cape Coast Castle for nearly fifty years. He was unable to make any lasting impression on his countrymen; and it is reported that at the approach of death he sought consolation in Fetishism. The Church of England has since that time been occasionally represented by a chaplain appointed and paid by the Government, but its efforts have been mainly directed to other parts of West Africa.

The establishment, and, as I trust, permanent establishment of Christianity on the Gold Coast has resulted from the continuous and increasing exertions of the Wesleyan branch of the Christian Church; for the last sixty years its missionaries have devoted time, health, and life itself to the social and religious improvement of the natives. Numerous schools and chapels scattered over the country bear witness to the enlightened liberality of this great body; and if its efforts have not been rewarded with complete success, it is owing to the difficulties with which religious teaching has to contend. The native language contains no words capable of expressing the principles of Christianity or the teachings of the Bible. Such words as faith, hope, and love, in the sense in which we understand them, are absent; and I can vouch, from personal hearing, that a good sermon, when translated into Fantee, entirely loses its force, and even meaning. Then, again, the daily work of the good missionaries was greatly frustrated by the bad example of friends and relatives, which met the young scholars on their return home. The English language is making rapid strides, and when its use becomes more general, when also morality is more extended, and vice more condemned, these obstacles will disappear. In the meantime, much good has been effected, and many useful members of society form a leaven of improvement in the community. As an employer of educated natives, I gladly bear witness to the honourable conduct and great ability of many young men in my business, who are indebted to the Wesleyan Mission for their early training.

But the first introduction of Christianity on the Gold Coast brought with it a train of evils hitherto unknown. I well remember the first case of forgery brought to justice; it occurred in the district in which I was chief magistrate, and the act was so clumsily committed that I at once detected it, and determined to check this new crime, so dangerous in an ignorant community, at its very commencement. I administered a very severe punishment to the offender. The evils referred to were not, however, such as could be easily repressed by the criminal law; education appeared to the natives the only mark of inferiority to the whites, and a pair of trousers and a shirt, added to the knowledge of reading and writing, seemed to remove the difference between the two races. Thus elevated in social rank, commercial pursuits, or employment under Government, appeared to them the only occupation suited to their station. In the paper I read last year, I pointed out the ordinary results of credit given to educated natives, coupled with the introduction of a law which they regarded as a fair means of escaping their liabilities; it is a singular fact that, in my trading operations on the coast, debts due by uneducated natives have been, almost without exception, paid in full. The reason is obvious. The uneducated trader, while pursuing his business, remained content with native fare and native fashion, whereas the newly-created gentleman must needs vie with, and even excel, the white man in his personal and household expenditure, in order to assert and maintain his acquired position. As education is extended we may reasonably hope that it may be used for nobler purposes. Hundreds of young natives have now received its great advantages where tens formerly possessed them; hence they will be compelled to turn their attention to other pursuits besides commerce, and they will become more modest in their demeanour to all around them.

It is difficult to suggest employment for the educated native. The development, by cultivation, of the resources of the country would appear the most natural, but he has to contend with the great obstacle to advance in that direction, the insuperable indolence of his countrymen, and we cannot yet expect him to dig and plant with his own hands. Her Majesty's Government must necessarily add to the number of their *employés*, and merchants are constantly engaging English clerks and book-keepers at great risk to both parties; such vacancies should be filled, as far as possible, by natives. It is for the native gentlemen now occupying offices of trust and responsibility to encourage, by their zealous and honourable conduct, her Majesty's Government and the merchants to avail themselves of the services of educated natives; the system is on its trial, and its success or failure mainly depends on the present generation.

The work of the Wesleyans is now, and has been for some years, partially shared by the Basle Mis-

sion, and it is impossible to overrate the good effected by this society. Not content with instructing the natives in the doctrines and practice of Christianity, the Basle missionaries endeavour to fix these principles in the minds of their converts by coupling with them the arts of civilised life; skilled artisans accompany the clerical missionaries, and by their example instruct the natives in the various branches of industry; under their guidance good houses are built and furnished with comfort, excellent roads are made, and steady and skilful labour produces a plentiful and wholesome supply of vegetables and fruit, as well as a considerable quantity of coffee; in fact, the Basle Station, on the Akropong Hills, is a model establishment for improving the natives, and the extension of their system would be the most effectual means of civilising the Gold Coast. I may say that the education given by the Wesleyan Mission was, in my time, too exclusively religious. I fear the system has not yet been materially altered, and, even after leaving the schools, few of the scholars read any books on history or science; this is undoubtedly a want which should be supplied. The African may well learn, from the history of other races, how to attain his proper position among them, and how to acquire the advantages enjoyed by his fellow-men.

But alas how small is the number of those who have attained to some degree of civilisation, when compared with the vast numbers still grovelling in the lowest state of barbarism and superstition. It appears scarcely credible, even under the circumstances I have described, that the Fetishism which teaches man to rely for success and safety in the meanest object should so long withstand the contact of European thought, and that human life should be sacrificed to appease the displeasure of deceased ancestors in a country where Christianity has been taught for 300 or 400 years. It seems almost impossible to eradicate Fetishism from the African mind. Faith in its principle is attested by most undoubted proofs. In my day it was no uncommon thing to receive in payment of a debt, cowries which had been buried in the ground for years, in the vain hope that they would be available after death, until present and pressing necessity prevailed over anxiety for the future, and they were reluctantly disinterred. It is still usual to furnish the dead with provisions and money for their journey, together with valuable cloths and garments wherewith to make a respectable entry into the next world. I myself saw in 1846 an old chief, a very great friend of mine, placed in a sitting position after death, and the whole of his body from his waist upwards powdered over with gold dust, and in that state buried. Happily the useless sacrifices made on these occasions are limited, within British influence, to property, but beyond it human blood is freely poured forth, and on great occasions neither bond nor free are safe.

British authority has succeeded in removing another great curse from the Gold Coast—the consequences of a belief or feigned belief in witchcraft. In many parts of Africa whole villages are decimated and abandoned through this horrible cause. For sometime even after Mr. Maclean's arrival the Fetishmen of the Gold Coast practised this rascally branch of their profession, but the punishment inflicted on the culprits selected was gradually reduced from slavery or death to a larger or smaller fine depending on the wealth of the accused; even as late as 1848 attempts were made to extort money by accusations of witchcraft. On the 12th June of that year two divisions or quarters of the town of Serafoa, or Apaful, appeared before me at Annamaboe Fort. A man named Quansak, of the Impeassafoo quarter, had recently died, and his friends, wishing to find out if any of the Essene people had caused his death by witchcraft, wrapped the body in matting, and placed it on the heads of two men, who carried it in front of the Essenefoo, and each man of that division held out his hand as the two men approached him. A man named Essow held out his hand and immediately the two bearers pretended that the corpse impelled them towards the unfortunate Essow; in vain they struggled in a different direction, their burden even in death overcame them, in fact they carried out their instructions, and Essow was declared guilty and was fined; accompanied by his friends, the Essenefoo, he appealed to me, the fine was returned to him, and the rascals who accused him had to pay heavily for their attempt. I have now in my possession the rough note of these proceedings.

But the power of the Fetish priests even now remains very considerable on the Gold Coast. It is scarcely credible, but it is the fact, that a recent outbreak of small-pox was attributed by the scoundrels to the cracking of the palm-nut to extract the kernel, and the practical result was an entire suspension of this branch of industry. This will give you some idea of their influence; it is, however, gradually giving way, and we hope may soon cease.

I regret that sufficient time could not safely be allotted by Sir Garnet Wolseley to the destruction of the head-quarters of Fetishism at Commassie. It was an opportunity of striking a blow at this cruel system from which it would never have completely recovered.

Thus, then, we find Christanity professed by daily increasing numbers, side by side with the most cruel and debasing superstition, and if the conflict be sufficiently prolonged there can be little doubt as to which will prevail. It is said that converts occasionally fall away, and again cower under the baneful shade of Fetishism, but I imagine such perversion is very rare. It is certain that the spirit of Christianity has entered the community on the Gold Coast, and that many honest and sensible men now form a centre from whence civilisation may radiate in every direction. Who can tell how wide the circle may spread?

Compulsory education has become one of the institutions of Great Britain. I see nothing to prevent its introduction to her youngest colony, We might then hope to hear of pleasant scenes enacted on the Gold Coast, such as those described by Mr. Pope Hennessy as occuring in Mohammedan villages of Africa;—the village children assembled under the great village tree, reciting verses of the Bible instead of the Koran, and learning that truth and industry are not only more honourable, but infinitely more advantageous than an idle dishonest career.

I have stated that in our first acquaintance with the natives of the Gold Coast we did not find them

entirely devoid of industrial pursuits, let us now see what encouragement was afforded them by Europeans to extend and improve cultivation.

One of the most notable features in the history of the slave trade is the entire absence of any attempt to employ the slaves in the cultivation of their native country, and yet both the soil and climate are admirably suited to the production of the very articles to the growth of which slave labour was applied after a costly and painful voyage. It is impossible to calculate the beneficial results which might have arisen from the employment of forced labour in Africa, at a time when such labour was not merely tolerated, but encouraged. Vast tracts of land, over which no human foot has hitherto trodden, and which now serve only as hotbeds of malaria, might at present have been in full cultivation, and producing such every day necessaries as cotton and sugar have now become. Industry is catching, and we might reasonably expect that the wealth and comfort arising from it would prove sufficient inducements to the present generation to labour steadily. The time has passed away, and the attempt can no longer be permitted. We cannot regret the great change made by her Majesty's Government, as anything like forced labour is utterly opposed to English law and English feeling. But before that change occurred a trial was made by means now illegal.

During the peaceable government of Mr. Maclean an attempt was commenced by Mr. James Swanzy to grow coffee for exportation. Several thousand coffee plants were imported, and a road between four and five miles long was made to Cape Coast Castle. To do this much labour was required, and it was supplied by pawns, consisting chiefly of men who borrowed money on the security of their own labour to purchase a wife, and it was hoped that the earnings of the two would soon enable them to reclaim the husband's freedom. The plants were just commencing to bear a good quality of coffee, and the enterprise looked promising, when Dr. Madden arrived on the coast, and although he reported most favourably as to the condition of these labourers, pawn labour was declared illegal, the plantation became worthless, and my brother suffered a very heavy loss. The experiment had not lasted long enough to prove to the natives the great wealth which might have resulted from it.

In 1850 a number of merchants and manufacturers interested in Africa subscribed a large sum of money, and under the superintendence of a gentleman from the Southern States of America cleared a large tract of land near Cape Coast, and commenced a cotton plantation. Labour sufficient for the clearance had been procured, but nothing like steady labour was obtainable, and not a bag of cotton was, I believe, exported. When abandoned by the original proprietors, a Mr. Thomas Hutton took possession of the plantation, only to succumb to the same obstacle. It appears, therefore, that the merchants have not been unmindful of their duties in this respect, but the only way in which success can be secured is by a system of contracts by which a sufficient number of free labourers would bind themselves to work for a certain period.

Even the traveller and the trader suffer greatly from the difficulty in procuring carriers and canoemen; the latter, indeed, think very little of the expense of detaining the steamers and ships having goods for their employers; nor is the Gold Coast exceptional in this respect, as almost every traveller in Africa complains of the same difficulty.

An increasing demand for European manufactures has, however, stimulated the natives to an increased production of the one article, palm-oil, they have to offer for export; the quantity now annually shipped from the Gold Coast is infinitely larger than it was when I commenced trade there. Probably four or five times the quantity made 30 years since is now brought to market, and I think I may fairly claim for my people and myself some share in the encouragement of this increase, by placing factories at close intervals along the Coast, and thus affording the inhabitants facilities for selling their produce. I do not pretend that we have done this for the producers' benefit alone, for the trade that is not mutually beneficial cannot flourish, but it requires a little more enterprise, and even courage, than some of our friends give us credit for, to risk our property on the shores of West Africa. Losses exceeding £10,000 from pillage and fire have taught us prudence, not fear; but if the British Government cannot protect us on the Coast, what can we expect when we carry our property beyond its reach? Open violence need not be feared; the Negro chief is far too cunning to resort to such means, desertion of the carriers leaves the unfortunate trader high and dry in some out of the way village, and even if these men leave their loads behind, a very short time suffices for their disappearance or diminution; native guards can no more be trusted than carriers, and the expense of a number of armed Europeans is out of the question. The native trader relies on his own family and dependants to carry his goods, which are rarely of sufficient value to tempt the cupidity of the tribes through whose country he travels; moreover he is generally well-known. I do not therefore consider that the European merchants manifest undue caution in confining their operations to the coast.

On comparing the imperfect accounts of early writers of the moral condition of the Gold Coast with what we now find, we become sensible of very great improvement. Direct theft either with or without violence is now extremely rare, and in all probability was never very common; drunkenness and its attendant vices are also very exceptional, and I really believe that the poorer classes are comparatively exempt from any glaring crimes. The truth is that embezzlement and fraud are the forms in which dishonesty mostly appears, and in old times these vices were considered rather honourable than otherwise; for instance, up to the commencement of the present century the adulteration of gold was considered a privilege of the great, but in 1805, Mr. John Swanzy imprisoned a native detected in passing spurious gold. The chiefs of Cape Coast resorted to arms to prevent this breach of privilege, but were unable to rescue the prisoner. European traders as a rule only received gold either within their fort walls or on board their vessels, where they had the means of testing its purity, but now each merchant receives gold in payment on his own premises. It is however remarkable that the Government has not

hitherto given sufficient attention to this crime, although it is obvious that it is in all respects as bad as making and passing base coin here. The embezzlement of goods entrusted to natives either on credit or for sale on the owner's account, was formerly common, but, I am glad to say, is now much less frequent, and traders in our new colony are comparatively exempt from the serious losses from robbery by canoe-men and carriers, which still exist in other parts of the coast. It is amusing to read of the tricks resorted to in old times to avert the attention of the traders while the robberies were effected.

It is with great reluctance that I state that such crimes as fraudulent bankruptcy, embezzlement, and what may be called the minor forms of dishonesty, such as taking advantage of an error, &c., are even now regarded with great toleration. Persons convicted of these acts suffer but little in reputation. You may meet men just out of prison and the chain-gang enjoying the society of their fellow men, apparently as respected as before. The sense of shame seems entirely absent, and as a check to crime it cannot be replaced. Self-respect and the desire for the respect of others, will grow up simultaneously with higher education, but it will take time to develop.

A consideration of the foregoing statement will enable us to estimate at their proper value the advantages derived by the people of the Gold Coast from their intercourse with Europeans, and to judge for ourselves whether we need feel surprise or disappointment that greater good has not resulted from it. It appears to me unreasonable to expect that the effects of ages of degradation and debasement should be remedied in comparatively a short time by the limited means hitherto available for the purpose. The growth of civilisation, like that of the oak, is the growth of years, time, much time, is required to bring it to maturity; but something has already been done, the storms of war have been averted, and the blight of slavery removed; the tender plant is already above the ground, but for some time it will require external support, and there remain many noxious weeds to be rooted out; indolence obstructs development, fraud discourages trade, and superstition stands in the way of education; but all these evils are removable, and we must not be too nice as to the means—a display of power fresh in the minds of the natives, and used solely for their benefit, enables and entitles her Majesty's Government to stretch its authority somewhat beyond its usual bounds for the good of its new subjects.

The peculiar position of the Gold Coast, as the only extensive district of tropical Africa where freedom reigns, points to the locality where new and increased exertions to regenerate the Negro can be most effectually tried. When I commenced the research required for this paper, I was inclined to the opinion that the experience of the past afforded an all-sufficient excuse for future neglect, but the facts I have discovered do not sustain that opinion. There is a reasonable hope that the Negro races will one day take their places among the civilised nations of the earth; it is our duty to help them to realise it.

The practical question remains, how can we help them, and it is a question not easily answered. I have frequently considered it, especially since I began this paper, and each plan that suggests itself to my mind is accompanied by its peculiar obstacles. The means at present in operation may be well enlarged, and the method imitated. Both the Wesleyan and the Basle missionaries deserve greater support, and Government schools might be founded in various localities on the model of Basle missionaries, but her Majesty's Government may well use force to fill them. Such a measure would appear to the natives far less arbitrary than the recent manumission of domestic slaves, and, in my opinion, would prove equally beneficial. The native African is accustomed to coercion; use it in this case for his benefit, and disregard the outcry which may possibly follow. Never mind whence it comes.

As Mr. Froude says of South Africa, so we may say of West Africa, "It is impossible to cultivate it without the assistance of the natives. We do not want them to work for us. We want them to work for themselves." And every word which follows in Mr. Froude's admirable letter in the *Times* of the 26th inst., is applicable to the Gold Coast, but nothing can or will be done without special means adopted by her Majesty's Government to secure labour. A system of contracts might be legalised, founded on the payment of a sum of money, and for which the labourer would bind himself to work for a certain number of years, and a Commissioner might be appointed to supervise the working of these contracts, which should be rigidly enforced; and despite its resemblance to the purchase of slaves, the introduction of labour from the interior should be organised on a plan which would secure compensation to the master and freedom to the slave, the assent of the latter being imperative. As a matter of course, labour in all cases should be regularly paid for by weekly wages.

Under some such system, carefully considered, capital could be found, and profitably invested in the cultivation of coffee on a large scale. The trial should not be made by one person, for the risk must necessarily be great, but by a company, whose shareholders could afford to wait some time for their dividends. I believe any attempt at extensive cultivation dependent on chance labour must necessarily fail.

The formation and maintenance of good roads must accompany any such scheme; and, indeed, the means of communication with the interior would seem to be among the very first requirements of commerce, but nothing has been done in this direction; the trader still travels along paths rarely exceeding two feet in width, and reduced in the rainy season to the breadth of his foot.

Commerce does her part by offering fresh objects of comfort and convenience for the use of the natives. A vast number of such objects have been added to the Gold Coast imports since I first commenced the trade, and have no doubt tended to the increase of industry. I may say that the goods sold there are equal to, and superior to most of the goods sold in other parts of West Africa. English furniture is now seen in many native houses, and even articles of luxury are in more request.

The question of domestic slavery has been so fully treated in the able paper of Consul Hutchinson, that I only refer to it in order to express my opinion that the European traders took no part in

the petitions presented to her Majesty and Governor Strahan against its abolition. The writer of the article in yesterday's *Times*, though correct in every other particular, is mistaken in supposing that educated Fantees do not possess art and skill sufficient to draw up those documents, and I am inclined to believe that the authors of these petitions and the active members of the Fantee Confederation are identical. The resident European traders objected rather to the mode in which abolition was effected than to the abolition of slavery itself, and this objection was, I believe, shared by most persons interested in the Gold Coast, myself among the number; but the decisive step having been taken, we must all admit the impossibility of retracing it; as the *Times* justly says, the effects of this step on Fantee society cannot yet be foreseen. One result is, however, clear, that great additional responsibility is thereby incurred by her Majesty's Government; just and firm measures are required. It will be useless to introduce the delicate machinery of English law into such a state of society as that which exists on the Gold Coast; special laws must be passed suitable to the circumstances of the people. The Africans have been justly called children, and for years to come they will require the guidance and discipline suited to childhood.

DISCUSSION.

The Chairman, in inviting any person present to open the discussion, said Mr. Swanzy had very properly referred to the rule which prohibited all meetings like that of entering into questions of party politics and sectarian religion; but it was impossible to discuss a subject connected with the promotion of civilisation and manufactures and commerce in Africa without referring to religion. Mr. Swanzy had given them a practical reason for that by pointing out how his own trade and that of others had been interfered with by superstition. It was by the promotion of education in every form, and particularly of religious education, that we must hope to encounter the obstacles which interfere with the promotion of commerce. He made these remarks so that no one should be deterred from going into the subject.

The Rev. Mr. Schrenk (of the Basle Mission) said he was exceedingly glad to be present at the meeting, and to have heard such a paper from a West African merchant. He thought on the whole that the paper was just, and if he said so, he professed or confessed that he had heard more than one paper read which had not been so correct. Some men had had no opportunity such as Mr. Swanzy had of seeing Negro life. Travellers went from home, and on their return wrote a book, the sources of all they wrote being hearsay, and not experience. They had heard that there was nothing of what we call love to be found among the Negroes. Though they did not find the love met with in English family life, there was a something which they might call love. He did not expect to find love there, and he would tell them why. At home they had so many blessings they forgot it entirely, and they forgot that they had been trained for it during centuries. The Negro mind required training and education, and that not for one generation only, but for many, just as had been in Europe. There was a great difference between our feelings and Negro feelings, which he had particularly observed at funerals, where he had seen women with gin bottles on their backs weeping bitterly, and at the same time taking good care to get as much gin as possible. If they looked to family life there was something which they must call love. There was a wonderful family con-nection between Negroes, which was especially seen i[n] war. Sir John Glover, during the recent campaign, ha[d] two companies of soldiers from their mission. Ever[y] man was a soldier, and knew his captain and his com-pany. There was an order and an organisation amon[g] them. Finding during the petty wars on the Coast th[at] their Christians had suffered very much, and that th[ey] came home weak in morality, sometimes they to[ok] occasion to separate them from the heathen compan[ies,] but their Christians tried to resist this, and why? Th[ey] told him if they were killed or wounded in the fi[eld] they knew their cousin or their brother who w[as] in the same company would not leave them on a[ny] account, but would carry them off at every risk. Th[at] was the reason they stuck to their compani[es] even after they had renounced Paganism, and [as] they would guarantee that some of them sho[uld] be left, and they therefore formed the two Christ[ian] companies, which had been found to be the m[ost] reliable men in the whole native force during t[he] recent campaign. That showed they could do som[e-]thing with the Negro, and that his character m[ight] be improved by Christianity. He could not believ[e in] a Christianity that would not form a character. Th[en] again, their family connection was seen in the wa[y a] Negro told you of his cousins for generations ba[ck.] During slavery they saw it repeatedly. If a member [of] a family was in danger of being sold, the head of t[he] family would come forward and redeem him if th[ere] was any possibility. They would not leave him. Th[ere] was some love amongst them, but it was natu[ral] —not Christian love. With regard to civilisa[tion] at large, he quite agreed with Mr. Swanzy that educa[tion] must be the great feature in civilising Gold Coast peo[ple,] as it had been of Europe; but in speaking of educati[on] he did not only mean education on the sch[ool] bench. He did not believe in boys who got nothing b[ut] lessons out of books in the school-room. Mr. Swan[zy] had said that education sometimes spoilt a man. B[ut] what was more natural than for a Negro to imitate? [If] he saw a merchant making money he would lik[e to] become a merchant, or a teacher, or a missionary ev[en] if he was not fit for it at all. He wished for eve[ry-]thing; but he would tell them what he did not wis[h;] he did not wish to be a man who worked with [his] hands. He did not speak of these things by theory, [as] he had been superintending the Basle Mission, wh[ere] they had industrial shops, a shop for joiners and carp[en-]ters, for locksmiths, blacksmiths, shoemakers, and so [on,] and for a number of years they had an architect w[ho] had charge of all their buildings at nine differ[ent] stations, and twice as many out-stations, and theref[ore] they came in contact with the people, and lived amo[ng] them entirely. There was a mercantile establishm[ent] in connection with the mission, to which they had [the] right to send clerks. They had found their boys [did] not like to become farmers. They had two coffee pl[an-]tations, and they had tried to grow cocoa and oth[er] things. Cotton also had been introduced; but th[e] boys when they had passed through a school thought [it] was not right to be farmers. Slaves had done it chief[ly,] and they did not like it. He did not say that free peop[le] did not farm at all, but it had been done by slav[es] chiefly. It was therefore most natural that these boy[s] should think that they were a foot higher than oth[er] people, and that they ought not to do this work. Wh[at] they wanted was free labour. They had artisans no[w.] Plenty of carpenters, locksmiths, and other peop[le.] There was no difficulty to induce young men to ent[er a] shop. They wanted to be able to instruct them in mo[re] of the European arts. One thing much wanted w[as] pottery. Gold Coast people knew how nice it was [to] have a plate to eat from. All the people on the Gold Coa[st] have some pottery, but it was very imperfect, and he w[as] quite sure that much good might be done if some skill[ed] men were sent over and tried to improve the manufa[cture]

ture of pottery. He was quite sure it would pay, and would prove a great blessing. Then large quantities of palm-oil were exported, and there were plenty of materials for making soap and candles, and he thought it would be a great blessing if that branch of industry were also cultivated. They must educate the people for work and to be useful. The Negro must be trained for years. He must learn how to keep his little money. The Negroes were weak in keeping money. They had seen native merchants get on for a few years, but then fail, simply because they did not know how to keep their money. Until now there had not been much done in introducing European arts by anybody, and he should be very glad if the Government would introduce these things, and let them go farther into the interior, as it was not quite the work of a mission. They had now about fifty-eight native agents engaged in teaching and preaching without these artisans. They had men who had been in the elementary schools, then in the middle school, and then trained for teachers in a theological seminary for four years, making altogether a training of twelve years. The people who had gone through these schools are very useful. Of course they had some who had fallen back, but they had a number of men who had been with them for years, and who had been teaching in their schools, and who were useful in every way. There were now 1,000 people, young men, women, and children, who were instructed by the Basle Missionary Society. It was a small beginning, and he was not satisfied with it, but it would grow. Mr. Swanzy had said that European merchants remain on the Coast, but they could not do that. They must push forward and press into the interior now there was no station. They had a station in the interior, but it had been destroyed by the Ashantees in 1869. But since then the whole system of Government had been changed by the abolition of slavery. The Government was still called a protectorate, but that was entirely wrong. It was no longer a protecting Government, but a governing Government, and the Gold Coast was now actually a colony, and therefore British law must be introduced and securities given for trade. Why could not there be some settlement in the interior, protected by a small military force? The police had done the work on the coast, and in most cases they must do it in the future. He wished that commerce should be protected in the interior. They had not yet quite finished with Ashantee. It had not settled down since the last war. They were going there this year, and intended to establish two stations, and to open schools, and to preach the Gospel, and teach them how they might better themselves, and above all how they might be saved. There was a great difference in the civilisation found in the sea towns and those a little more in the interior. A friend of his who had been living with his wife at Coomassie, estimated the number of human sacrifices at 600 annually. In one place there was a mausoleum, where, whenever it required repairing, human blood had to be shed. To him it was a humiliating fact that they had been in connection with the Gold Coast nearly 500 years, and that until about 1820 nothing had been done for the civilisation of the people. From the time of the Portuguese they had no trace of Christianity. It commenced with the Basle and Wesleyan Mission, and some chaplains that were there. A merchant and a Government official were fellow labourers of the missionaries. Any European Government was ten times better than any native, and he rejoiced that the whole Gold Coast, stretching for 360 miles along the coast, and some 60 to 80 miles to the interior, was now British territory, and he was quite sure they would soon see real progress. In conclusion, he repeated that, as he had not come there to make a speech, his remarks had been somewhat desultory and disjointed. He had thrown off his coat, as they said in Germany, and just given them the result of his observations.

Dr. Mann said the Gold Coast, which was the subject of the paper, was a stretch of about 360 miles of the central part of the Gulf of Guinea, where it makes its great sweep in on the western outline of the vast continent, touching in one part the meridian of Greenwich, and being but little more at any part than five degrees from the Equator, with the Grain Coast and Ivory Coast bordering it on one hand, and with the Slave Coast on the other side. It was reckoned one of the hottest pieces of sea-board in the world, having a mean annual temperature of 78°, with the temperature of a pleasant summer day in England, namely, 73°, for its greatest cold. It has heavy rain from March to June, and then its greatest heat from July to September, this being accompanied by frequent heavy fogs and superabundant moisture, so that a very unhealthy state of the atmosphere is in this way established. There were, nevertheless, several trading stations on the coast which were permanently held by English traders, foremost among whom was the firm of the author of the paper. The principal stations were the well-known Cape Coast Castle; Accra, near the middle of the territory; Annamboe and Dixcove; Crevecœur, Christiansberg and Fredensberg were subordinate settlements. There were no harbours along the coasts, and the landing of merchandise and the shipment of produce was effected upon a rock-bound and surf-fringed shore, by the instrumentality of surf-boats. The native tribes of the district were principally the Fantis, and the notorious Ashantees. The Fantis were a fine race of men physically, and made admirable boatmen, being only inferior to their neighbours further west, the Kroomen, in that particular, but they were also the men of whom it was told that when they were supplied with wheelbarrows to facilitate some building work which they were required to do, they put the stones into their barrows and then put the barrows upon their heads and walked off with them. The boats of the Fantis were of much larger size than the canoes of the Kroomen, being often from 30 to 40 feet long, and managed by several men. He believed it was the Fantis who adopt the most ingenious expedient of loading their boats in the surf-swept sea by rolling the oil truncheons into the water, and drawing them through the surf, and by their sinking their boats under the puncheons and bailing the water out from them until they rise buoyantly with their loads. The Kroomen who came from the Grain Coast a little further to the west were perhaps about the most miraculous boatmen in the world. Their canoes were hollowed out of the trunk of a kind of poplar tree. They were very narrow, projected up at each end like the horns of a crescent, and were so light that they did not sink even when filled with water. It was said that no white man was able to manage one of these ticklish crafts, but the Krooman squats down with the most perfect comfort and stability upon his knees, and urges it through the boiling surf, and sometimes spins it swiftly round, one leg thrust out over the side into the sea to act as a pivot. When the canoe turns over he swims by the side, rights it, and bales it out with a calabash, and then takes his place in it again, as if nothing out of the ordinary course had occurred. In his physical development and ready agility the Krooman resembles very much the Zulu Kafir of the eastern coast; but it was a remarkable, and perhaps unaccountable fact that the physical development and power takes such an entirely different turn on the opposite side of the continent. The Zulu is as great in journey upon land as the Krooman is at sea, but he will have nothing to do with the water, and has no boat of any kind. There was another reflection that continually recurred to him when thinking of the resemblance of these people, and which he thought might be worthy of a passing notice while speaking of them—the seemingly trivial and simple fare out of which this muscular energy was developed. The diet of the Krooman was a pint and a half of rice per day, and upon that allowance of food could paddle his forty miles upon a boisterous se

keep his lithe frame in vigorous condition. The daily allowance of the Zulu Kafir engaged in hard work in a similar way, was two pints of ground maize, or Indian corn. With a considerable acquaintance with the principles of physiological economy, he confessed that when he thought of these instances, he was filled with a never-ceasing admiration and wonder at the work which can be extracted, in these exquisite pieces of living machinery, out of such a limited and apparently inadequate fuel supply as a few handfuls of grain. The Ashantees, who were so nearly associated with the Fantis, upon the Gold Coast, again suggested another very curious analogy with the Zulus of the opposite side of the continent. In their barbarous and unreclaimed state they had established a warlike despotism, exactly resembling that of the Zulus of half a century ago, and based upon identically the same principles of strategy and management. They have eaten up tribe after tribe, in their immediate neighbourhood, of less adventurous and less ambitious natives, and have turned their young men into disciplined soldiers with an insatiable thirst for martial glory and conquest. The Ashantee power has grown in this way out of the gradual absorption of the smaller independent tribes, exactly as the Zulus grew under the warlike chief Chaka, whose history was told on the first meeting of the African Section of the present Session; and no doubt Mr. Swanzy and his compeers were now doing for the Ashantee despotism, and barbarism, what Lieutenant Farewell and Mr. Fynn were doing for the Zulu power, when they formed their trading settlement at the Bay of Natal in 1823. Nothing was more true than the remark, which was made by Sir Bartle Frere in his inaugural address to the African Section last year, that the work which has to be done in reclaiming the vast equinoctial continent of Sunshine from the fell grasp of barbarism, was the direct reverse of the chain of sequence that was expressed in the designation of their Society. It must be commerce, manufactures, and arts, rather than arts, manufactures, and commerce. All round the vast surf-girdled coast small wedges were being driven by the enterprise and irrepressible energy of commerce and traffic into the sea-board of the barbarous land, and through the rifts that were in that way torn into the outer defences the light of the higher and better life of civilisation and intelligent culture assuredly finds its way. Such, no doubt, was the proper and appointed task, and the noble privilege of the irrepressible and invincible spirit of trade. It was the great natural pioneer of enlightenment and of social development. He then referred to a leading article in the *Times* of last Saturday, as notably bearing out a remark he had already made in this room, on the obvious distinction between common and domestic slavery. The writer said, in reference to the Gold Coast—"Nor had the condition of the slave been necessarily, or usually, one of hardship. Cases of cruelty had long been held to justify enforced manumission, and by this practice the evils native to the system were sensibly mitigated. Servitude was often voluntarily preferred to free labour, and, curious as it may seem, was held from an economical point of view to possess advantages over it. If we may apply common expressions to a state of life so unlike anything European, we may say that the Fantee slave was socially on a footing with his master; he sat at his table, shared his pleasures, had a voice in the family councils, and often married a free-born daughter of the house. The slave might hold property, and even be his master's heir. Fantee slavery, in short, like that with which we are familiar in the Mosaic law, was of the patriarchal type, and differed totally from the odious forms of predial servitude which has cost us and other communities so dear in their abolition. Yet nothing of this kind justified us in conniving at its maintenance when we had so good an opportunity of interposing our authority to get rid of it. Slavery is slavery all the world over, and the least intolerable of its forms may, under changed conditions, develope into the very worst."

The Chairman said he was very sorry to close the discussion, and thus prevent many gentlemen present from speaking, but he was glad to congratulate them on the practical interest and value of the labours of the African Section. They could not discuss anything with regard to one part of Africa without its having some bearing upon other parts. Even Sir Garnet Wolseley's experience on the Gold Coast was found to be useful to him in the mission he had recently undertaken in the south. Mr. Swanzy had called attention to a point of history, and if time permitted he would have gone into it. It might well be matter of wonder to them how so early as the reign of Edward, the little town of Dieppe should engage in such an enterprise. Then all people were looking out for gold, and great enterprises were undertaken, such as those connected with the Hanseatic traffic and the trade in the Levant. One subject which had been of practical value was the way in which Mr. Swanzy pointed out to them how slavery in its varying relations affected the agricultural improvement of the country. It must be particularly injurious to a pursuit of that nature, for when in well-settled countries it was difficult to get the cultivation of a crop which required labour and capital, how was it to be expected in a country where life was of little value. But the introduction of a proper Government would, no doubt, affect great changes, and the introduction of labour under improved circumstances would wonderfully develop the resources of West Africa. In conclusion, he proposed a vote of thanks to Mr. Swanzy, observing that they would not be his sole reward, but, having laid down the principles of truth, he would find they would continue to be productive of good, years after this assembly had ceased to exist.

Mr. Simmonds seconded the motion, which was carried unanimously.

Mr. Swanzy, in reply, thanked the meeting for its expression, and regretted that, owing to the length to which parts of his paper had run, he had in other parts curtailed it, for he found it extremely difficult to compress within the space of an hour what he wished to say. But they had no cause for despair as regarded the future. What he had in view was to show that until about the beginning of 1834 nothing whatever had been done, and that, although they had been in contact with West Africa for the last 500 years, it was not until the last 40 years that any efforts had been made to improve the people, and to advance the interests of civilisation. If he had drawn attention to this he had succeeded in his object.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 31st, 1875; Dr. William B. Carpenter, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Alcock, Sir Rutherford, 14, Great Queen-street, Westminster, S.W.
Bailey, C. Stuart, jun., 10, Harrington-square, S.W.
Bird, Edward, 2, Lawrence Pountney-hill, E.C.
Brown, Alexander Forrester, 53, Gloucester-terrace, Hyde-park, W.
Crowe, Francis, LL.D., F.R.G.S., 22, Westbourne-park-road, Bayswater, W.
Durlacher, Henry, 134, Harley-street, W.
Faija, Henry, 30, John-street, Bedford-row, W.C.
Fenn, Thomas, 14, Bedford-square, W.C.
Fry, Frederick Morris, 14, Montague-street, Russell-square, W.C.
Green, William John, 24, Spring-gardens, S.W.
Holborn, R. M., 11, Highbury-crescent, N.
Kent, Frederick, 8, Red Lion-court, Cannon-street, E.C.

Lessen, Herbert Seymour, 4, Old-square, W.C.
Liggins, Henry, 3, Ladbroke-square, W.
Middleton, Thomas, Springfield, Heath Charnock, near Chorley, Lancashire.
Palmer, T. G. A., 5, Paper-buildings, Temple, E.C.
Parbury, Frederick, 99, Lancaster-gate, W.
Peacock, Joseph, 15, Bloomsbury-square, W.C.
Poynder, William Henry, 21, Upper Brook-street, W., and Hartham-park, Wilts.
Pratt, J. J., Consul-General of South African Republic, 24, Coleman-street, E.C.
Price, Captain George Edward, M.P., 39, Onslow-gardens, South Kensington, S.W.
Riley, Moreton John, 7, Lancaster-place, Strand, W.C.
Stone, John, 5, Bernard-street, Regent's-park-road, N.W.
Woolley, Joseph, M.A., LL.D., Norbiton, Surrey.

The following candidates were balloted for and duly elected members of the Society:—

Anderson, Charles, Sligo.
Binko, Henry Bock, 28, Bath-street, City-road, E.C.
Cole, Henry Aylwin Bevan, 5, Northumberland-terrace, Tynemouth, Northumberland.
Dangars, John William Gustave Leo, 3, Plowden-buildings, Middle Temple, E.C., and Clarendon-house, St. John's-wood-park, N.W.
Duncan, George, 2, East India-avenue, E.C.
Holland, W. H., St. Mary-street, Gloucester.
Langton, George, 2, Northfield-villas, Wandsworth, S.W.
Langton, John, 1, Northfield-villas, Wandsworth. S.W.
Langton, Joseph, jun., 2, Northfield-villas, Wandsworth, S.W.
Robinson, William, Mount-pleasant, Wembdon, Bridgwater.
Sharpe, Captain W., J.P., Hanwell-park, Middlesex.
Soto, Don Carlos Ernesto, Consul-General of the Republic of Uruguay, 3, Spring-gardens, S.W.
Steel, James, F.C.S., Messrs. Steel and Co., Glasgow.
Waymouth, B., Lloyd's, 2, White Lion-court, E.C.
Young, William, Lloyd's, E.C.

The paper read was—

FOOD ADULTERATION AND THE LEGISLATIVE ENACTMENTS RELATING THERETO.

By Wentworth Lascelles Scott,

Public Analyst to the Counties of Derby and N. Stafford, the Borough of Hanley, &c., &c.

I have undertaken to lay before you this evening a few facts relating to the adulteration of food, drink, and drugs, as commonly practised in this and other countries; to pass briefly in review some of the laws, past, present, and prospective, bearing upon the class of offences just indicated; and finally to invite the expression of your opinions as to the best mode of amending, equalising, and consolidating those laws in such a manner that the public pocket and the public health may be duly protected without injuring or hindering the development of the legitimate interests of trade.

I have the honour of belonging to that small but well-abused class of officials known as "public analysts;" and although I hope to show you that collectively the public analysts of this country have done good and practical service within the last two years, and that individually they have been from the first more sinned against than sinning, I come before you to-night as a simple truth-seeking student of science, trammelled by no trade connections, wedded to no pre-arranged views, and representing no one party, society, or association whatsoever. It has been, I regret to say, but too much the custom of late, throughout all discussions bearing upon the subject of my paper, to treat the question as if it must necessarily be a constant bone of contention amongst four antagonistic sections of this great community—the chemists, the lawyers, the traders, and the public—each of whom should earnestly strive to obtain as many real or fancied advantages as possible at the expense or to the prejudice of any or all the others. With this mode of dealing with an important social problem I have, I must confess, no sympathy whatever; and, without desiring in any way to trench upon the province of the Chairman, I beg to submit that the question now before us may be rationally, effectively, and dispassionately considered by all parties conjointly; and that in the end it will be found that the food legislation which is best for all is in reality best for each. It is in this spirit alone that I invite your opinions and suggestions to-night.

I do not think that, whatever might have been the case a few years ago, there are now many people who actually believe that our "food, drink, condiments, and narcotics" are invariably good, pure, and unsophisticated, that they are fairly represented by the names under which they are sold, and that, in point of fact, no such practice exists, or has existed, as that of "adulteration," except in the heated imaginations of a few *dilettanti* chemists and impecunious magazine contributors. It is therefore perhaps superfluous to trouble you with any very long array of facts or arguments to prove, firstly, that the adulteration of both necessaries and luxuries is comparatively common; secondly, that it is detrimental to the public health and public morals; and, lastly, that a just and effectual mode of checking it is desirable.

Nevertheless, it may not be quite inappropriate if we devote a few moments' consideration to a time when there were no analysts to discover or to invent adulterants, as the case might be, and when both "food" and "drink" were almost universally referred to under the term of "victuals." As early as the reign of Henry III. it was found necessary to take cognisance of various malpractices prevalent amongst bakers, millers, and wine-dealers,* especially in relation to forestalling, short weights, deficient measures, and admixtures, and to award punishments for such offences; and shortly after the accession of Edward I. the laws and ordinances, both imperial and municipal, against adulteration, were greatly extended in operation, and were more generally enforced.

In the quaint, but carefully-written "History and Survey of London and Westminster," of Entick (1766), we read that in A.D. 1274 adulteration of various kinds, short weights and measures, as well as "engrossing, forestalling, and *all sorts of frauds and impositions in the sale of provisions*, has now got to such a height as to oblige the Legislature to provide new laws against such practices; especially against bakers for short weight and bad materials in bread, and against

* *Vide* "History of Survey of London and Westminster," by the Rev. John Entick, M.A. Vol. 1. London—W. Ward and Charles Tilley, A.D.

millers for bad measure. Therefore his Majesty commanded the Mayor of London and the Sheriffs to enforce those laws, and also to regulate the price of provisions, especially of poultry and fish. By which laws, the baker for his first offence was to forfeit his bread; for his second to suffer imprisonment; and to be pilloried for the third. The miller was to be carried in a tumbril or dust-cart through certain streets, exposed to the derision of the people; and accordingly an ordinance was published by the Mayor and other magistrates of the city, in this form."

In spite, however, of these which may be called mildly repressive measures, adulteration and other "foul practices" appeared to continue and increase during the next twenty years; so much so indeed that on "the 28th of May [A.D. 1295], the King sent a precipe to the Mayor and Sheriffs of London to *punish corporally* all bakers, brewers, and millers, convicted of bad practices and also to oblige millers to return the flower by *weight* according to the weight of the grain sent to be ground."*

By way of following up these measures, there was passed in 1296, during the mayoralty of Elias Russell (according to Stowe), an Act of Common Council, subsequently approved by Parliament, to regulate the quality, prices, and modes of sale of all kinds of provisions.

Wine formed the object of a special writ of Edward II. in 1311, according to which, among other things, it was enacted that no wholesale dealer in wine should also be a retailer of the same, or *vice versa*, that arrangements should be made for the "assay" of "wines in all the taverns of London, and in the suburbs,"† also that "every wine be set at its value, *without mixture*." Under certain circumstances the "dregs of wines" were permitted to be "put into wines of lower price," but the "droppings of wines" were "to be thrown away, so as not to be put into any drink that has to enter man's body," under divers heavy pains and penalties.

It is about this period that we begin to find some authentic records of the detection and punishment of vendors of adulterated articles, and I have thought it well to lay before you a few typical instances of these existing "food prosecutions;" thus in August, 1311, a baker, named William de Somersete, was arrested by the Sheriff for selling bread made of bad materials, "so that persons by eating that bread would be poisoned and choked." In 1316 a number of bakers appear to have been punished in various manners for selling bread which was of short weight, and "made of false, putrid, and rotten materials, through which persons who bought such bread were deceived, and might be killed." (Appendix, Section 6.) Here we have the "injurious to health" clauses coming prominently forward, and a gentleman of the name of Alan de Lyndeseye "appears to have particularly distinguished himself in this direction, as he gets twice convicted and pilloried," within a very short time.

Entick‡ tells us that in 1329 "the adulteration of wines and the evil practices of the wine merchants and tavern-keepers having endangered the bodily health and lives of the citizens, his Majesty (Edward III.) issued out his command to the Mayor and Sheriffs, publicly to proclaim and to publish that none presume in any manner to mingle such wines, nor to sell any mixed, but good and pure, and to punish the offenders against this prohibition by levying a forfeit upon them for the King's use." Again, in 1364, a seller of unsound or adulterated wine was punished by being forced to drink some of his mixture, and to have the remainder poured over him, as well as to lose all his trade privileges.

In the reign of Richard II. proclamation was made, amongst other things, against the adulteration of oils used for food with others of lower quality, and in Henry V.'s time (1416) we find records of what might be called a Report of the City Wine Assayers, when four pipes of wine appear to have been condemned. Ten years later the "Merchants had carried the practice of adulterating foreign wines imported *to such an excess*, and with *such pernicious ingredients*, that the Mayor, Sir John Rainwell, ordered a general search, and caused 150 butts of the corrupt liquor seized to be staved and thrown into the streets, whose noxious smell almost infected the air."* Thus were some of the regulations contained in Henry the Fifth's celebrated proclamation in 1419 against the fraudulent mixing and adulteration of wines enforced, and in the very year in which the proclamation was made we find that one William Horold was punished for, as we should say now, injuriously adulterating certain wines, and public announcement made at the pillory of his offences. It would be easy to multiply instances showing that the adulteration of articles of food and drink is no "nineteenth century offence," and has troubled the people and their rulers for centuries, but those I have already referred to are amply sufficient for my present purpose. It should be remembered, moreover, that in former times the vendors of food, as of other classes of goods, were for the most part banded together in crafts, guilds, or companies, such company possessing, either in addition to or in lieu of a regular charter of incorporation, a code of bye-laws or regulations which included provisions for the discouragement of malpractices of all kinds, and for punishing any members found guilty of the same; thus the association of Spicers or Pepperers agreed amongst themselves to draw up and observe the ordinances issued by them in 1361, which contain very important prohibitions against short weights, adulteration, and other tricks of trade; and the Vintners (1370) appear to have been equally desirous that the members of their guild should be just in their dealings with the public, as it was ordained "that four men of the trade should be chosen and sworn to search into such defaults, and to oversee that the ordinances are well and justly kept and observed from year to year; and that no wines shall be exposed in taverns for sale before that the four persons aforesaid shall have seen that they are good and fit for sale.†" Such articles and ordinances, if duly approved by the Mayor and Aldermen, had all the efficacy of an Act of Parliament, and were enforced accordingly.

As population increased and commercial rela-

* Entick's "History and Survey of London," I. p. 194.
† Riley's "Memorials of London," p. 81.
‡ "History and Survey of London," &c. I. p. 249.

* "History and Survey of London, Vol. I., p. 347.
† "Memorials of London," p. 343.

tions extended in every direction, these trade associations became less powerful and their laws less observed, and in course of time the guilds themselves in many instances ceased to exist; and it is not a little instructive to note the tendency there seems to be at the present day to resuscitate, or at least to rebuild upon a new basis, trade companies and associations like those of 500 years ago. There is, however, this remarkable difference between the ancient craft-guilds and the modern associations, that the former were especially solicitous about the good conduct of their craftsmen generally, and professed to discourage adulteration and sophistication of all kinds, frequently depriving members of their own body of the means of following their calling, if convicted of such offences; while the licensed victuallers', the druggists', the grocers', and other associations of our time, not only express no material disapproval of such conduct, but frequently put the whole weight of their influence, organisation, and finances against a much-needed prosecution, and are only too happy if they can succeed in defeating the ends of justice on any terms. Then the hat goes round pretty freely, the wrongs of the "injured tradesman" are trumpeted forth *ad nauseam*, and that suddenly celebrated individual sends a handsome donation to the association fund, lives happy ever after, and probably adulterates more than ever. Happily there are a few exceptions, among which I may point to the Wolverhampton Chemists' and Druggists' Association, which has recently decided that in the opinion of this association all traders, and especially chemists, ought to be acquainted with the quality of the foods they sell, and to discourage adulteration by all possible means, and for the good of the public and the honour of traders themselves, I trust that these may gradually increase, and that, as time and intelligence progress, the trade associations of this country may, in one respect at least, resemble the guilds of our forefathers' days, and apply their minds and means to the repression of adulteration—not to its defence.

Resuming for a moment this necessarily hurried review of past food-legislation, I may observe that within a short period of our history, the adulteration of intoxicating liquors was the cause of more than one Act of Parliament and Royal precept; and at various later periods bread, coffee, cocoa, tea, &c., were each in turn treated to an Act of Parliament or two of their own. One capital defect, however, seemed to paralyse all legislation upon this subject, viz., that although certain offences were recited therein as being punishable by heavy penalties, &c., no practical and equitable method of obtaining evidence of the committal of such offences seems to have been provided for. As a natural consequence, fresh measures were frequently passed, each repealing all or part of some previous law, until at one time during the Hanoverian period the regulations as to the sale, &c., of bread threatened to become as complicated and perplexing as those pertaining to intoxicating liquors. If one Parliament enacted that bread should be made of wheaten flour only, a later one would revise this decision altogether, and a third would repeal this in turn and manage to leave the question open to about half-a-dozen interpretations.

The Act of William IV. (6 and 7 Giugl. IV., c. 37), did not import any very great novelty into the matter, but some good results have been obtained—thanks to its provisions—both by the late Dr. Normandy and by Mr. John Horsley, of Cheltenham.

It cannot be denied that the public of this country are greatly indebted to the Inland Revenue Department and to her Majesty's Customs for a great deal of sound and useful work in relation to the repression of the adulteration of certain classes of articles, but as these departments have naturally looked at everything from a purely "revenue" point of view, it follows that the benefit derived from their examination of food products, &c., has been very considerably less than it might have been, had the health and pockets of the people been a little more thought about. The four hundred and odd "Acts and Ordinances" relating to duty-paying articles I shall leave without notice, in the hopeless state of barbaric confusion to which successive generations of party and petty legislators have brought them, and will turn at once to the Adulteration Acts proper of 1860 and 1872, as the circumstances leading to their being passed, the "Lancet Analytical Commission," and the report of the Parliamentary Committee on adulteration, are comparatively fresh in our minds to-day.

The appointment of analysts under the Act of 1860 being purely optional, thanks to trade opposition in and out of Parliament, some six or seven only appear to have been appointed, of whom four were allowed to do nothing at all, two others had a few samples submitted to them at first, and at first only, and one has managed to keep the Act in practical working order for the last thirteen years. I allude to Dr. Cameron, of Dublin, whose last report, that for 1874, is on the table. Since 1862, Dr. Cameron tells me he has performed about 2,600 official analyses of food, drugs, and drink, of which about 1,500 were of adulterated articles, while the list of convictions for the period just indicated stands thus:—

For adulterated	milk	286
"	coffee	28
"	tea	2
"	bread	2
"	butter	2
"	mustard	6
"	essence of coffee	1
"	champagne	1
"	brandy	1
"	gin	1
"	confectionery	12
Total convictions		342

This return, however, may almost be taken as that for Ireland, although but little comparatively has been done, except in the City of Dublin; and this is, I believe about the only return worth mentioning as resulting from the Adulteration Act of 1860. In England I do not believe that 250 samples were examined under its provision in the twelve years preceding 1872.

A passing notice is due to the "Adulteration of Seeds Act, 1869," which might have been a good and useful measure, if there were any practical means of proving the offences it cites. Thus the "killing" and "dyeing" of seeds, and the selling of "killed" or "dyed" seeds are offences punishable for the first time with a fine not exceeding £5, but as no

reference is made to any authority or expert for the purpose of determining when seeds are "killed" or "dyed," or are left in the original condition, it is not surprising that I can find no record of any proceedings having ever been taken under this Act. I am of opinion that the Act should be repealed, and its spirit and intentions more clearly and satisfactorily expressed, and then incorporated in the next Food Adulteration Act passed in this country.

The Adulteration of Food, Drink, and Drugs Act of 1872, next claims our attention. The purely permissive character of the clauses referring to the appointment of analysts in the Act of 1860 are in that of 1872 so far modified, that out of the 225 districts capable of appointing such officers, nearly 150 have done so up to the present time, leaving over 75 places where no attempt whatever has been made to repress adulteration.

In the columns of Table III. you will see the number and names of those districts which have appointed "approved" analysts, the names and remuneration of the officers, &c., as far as can be ascertained up to a recent date; and I may at this point not inappropriately refer to the very great inexpediency of allowing the anomaly to continue of one district putting the Adulteration Act into operation very vigorously and usefully, while another one adjoining does nothing of the kind, and permits the "usages of trade" in their worst forms to flourish unrestrained. If a virulent epidemic were suddenly to arise in all parts of this metropolis, what would be said of its governing bodies and of its medical officers? If Paddington was allowed to adopt no sanitary measures whatever, while Marylebone set to work with a will to stamp out the plague within its boundaries; if at Hackney special hospitals, house-inspections, disinfections, and other precautionary measures were inaugurated, and in Holborn people were allowed to eat, drink, and sleep in infected houses, and the disease was left to take its own course, and so on throughout the catalogue of parishes or districts, what would be the result? Yet this state of things is precisely what is going on all over the country with regard to the Adulteration Act. In one county the Act is adopted and doing good, in the next there is no analyst appointed, and the public may be within its boundaries cheated and poisoned without hope of redress. To go no further than Staffordshire; in the county itself, the Act has done a very considerable amount of good, and I can trace some little improvement, even in Hanley during the last few months; but the boroughs of Lichfield, Walsall, and Newcastle, although within the county geographically, are not within its jurisdiction, and therefore articles of food and drink are frequently sent to those towns, especially the two latter, to be sold, which might be dangerous outside their walls if "inspectors" were about.

Again, in many instances, local authorities have hit upon another and even effectual way of how not to do it. An analyst is appointed, or perhaps two, even, and after a lengthy correspondence, an elaborate scale of fees is drawn up and printed, and there ends the entire matter; the analyst of that district may write, he may memorialise, he may report, he may, in fact, do anything he pleases but analyse—not a single sample can he obtain, either because no food inspector has been appointed, or else because that official has been instructed not to purchase any. I may point to Derbyshire by way of illustrating the former, and to Ipswich as an instance of the latter.

I have endeavoured in Table IV. to give you a tolerably fair idea of what public analysts have actually done up to the present time, and, as in the great majority of cases I am indebted to the analysts themselves for their individual returns, I desire to take this opportunity of tendering my best thanks to all who have replied to my circular letter of last month. In some seven or eight instances the figures are taken from the list of Mr. Wigner, the Secretary of the Society of Public Analysts, and my thanks are also due to that gentleman for allowing me access to the same.

It will be seen from these tables how many samples have been officially examined by public analysts during the past two years and a-half; the number of those which have been certified as adulterated to a greater or less extent, and the number of convictions which have been obtained.

With the view of affording a better means of comparison, I have calculated and introduced in Table IV. the percentage of the adulterated samples in the total number analysed in each district, and also the proportion of convictions obtained per 100 samples submitted; and I would suggest that in any future returns, whether for Parliamentary or other purposes, a similar plan should be adopted. Owing to the somewhat loose and variable manner in which the details of the work has been noted in the returns forwarded to me from each district, I have only shown the number of samples found to be adulterated, and not those of other articles. Milk has received, and in my opinion very properly, greater attention than any other article, and the importance of obtaining it in a pure and unmixed state, not only on account of the difference in money value between pure and highly-watered milk, but also because of the diminished nutritive power of the latter and the probability of its spreading disease under some conditions. In the course of my general inquiries and researches in relation to the food of the people during the last nineteen or twenty years, I have of course paid very considerable attention to the natural variations possible in this secretion, and to the best modes of examining it analytically. Within the time just mentioned over 22,000 analyses of milk have been performed either by or for myself, and it follows, therefore, that (without intending anything either offensive or personal in this remark) I cannot approve of many of the recommendations given in some recent treatises on this subject. I am very decidedly of opinion that in any future Adulteration Acts analysts should be required to state to the Local Government Board, on their being formally confirmed in office by that authority, the standard percentage of "deoleised milk solids" they propose to adopt for the particular district for which they are appointed, as representing on the average 100 parts by weight of pure milk, and also the evidence, analytical or otherwise, upon which that standard has been based. I am convinced that these milk standards vary very considerably in different parts of the United Kingdom, and I think that it would be fair and just generally

acknowledge this fact. This standard, when approved by the Board for any district, would be officially published as the standard for the same, and all analyses of milk should be ascertained thereon. I think, too, that all certificates should state exactly the percentage of added water, if any, shown by the analyses calculated on such published standard, but that it should be provided in the Act that no prosecutions should be valid in respect of milk certified to be adulterated with 6 per cent or less of water, unless other evidence, chemical or microscopical, showed the presence of any substance likely to be injurious. I submit that it is a point of much importance whether water clean and wholesome in itself is employed as the adulterant for milk, or whether the diluent can be proved to be impure, and contaminated with living organisms, or other presumably unwholesome matter. I have met with many cases of milk so adulterated, and heavier penalties have in consequence been inflicted.

Next in importance to milk in relation to the public health I place intoxicating liquors of all kinds, and I think that the evidence in my possession in relation to the very extensive and pernicious manner in which these articles are adulterated would, if it had been given before the Committee of the House of Commons last year,* have induced that paragraph of their report, headed "Wine, Spirits, and Beer," to have been very materially modified.

As may be seen from Tables I. and II., I have officially examined some 170 samples of intoxicating drinks in North Staffordshire, of which a comparatively large proportion were found to be adulterated in some degree, and about 16 convictions have been obtained for the worst cases, some half-dozen of which were for adulterating ale with *Cocculus indicus*, in addition to salt and other flavouring matters. A licensed victualler at Tutbury, near Burton, was convicted, under my certificate, of selling ale much adulterated with salt and *Cocculus indicus*, and brandy which had been first "lowered" with water, then "fortified" with common spirit, and, lastly, had had a fictitious strength imparted to it by means of some preparation of Cayenne pepper. This ingenious gentleman, in spite of a vigorous defence, in the course of which he declined the offer of the Court to offer the remaining portions of the samples to an independent analyst, was fined £5 in each case. At Tunstall a sample of a compound—I cannot dignify it by the name of wine—known in the district by the name of "Good Templars' claret"—I found to be very grossly adulterated indeed, water, impure spirit (containing much fusel oil), free sulphuric acid, and extract of logwood, forming nearly half of this sample. Of course a medical man, the analyst of a neighbouring district, was called in for the defence, and if he had confined his evidence to the fact that he had received a sample of claret from the defendant (Mr. Pendleton), and had found that to be pure, his observations would have commanded my respect; however, carried away by over-zeal for his client, he offered (in court at least) to buy all the claret in defendant's cellars—it was so wonderfully good at the price—informed the Bench that the colouring matter of logwood was "incapable of detection," that all wine contained "impure spirit," and that therefore this allegation was of no importance. With this conflicting testimony before them, the Bench had no resource but to seek information elsewhere, and accordingly one of the highest authorities on the chemistry of wine, viz., Dr. Thudichum, was appealed to, and his report fully confirmed my original certificate. A conviction followed, but was appealed against, and the battle was fought over again at quarter-sessions, with the result of confirming the original judgment (£5 and costs) on every point, and of causing this monstrous instance of injurious adulteration to stand in a worse light than it did at first.

Five or six convictions have been obtained under my certificates for the adulteration of beer with *Cocculus indicus*, and one where the most pernicious ingredient present was found to be some preparation of *colchicum*. At Hanley, some bitter ale was submitted to me containing picric or carbozotic acid, and a large proportion of common salt, but the prosecution herein was futile, through the proper notice of purchase not having been given. While on the subject of the adulteration of malt liquors, I wish to direct your attention to some important changes which have taken place during the last few years in the preparation of these beverages.

It is a trite saying, that people seldom know when they are well off, and a practical illustration of its truth is afforded by the experience of the hop growers and dealers of this country. While the hop duties were in force, the Inland Revenue Department exhibited a very decided objection to beer being "bittered" by anything but hops, for the good and sufficient reason that the more hops used, the more duty was collected by that department. Now, it happened incidentally that the hop duty protected the public to a very material extent from the evil effects of a number of beer adulterants, but the hop trade did not like paying duty upon their staple—somehow people never do like paying duty—and they petitioned and memorialised and petitioned again, until in 1862 their wishes were complied with, and now I think, after a lapse of only a dozen years from that date, 99 per cent. of the hop merchants of this country would be very glad to see that duty re-imposed, inasmuch as for every sovereign formerly paid as duty, they now lose at least three by reason of the "hop supplements," "hop substitutes," "hop essences," and a host of other bitter abominations now sold to the brewers in lieu of the hop itself. Some of these may not be positively and actually "injurious to health," although some are thus objectionable; but the entire family of these cheap and acrid "bitters" possess properties differing widely from those of the hop, and they are all adulterations which, in my opinion, should not be permitted to contaminate an Englishman's beer unless declared in a fair and open manner. Malt and hops are supposed by the public to be the sole materials from which beer can be legitimately produced, with the exception perhaps of saccharine or grape sugar,* now allowed

* The writer was given to understand that he would be required to attend the Committee, and held himself in readiness to do so, but was not called.

* Formerly produced by the action of dilute sulphuric (or other) acid upon starch or cellulose; now more frequently by subjecting starch to the influence of *diastase*.

under certain restrictions to be used in connection therewith; and if beer is also to contain a whole host of astringent bitters in order to further increase the profits of a very powerful class of traders, whose incomes are generally amongst the most certain, at the expense of another section of the commercial world whose annual takings are necessarily very uncertain indeed, and to the serious although gradual detriment of the digestions of her Majesty's lieges, then I say such multifarious decoctions of quassia, gentian, chiretta, calumba, chamomile, oak-bark, barberry-root, bitter-ash, *et hoc genus omne*, should be sold as such, and not be allowed to delude all thirsty souls in the garb and under the respected name of "John Barleycorn."

The late Sir W. H. Bodkin gave it as his opinion that fully 75 per cent. of the pauper lunatics of this country owe their said condition solely to the influence of drink, and that, in respect to more than half of this proportion, the adulteration of intoxicating liquors had done more towards producing mania than the liquors themselves in their legitimate or pure condition. Then, again, as regards our criminals, the Hon. and Rev. Arthur C. Talbot writes, as regards Staffordshire:—"My experience of gaol statistics tells me that in our prisons, containing always 600 or more inmates, not less than 85 per cent. find their way there through drink. The police officers tell me that in many instances the effects of drink consumed in low localities are a temporary state of madness, causing assaults and other offences to be committed before the effects of the liquors have passed off. This shows the extreme necessity of great attention being paid to this point. If liquors were pure I am sure the numbers in the prison would be considerably diminished."

The next Act for preventing adulteration ought to contain provisions with special reference to intoxicating liquors. If the Bill now before Parliament passed in its present form, with a proviso that convictions should only follow where absolute knowledge of adulteration was actually proved, the effect would be to restore the system of adulteration which prevailed some years ago. And, again, if the form of certificate given in the schedule was alone to be received as evidence, much inconvenience would be felt.

TABLE I.

Showing the number and kind of Articles of Food, Drink, &c., examined by the Analyst of the Borough of Hanley during the Nine Months* ending the 28th day of February, 1875, the number of such Articles found to be Adulterated, the number of Convictions obtained, &c.

Description of Articles of Food, Drink, &c.	No. of Samples Analysed.	Adulterated. Injurious to Health.	Not Injurious to Health.	Total.	Total not Adulterated.	Number of Convictions.	Number of Cases Pending.	Remarks.
Arrowroot	3	...	3	3	...	...	1	
Ale	2	1	1	2	...	...	...	One specimen of bitter ale adulterated with salt and picric acid.
Bread...	6	...	2	2	4	...	...	
Brandy	5	1	...	1	4	...	...	
Coffee	3	...	1	1	2	...	...	
Citric Acid	1	...	...	...	1	...	...	
Confectionery	1	...	...	...	1	...	...	
Cocoa	1	...	1	1	...	...	...	
Damson Jam	1	...	1	1	...	...	...	
Gin	5	2	...	2	3	1	..	Adulterated with impure spirit and lead.
Mustard	2	...	1	1	1	..	...	" " flour and turmeric.
Milk	14	2	6	8	6	3	...	" " impure water in two cases; one specimen contained 41 per cent. adulterant water. Fined £10 and costs.
Pepper	8	1	4	5	3	0	...	
Pickles	2	2	...	2	...	1	...	Adulterated with sulphuric acid and some precipitate of copper.
Precipitated Sulphur	1	1	...	1	...	1	...	Adulterated with over 62 per cent. of gypsum.
Pulverised Scammony	1	1	...	1	...	1	...	" " sand, chalk, and wheaten flour.
Quinine	1	...	...	...	1	...	...	
Raspberry Jam	1	...	...	...	1	...	...	
Rum	4	...	1	1	3	..	...	
Tea	8	...	4	4	4	...	...	
Wine	23	3	10	13	10	...	...	
Whiskey	22	1	7	8	14	0	...	One sample grossly adulterated with lead and methylated spirit.
Total	115	15	42	57	58	7	1	*** At the inauguration of the Act, the inspectors omitted to give the proper legal notices to vendors, hence some vendors escaped prosecution.

* No samples have been submitted since November, 1874.

TABLE II.

Showing the Number and Kind of Articles of Food, Drink, &c., Examined by the Analyst for the County of Stafford (Northern Division), during the 15 Months Ending the 28th Day of February, 1875, the Number of such Articles Found to be Adulterated, and the Number of Convictions Obtained.

Description of Article of Food, Drink, &c.	No. of Samples Analysed.	Adulterated.	Not Adulterated.	Number of Convictions.	Remarks.
Ale	89	26	63	10	Several adulterated with cocculus indicus; one with colchium; others with salt and foreign flavouring matters.
Anchovy Sauce	6	5	1	..	
Arrowroot	55	29	26	12	Chiefly adulterated with potato, maize and other starches.
Butter	9	2	7	..	
Bread	22	3	19	..	
Coffee	8	3	5	..	Chicory the only adulterant here.
Cocoa	4	3	1	..	
Confectionery	22	2	20	1	Chromate of lead in one sample vendor fined 6d. and costs.
Flour	4	..	4	..	
Ginger	25	3	22	..	
Lard	8	..	8	..	
Linseed Meal	2	..	2	..	
Mustard	58	32	26	14	Flour and turmeric chief adulterant herein.
Milk	153	77	76	42	Many adulterated with highly impure water.
Oil of Lemon	3	1	2	1	Adulterated with fixed oil and with light petroleum spirit.
Oil of Cloves	1	..	1	..	
Pepper	132	53	79	22	Large quantities of sharp sand and a variety of vegetable matter.
Pepper (Cayenne)	7	2	5	1	Adulterated with flour, salt, and red lead; 5s. and costs.
Pickles	42	26	16	22	Adulterated with copper and mineral acids.
Precipitated Sulphur	11	4	7	3	Adulterated with 40 to 65 per cent. of gypsum.
Soda Water	4	3	1	..	Total absence of soda, but magistrates declined to convict.
Spirits	21	5	16	2	One, brandy and water, impure spirit and capsicine, 5s. and costs; and one, whiskey, lead, and methyl spirit.
Sugar	27	..	27	..	
Sulphate of Quinine	7	1	6	1	Nearly 13 per cent. of sulphate of chichomin in this sample; £5 and costs.
Tea	192	93	99	24	
Vinegar	8	2	6	..	
Wine	16	5	11	1	This conviction was upon the now well-known "Tunstall claret case."
Powdered Scammony	1	1	..	..	
Totals	937	381	556	155	

TABLE III.

Showing Number of Analysts Appointed under the Provisions of the "Adulteration of Food Act, 1872," their Names, Remuneration, and the Districts for which they hold Office.

CLASS AND NAME OF DISTRICT.	NAME OF ANALYST.	Date of Appointment.	REMUNERATION.	REMARKS.
London.				
City	William S. Saunders, M.D....	...	£600 per annum, as medical officer of health and analyst	*Vice* Dr. H. Letheby, resigned.
Metropolitan Vestries.				
Paddington	William Hardwicke, M.D. ..	Feb. 4, 1873	£150 per annum	
St. George's in the East ..	John J. Rygate, M.B. ..	...	£100 per annum.	
St. Giles, Camberwell .	Albert J. Bernays, Ph.D. ...	Jan. 31, 1873	10s. 6d. to 21s. for analysis.	
St. George's and St. Giles's, Bloomsbury...	Theophilus Redwood... ..	May 8, 1873	£100 per annum.	
St. George, Hanover-square	William H. Corfield, M.D. ...	Nov. 7, 1872	£350 per annum.	
St. George the Martyr, Southwark	John Muter, Ph.D.	Jan. 25, 1873	2s. 6d. to 10s. 6d. for analysis.	
St. James and St. John, Clerkenwell...	Theophilus Redwood... ..	May 8, 1873	£100 per annum.	
St. John, Hampstead... ..	Charles Heisch, F.C.S. ...	...	£50 per annum, and £1 1s. for analysis.	
St. Leonard, Shoreditch ..	Thomas Stevenson, M.D. ...	April 8, 1873	£50 per annum, and 10s. for analysis.	
St. Luke, Chelsea	Andrew W. Barclay, M.D. ..	Mar. 18, 1873	£250 per annum.	
St. Luke, Middlesex ...	Fredk. W. Pavy, M.D., F.R.S.	Nov. 5, 1872	£150 per annum.	
St. Martin in the Fields ..	Alfred G. Anderson	...	£100 per annum.	
St. Mary Abbotts, Kensington	Edward L. Cleaver ..	...	£50 per annum, and 5s. for analysis	
St. Mary, Islington	Charles M. Tidy, M B. ..	Dec. 6, 1872	£300 per annum.	
St. Mary, Lambeth	John Muter, Ph.D.	Oct. 10, 1872	2s. 6d. to 10s. 6d. for analysis.	
St. Marylebone ...	John Whitmore, M.D. ...	Jan. 24, 1873	£100 per annum.	
St. Mary Magdalen, Bermondsey	John Muter, Ph.D...... ...	Mar. 3, 1873	2s. 6d. to 10s. 6d. for analysis.	
St. Mary, Newington ..	Do. do.	Apr. 18, 1873	Do. do.	
St. Matthew, Bethnal-green..	Charles M. Tidy, M.D. ..	...	£51 per annum, and 7s. 6d. for analysis.	
St. Pancras	Thomas Stevenson, M.D. ..	Jan. 15, 1873	£100 per annum.	
Metropolitan District Boards.				
Fulham	Fredk. J. Burge, M.R.C.S. ...	...	5s. to 21s. for analysis.	
Greenwich	George W. Wigner	Dec., 1873	£100 per annum.	
Lewisham	Charles Heisch, F.C.S. ...	Mar. 31, 1873	£50 per annum, and 10s. for analysis.	
Limehouse	G. A. Rogers, M.R.C.S. ..	Aug., 1873	£150 per annum.	
Mile-end Old-town	Mathew Corner, M.D. ..			
Plumstead	George W. Wigner	May 16, 1873	£50 per annum.	
Poplar	Alfred G. Anderson	..		
Hackney	John W. Tripe, M.D. ...	Mar. 3, 1873		
Holborn	Theophilus Redwood, Ph.D...	May 8, 1873		
Rotherhithe	John Muter, Ph.D....... ...	...	2s. 6d. to 10s. for analysis.	
Strand	C. H. Piesse	...	£100 for one year.	
St. John, St. Thomas, and St. Olave, Southwark ...	James M. Vinen, M.D. ..	Apr. 18, 1873	£50 per annum.	
St. Saviour's, Southwark ..	Albert J. Bernays, Ph.D. ..	...	£105 per annum.	
Wandsworth	John Muter, M.D. ... ··	Jan. 22, 1873	2s. 6d. to 10s. 6d. for analysis.	
Westminster	A. Dupré, Ph.D. ... ··	Apr. 25, 1873	£100 per annum.	
Whitechapel	Charles M. Tidy, M.D. ...	Mar. 11, 1873	10s. 6d. to 21s. for analysis.	
Boroughs.				
Abingdon	W. F. Donkin, M.D., F.C.S.	April	20s. for analysis & travelling expenses	Act practically a "dead letter" in this district.
Bedford	Charles E. Prior, M.D. ..	Jan. 15, 1873	£50 per annum.	
Beverley	William Procter, M.D. ...	Feb., 1874	£10 per annum and fees.	
Birmingham	Alfred Hill, M.D.	Dec. 17, 1872	£150 per annum.	
Bolton	Edward Sergeant	...	£50 per annum.	
Bradford	Felix M. Rimmington, F.C.S.	...	£100 per annum and expenses.	
Bridgnorth	T. P. Blunt, M.A., F.C.S. ...	Feb., 1874	Fees.	
Brighton	E. H. Moore	Jan., 1874		
Bristol	William W. Stoddart, F.C.S.	Jan., 1874	£100 per annum, & £50 for expenses.	
Buckingham	J. A. Wanklyn, M.R.C.S. ...	...	20s. for analysis and expenses.	
Cambridge	R. Apjohn	Jan., 1874	Fees.	
Canterbury	Sidney Harvey	Feb. 26, 1873	7s. 6d. to 10s. 6d. for analysis.	
Colchester...	John Wiggin, F.C.S.... ..	...	10s. 6d. to 21s. for analysis.	
Cork	C. O'Keefe	...	£50 per annum, and 5s. for analysis.	
Dublin	Charles A. Cameron, M.D. ...	Mar. 6, 1873	£300 per annum, & £20 for expenses.	
Dewsbury	Felix M. Rimmington, F.C.S.	...		
Edinburgh	J. F. King	June, 1873	Fees and expenses.	
Ely (Isle of)	Richard Apjohn	...	£5 5s. per annum, & 20s. for analysis.	
Gateshead	Alfred J. M. Edger	...	£10 per annum; 6s. 6d. to 21s. for analysis and expenses.	
Galway (City and County)...	Charles A. Cameron, M.D. ...	...	£25 per annum.	
Glasgow	.. ...	...		
Gloucester	John Horsley, F.C.S. ..	Dec. 31, 1872	£30 per annum............................	Also appointed previously, under the Act of 1860.
Gravesend	J. H. Gramshaw, M.D. ...	May 21, 1873	£15 per annum.	
Greenock	T. L. Paterson & T. R. Ogilvie	Mar. 7, 1873		

TABLE III.—*Continued.*

CLASS AND NAME OF DISTRICT.	NAME OF ANALYST.	Date of Appointment.	REMUNERATION.	REMARKS.
Henley	Wentworth Lascelles Scott, F.C.S., &c.	...	£25 per annum; 6s. 6d. to 21s. for analysis and expenses.	
Hastings	Charles Ashenden	...	£200 per annum.	
High Wycombe	J. A. Wanklyn, M.R.C.S.	...	20s. per analysis	Nothing done here yet.
Huddersfield	George Jarmain	...		
Ipswich	John Wiggin, F.C.S.	...	£25 per annum, and 5s. to 10s. for analysis.	
Leeds	Thomas Fairley, F.C.S.	...	£30 per annum.	
Leith	Falconer King	June, 1873	Fees and expenses.	
Limerick	Charles A Cameron, M.D.	...	£25 for one year.	
Liverpool	James C. Brown	Oct. 2, 1872		
Londonderry (City & County)	J. R. Leebody, M.A.	...	£20 per annum.	
Manchester	Charles Estcourt, F.C.S.	Mar. 5, 1873	£150 per annum.	
Middlesborough	John Betell	...		
Newcastle-on-Tyne	J. Patinson	...		
Norfolk	Francis Sutton, F.C.S.	Apr. 10, 1873		
Norwich	...	..		
Nottingham	Edgar B. Truman, M.D.	April 9, 1873		
Oxford	W. F. Donkin, M.A., F.C.S.	April 7, 1873	20s. per analysis and expenses	Act a "dead letter" here; no samples submitted.
Reading	John Shea, M.D.	...	£15 per annum and fees.	
Rye	A. W. Smith	...	5s. to 10s. for analysis.	
Salford	J. Carter Bell, F.C.S.	...		
Sheffield	Alfred H. Allen, F.C.S.	June 17, 1873	£100 per annum.	
Sligo	Charles A. Cameron, M.D.	...	£25 per annum.	
Shrewsbury	Thos. P. Blunt, M.A., F.C.S.	Dec. 30, 1872	21s. per analysis.	
Southampton	James Brierly	...	£40 per annum and fees.	
Swansea	William Morgan, Ph.D.	May, 1874	£100 per annum.	
Tenby	K. M. Davies	Feb., 1875	Fees, 2s. 6d. to 10s. 6d. per analysis.	
Waterford	Charles A. Cameron, M.D.	...	£25 per annum.	
Wigan	Ralph Betly	...	£30 per annum.	
Windsor	Henry Letheby, M.B., and Charles M. Tidy, M.B.	...	6s. to 21s. per analysis.	
Woolwich	George W. Wigner, F.C.S.	...	£50 per annum and fees.	
Wolverhampton	E. W. T. Jones, F.C.S.	Mar. 1, 1872	Fees, 5s. to 10s. 6d. per analysis.	
COUNTIES.				
Buckingham	J. A. Wanklyn, M.R.C.S.	...	20s. per analysis and expenses.	
Bedford	Thomas Stevenson, M.D.	July 1, 1873	£50 per annum, and 6s. per analysis	
Berks	W. F. Donkin, F.C.S., and John Robinson	April 7, 1873	20s. per analysis and expenses	
Cambridge	Richard Apjohn	...	£5 5s. per annum and fees.	Act a "dead letter" here; No samples submitted.
Carlow	Charles A. Cameron, M.D.	...	£25 per annum.	Do. do.
Carnarvon	James C. Brown, D.Sc.	April 2, 1873	£5 per annum and 21s. per analysis.	
Cheshire	Do.	...	£100 per annum and 6s. per analysis.	
Clare County	Charles A. Cameron, M.D.	...	£25 per annum.	
Cornwall	Joseph H. Collins	Sept., 1873	£1 1s. per analysis, and £2 2s. per quarterly report	"The Adulteration Act here a complete sham. No samples submitted."
Denbigh	J. J. Bancroft, F.C.S.	Jan. 2, 1873	10s. 6d. per analysis and expenses.	
Derby	Wentworth Lascelles Scott, F.C.S., &c.	April 8, 1873	5s. to 15s. per analysis.	Not a single sample yet submitted.
Devon	A. W. Blyth, M.R.C.S.	...	7s. 6d. to 21s. per analysis.	
Dublin	Charles A. Cameron, M.D.	...	£50 per annum.	
Durham	A. J. M. Edgar	...	£10 10s. per annum, 7s. 6d. to 21s. per analysis.	
Essex	Henry Letheby, M.B., and Charles Tidy, M.B.	Feb. 18, 1873	6s. to 21s. per analysis.	
Fermanagh	Charles A. Cameron, M.D.	...	£25 per annum.	
Hampshire (main division)	A. W. Bickerton, F.C.S.	...	10s. to 21s. per analysis.	
Hampshire (Isle of Wight division)	Arthur H. Hassall, M.D.	...	10s. to 21s. per analysis.	
Herts	Henry Letheby, M.B., and Charles M. Tidy, M.B.	Dec. 31, 1872	6s. to 21s. per analysis.	
Hunts	Richard Apjohn	...	£5 5s. per annum and 20s. per analysis.	
Isle of Man	James C. Brown, D.Sc.	...		
Kent	Henry Letheby, MB., and Charles M. Tidy, M.B.	...	6s. to 21s. per analysis.	
Kerry	Charles A. Cameron, M.D.	...	£25 per annum.	
Kildare	Do.	...	£30 per annum.	
Kilkenny (City and County)	Do.	...	£30 per annum.	
Leicester	Joseph Young	...	£60 per annum.	
Lincoln	G. M. Lowe M.D.	Jan. 6, 1873		
Longford	Charles A. Cameron, M.D.	...	£25 per annum.	
Mayo	Do.	...	Do.	
Middlesex	Theophilus Redwood, Ph.D.	...		
Monmouth	E. H. Jones	...	10s. for analysis.	
Montgomery	Henry Johnson, M.D., and Thos. P. Blunt, M.A., F.C.S.	...	21s. per analysis and expenses.	
Nottingham	Edgar B. Truman, M.D.	...	10s. 6d. to £2 2s. per analysis.	

TABLE III.—*Continued.*

CLASS AND NAME OF DISTRICT.	NAME OF ANALYST.	Date of Appointment.	REMUNERATION.	REMARKS.
Oxford	W. F. Donkin, M.A., F.C.S.	...	20s. per analysis and expenses.	
Portsmouth	G. Turner, L.R.C.P. Lond. ...	...	£50 per annum.	
Queen's County	Charles A. Cameron, M.D. ...	...	£50 per annum.	
Roscommon	Do. ...	...	£25 per annum.	
Rutland	Joseph Young	...		
Sligo	Charles A. Cameron, M.D. ...	...	£20 per annum.	
Salop	Henry Johnson, M.D., and T. P. Blunt, M.A., F.C.S. ...	Dec. 30, 1873	13s. 4d. per analysis.	
Somerset	W. A. Stoddart, F.C.S. ...	...	£100 per annum and £50 for expenses, &c.	
Staffordshire (North Division)	Wentworth Lascelles Scott, F.C.S.	June 30, 1873	£100 per annum.	
Staffordshire (South Division)	E. W. T. Jones	June 30, 1873	£100 per annum.	
Suffolk (East)	John Wiggin, F.C.S	...	10s. 6d. per analysis.	
Surrey	Thomas Stevenson, M.D. ..	Jan. 28, 1873	10s. to 20s. per analysis.	
Sussex (East)	E. H. Moore	...	6s. to 21s. per analysis.	Vice Dr. Tidy resigned.
Sussex (West)	Francis V. Paxton, M.B. ...	...	6s. to 20s. per analysis.	
Tipperary	Charles A. Cameron, M.D. ...	...	£20 per annum.	
Warwick	Alfred Hill, M.D.	April 8, 1873	£75 per annum and 10s. per analysis.	
Wicklow	Charles A. Cameron, M.D. ...	...	£25 per annum.	
Worcester	A. E. Davies, F.C.S. ...	...	£100 per annum and fees.	
Yorkshire (West Division) ...	William Baker	...	...	

TABLE IV.

SHOWING (IN EACH DISTRICT FROM WHICH RETURNS HAVE BEEN RECEIVED) THE NUMBER OF SAMPLES ANALYSED, IN ACCORDANCE WITH THE PROVISIONS OF THE "ADULTERATION OF FOOD, DRINK, AND DRUGS ACT, 1872," THE NUMBER FOUND TO BE ADULTERATED, AND THE NUMBER OF CONVICTIONS OBTAINED, &c.

NAME OF DISTRICT.	NAME OF ANALYST.	Time Act has been in operation.	Total Number of Samples Analysed.	Number found unadulterated.	No. found Adulterated.		Number of Convictions obtained.	Percentage of Adulterated Samples to Total Analyses.	Percentage of convictions to total No. of samples examined.	REMARKS.
					Milk only.	Total.				
		Months.								
Bedford	C. E. Prior	27	about 200	...	...	...	none	...	...	Four prosecutions fail through informalities.
Bedfordshire	T. Stevenson ..	21	570	528	5	42	20	7·37	3·51	
Bermondsey	John Muter	17	281	236	25	45	33	16·01	11·74	
Beverley	H. W. Procter ..	13	a few of milk ..	..	1	1	none	...	...	
Birmingham	Alfred Hill	30	165	63	38	102	38	61·82	23·03	First appointed under the Act of 1860.
Bolton	Edward Sergeant* ...	32	289	278	...	11	10	3·80	3·46	* Vice Collins, resigned in 1873.
Bradford	Felix M. Rimmington	9	126	102	10	24	24	19·05	19·05	We have had no trouble in working the Act here; fear the new Bill will not work as well.
Brighton	E. H. Moore... ..	15	124	114	8	14	6	11·29	4·84	
Bristol	W. W. Stoddart ...	15	281	132	30	149	10†	53·02	...	† Returned as "prosecutions."
Buckingham ... / Buckinghamshire	G. A. Wanklyn ..	...	22	19	2	3	none	13·63	...	
Canterbury	Sidney Harvey ..	24	45	38	...	7	2	15·55	4·44	
Camberwell (St. Giles) ...	A. G. Bernoys ...	25	545	477	59	68	66	12·47	12·11	
Cambridge	R. Apjohn	13	2	1	1	1	none	50·00	...	One sample per six months.
Colchester...	John Wiggin ...	12	1	none	...	1	none	100·00	...	One sample in twelve months.
Cork (City) ... / ,, (County) ...	C. O'Keefe	32	115	167	33	48	2	41·74	1·74	
Chelsea	A. W. Barclay ..	32	281	266	...	35	5 (or 6)	12·45	1·78	First appointed under the Act of 1860.
Cheshire	G. C. Brown... ...	27	587	423	...	164	96	27·94	16·35	
Dublin	Chas. A. Cameron ...	32	...	...	...	...	...	...	...	First appointed under Act of 1860.

TABLE IV.—*Continued.*

NAME OF DISTRICT.	NAME OF ANALYST.	Time Act has been in operation.	Total Number of Samples Analysed.	Number found unadulterated.	No. found Adulterated. Milk only.	No. found Adulterated. Total.	Number of Convictions obtained.	Percentage of Adulterated Samples to Total Analyses.	Percentage of convictions to total No. of samples examined.	REMARKS.
Devonshire	A. W. Blyth.... ...	12	58	30	...	28	none	48·27	...	
Durham	A. G. M. Edger ...	15	70	44	8	26	1	37·14	1·43	Only one or two places in this large district have sent any samples.
Denbigh	G. G. Bancroft ...	...	...	...	...	...	...	...	...	
Edinburgh (Leith) ...	G. Falconer King ...	22	about 150	100	...	about 50	12	33·33	8·00	Not very active during last five months.
Gateshead	Alfred G. M. Edger...	16	92	54	30	38	20	41·30	21·74	
Gravesend	G. H. Grimshaw ...	12	10	none	...	10	1	100·00	10·00	
Greenock	T. R. Ogilvie ..	...	...	...	...	...	...	...	...	The first town in Scotland to successfully inaugurate the Act.
Greenwich (including all Plumstead and Woolwich)	G. W. Wigner ...	16	701	617	48	84	...	11·98	...	
Hackney	G. W. Tripe	21	206	178	7	28	13	13·59	6·31	
Henley	Wentworth L. Scott	9	115	58	8	57	7	49·56	6·09	For details see Table I. No samples submitted during last 4 months.
Hampstead	Charles Heisch ...	12	39	38	...	1	none	2·56	...	
Huddersfield	George Jarmain ..	16	18	17	1	1	none	5·55	...	
Isle of Man	G. C. Brown... ...	24	140	107	...	33	about 25	23·57	17·85	
Kensington	E. G. Cleaver ..	8	140	115	16	25	20	17·85	14·28	
Lambeth	John Muter	20	252	223	10	29	28	11·51	11·11	
Leeds	Thomas Fairley ...	19	270	238	15	32	18	11·08	6·66	
Lewisham	Charles Heisch ...	22	123	105	14	18	17	14·63	13·82	
Leicestershire	Joseph Young ...	...	...	...	...	...	...	..	...	
Limehouse	G. A. Rogers ...	20	169	154	3	15	5	9·23	3·08	
Lincolnshire	G. M. Lowe	32	1,036	546	18	490	66	47·30	6·37	Only about 1 conviction in each 7 or 8 of the adulterated samples.
Liverpool	G. C. Brown... ...	30	368	251	...	117	60	31·25	16·30	
London (City)	G. S. Saunders ...	...	...	...	...	...	...	...	...	
Londonderry	G. R. Leebody ...	26	158	115	30	43	5	27·21	3·16	Not much more than one conviction in nine adulterated samples.
Manchester	C. Estcourt	15	75	63	6	12	7	16·00	9·33	
Monmouth	E. H. Jones	25	9	7	2	2	2	22·22	22·22	
Montgomeryshire ...	T. P. Blunt	12	17	11	3	6	none	35·30	...	
Newcastle-on-Tyne ...	G. Pattinson ...	32	293	196	74	96	14	32·87	4·81	
Newington (St. Mary's)...	John Muter	22	...	...	...	...	...	...	...	
Oxfordshire	W. F. Donkin ...	24	27	13	1	14	none	50·00	...	Rather more than 1 sample per month for all Oxfordshire.
Portsmouth	George Turner ...	15	164	...	...	...	15	...	9·14	
Reading	John Shea	13	28	27	1	1	none	3·57	...	
Rotherhithe	John Muter	9	45	39	5	6	none	13·33	...	
St. George's, Hanover-sq.	W. H. Corfield ...	17	154	103	14	51	5	33·11	3·24	
St. Pancras	Thomas Stevenson ...	26	570	491	56	79	23	13·86	4·04	
Shoreditch (St. Leonard's)	T. Stevenson ...	23	87	65	12	22	8	25·28	9·19	
Shrewsbury	T. P. Blunt	13	7	4	3	3	none	42·86	...	Samples delivered at the rate of about 1 in 2 months
Shropshire	T. P. Blunt	30	26	21	2	5	2	19·23	7·70	Not one sample per month.
Somersetshire	W. W. Stoddart ...	16	2,312	1,449	105	863	520	37·33	22·49	
Southampton	G. Brierley	9	21	14	7	7	none	33·33	...	
Southwark (St. George's)	John Muter	21	92	70	10	22	21	23·91	22·82	
Southwark (St. Saviour's)	A. J. Bermoys ...	23	128	92	22	36	23	28·12	17·97	
Staffordshire (North) ...	Wentworth L. Scott	15	937	556	...	381	155	...	...	
Staffordshire (South) ...	E. W. T. Jones ...	15	526	275	88	251	...	47·30	...	
Suffolk (East)	G. Wiggin	18	...	..	...	...	...	...	...	
Surrey	Thos. Stevenson ...	24	1,513	1,345	34	168	140	11·10	9·27	
Sussex (East) ... -	E. H. Moore... ...	about 18	8	..	...	...	none	...	...	
Sussex (West)	F. G. Paxton ...	21	48	46	...	2	none	4·16	...	
Swansea.	W. Morgan	4	56	30	21	26	17	46·43	30·35	The Act has been approved of by the public, and has been of great service.
Tenby	M. V. Davies ...	2	2	none	2	2	none	100·00	...	
Wandsworth	John Muter	21	974	890	44	84	22	8·62	2·26	
Westminster	August Dupré ...	20	241	201	28	41	16	16·11	6·61	One magistrate has decided that a label is sufficient declaration of mixture; two others that verbal declaration is necessary; two magistrates always require attendance of analyst, and one thinks this unnecessary.
Wigan	Ralph Betley ...	17	58	48	5	10	2	17·24	3·44	
Wolverhampton	E. W. T. Jones ...	24	163	107	28	56	...	34·35	...	
Worcester...	A. E. Davies ...	...	...	...	...	...	...	...	...	
Worcestershire	A. E. Davies ...	30	246	178	45	68	...	27·64	...	

DISCUSSION.

Dr. Thudichum, in opening the discussion, said he thought Mr. Scott had stated his case very clearly and forcibly—on the whole, perhaps, a little too forcibly. He might have given them a little more of actual fact, and a little less of what took place centuries ago. The subject was one of great importance, and if anyone would read the Blue Book of the Parliamentary Committee on the subject, they would see that the cases of adulteration that actually occurred had not been fairly represented. The analysts appointed were partly inexperienced, and the consequence was that they made some slips, and the bakers particularly got the better of them; but, on the other hand, the actual evils, the great evils that were occurring, were not at all stated before the committee. That was one of the greatest faults he found in the whole inquiry. The adulteration of beer, wine, and spirits was formerly dealt with under the Licensing Act. That was not known to many of the analysts, and the consequence was that they did not analyse, as they might have done, the adulteration of drinks, which was a source of great evil. In the course of his inquiry he fell upon a little book called "The Licensed Victuallers' Guide," which had passed through a fourth edition. It was published by subscription, and the author's name was on the title-page. It was a book of advice, recipes, and prescriptions, and was in itself no proof that the adulterations recommended actually took place; but there was evidence of adulteration in accordance with the prescriptions in the book. It comprised several hundred pages. He might classify the substances which were use under different heads:—First, substances which are always injurious to health, such as sugar of lead, *Cocculus indicus*, and bluestone. Second, substances which may be injurious to health by being taken in small doses for a length of time, such as oil of vitriol and the neutral and acid sulphate of potash, oil of bitter almonds, and the several kinds of pepper prescribed in the "Guide." Thirdly, substances such as gypsum, quicklime, treacle, liquorice, linseed, and others, which in themselves were harmless, but sure to alter the appearance or mask the taste of spoiled beverages, which are repugnant to taste and injurious to health. Fourthly, substances which, being in the nature of food or drugs, and being surreptitiously mixed with a beverage or dram, cause it to produce thirst in the persons drinking it, and thus demoralise their taste, and sometimes produce a state approaching insanity. The madness of drink was undoubtedly caused by these, to which class belonged salt, pepper, mustard, the oils of cinnamon, juniper, cassia, and turpentine. The latter oil might also act injuriously upon the urinary organs. Some of the absolutely injurious substances prescribed in the "Guide" might be alleged to leave the liquids to which they were to be applied quite innocuous. Thus the finings of wine (p. 108 and 109) were actually excused on the ground that the lead was made insoluble by the process. Therefore the man who wrote that had some chemical knowledge. He was not aware though of the particular fact. Any analytical chemist would, however, be afraid to use this process, even with the aid of a chemical balance. How much more dangerous then when applied by someone with the rule of thumb. The presence of lead in various substances had been detected. Some of the processes seemed to be mere superstitions, such as the prescriptions for strengthening gin or whisky (p.73 and 74). The oil of vitriol ultimately contained in the gin amounted to about 0·00017 per cent. Seeing that the law allows the pressure of 0·1 per cent. of oil of vitriol in vinegar, the above addition to gin must be considered as nearly 600 times less injurious than the addition allowed to be made to vinegar. Wine must contain at least 0·4 per cent. of free acid to have a reReshing taste. The quantity of free acid contained in the above gin would stand to that of wine in the proportion of 17 to 40,000. Assuming the acids to have the same degree of acidity to taste, natural wine would be 2,352 times more acid than the acidified gin; or inversely, the acidity of the gin would be so slight as to be quite imperceptible to even the finest taste. This, therefore, was a mere absurdity. More injurious to health are the processes and agents applied to spirits for fining. One of these was sulphate of copper, bluestone, which looked very rational, and he had sympathy with the method of fining spirits. They knew that sulphate of copper was insoluble in alcohol, and, in fact, it was used for the purpose of drawing water out of the alcohol and making it bright. The spirits used by the populace had a particular knack of holding a quantity of these in solution without their being able to discover them by the taste or colour, and the method of detecting them was only discovered this year by a French chemist, M. Bosanq[illegible]. More injurious to health were the adulterations which were applied to beer. At page 60 there was a receipt for "making up" porter. The butt of beer received an entire pound of sulphuric acid, or nearly as much as was allowed for vinegar, besides the extract of an entire pound of *Cocculus indicus*, and an ounce of capsicum; liquorice, alum, treacle, and beading made up the horrible list. This porter they would, no doubt, think was sufficiently adulterated. As the Parliamentary Committee has power to send for persons, books, papers, and documents, he would suggest that they should send for the printer of this "Guide," and for the writer of it, and if they were asked a few pertinent questions a vast amount of information would be obtained. In the country at large he was glad to give it as his experience that the adulteration of food and drink was very small indeed, and in his occupation as sanitary inspector he had gone into many parts of the country, and into the market places and shops of the different districts, and he was astonished by the mass, and the beauty and the purity and splendour of the materials of the trade at large. There were black sheep in every profession, and no doubt there were some few who adulterated, and who were the cause of the outcry.

Mr. Branston said he was afraid that while they had been straining at a gnat they had been swallowing a camel. It appeared to him most extraordinary that this country should suffer from such amazing evils as had been represented, when Parliament could, by a stroke of its pen, wipe out one half of the evils. The great adulterant of alcoholic liquors was *Cocculus indicus* in beer, and fusil oil in spirit. This fusil oil was not put artificially by the dealers, but it arrived in this country in the form of a spirit from Hamburg and the North of Europe, and was made from the potato. The effect of this oil on the brain was to produce madness, and it was owing to a large extent to its admixture with gin and whiskey and brandy that the public suffer in the way they do from the consumption of the spirit. But if it was so poisonous, it was the duty of the Government, who had complete control over it, to stop it. They received duty, for it and they might arrange that no crude spirit should be allowed to go into public use, except [illegible]lated, and to be used for trade purposes. As to *Cocculus indicus*, it was imported by the ton, and was very largely used in the adulteration of beer. It had a greater effect on the body than on the head. With regard to the analysis of food, the whole thing had got into an abominable mess, and the proposed Act, if carried out, would make one half the retailers criminals. The baker, the milkman, and the grocer, were the three persons who had been most prosecuted. They were all interested in having good food, but one great cause of adulteration was to be attributed to the people themselves, that they were content to put anything into their stomachs so long as it was cheap. The legislation that was proposed was so far wrong and bad that it must prove abortive. If legislation were strained it would ultimately defeat itself. If tradesmen were to be charged with selling adulterated

articles the magistrates ought to be compelled to hear witnesses in their defence, which was now practically never done, for they would not hear witnesses of trade reputation. Unless independent evidence of experienced tradesmen corroborating the charge of the analyst were given, he thought it ought not to be supported. But it was a very difficult question and not likely to be settled, and the present Bill was so abominable that it ought to be withdrawn.

Mr. J. Holm, although representing a trade interest, said he was not going to defend adulteration. It was to the interest of a trader that it should be stopped; unless it were, the honest trader had no power of competing with a dishonest rival. But the analysts were unfortunately placed in this position, that it was their interest to keep up a sort of unhealthy excitement in the public mind. In some cases it had been almost necessary to their existence. To these gentlemen he thought was due the odium which attached to the Act. In the main it was a good Act, and, if worked with discretion, it would have been productive of very great good. But, unfortunately, the analysts, in acting from a chemical knowledge, and not adapting it to the ordinary exigencies of common life, were responsible for many instances of gross oppression. The sensational stories about our being poisoned by the adulteration of food were proved to have been utterly and entirely without foundation. The most important article analysts had to deal with was milk, and their action had undoubtedly been productive of great good, and that perhaps might weigh against the great harm and injustice which had been done. In fact, so absurd were some of the prosecutions, that he was surprised that every greengrocer in the kingdom had not been prosecuted for selling articles adulterated with injurious substances—to wit, potatoes adulterated with earth. The idea was not so far fetched when they considered many of the prosecutions which had taken place. Then there had been an onslaught upon mixed foods, which were principally mustard and cocoa, but that was now dropped. Certain admixtures were sanctioned in regard to cocoa, which was dealt with by a separate Act, and this Act provided that they should not be burnt or baked so as to impart a false flavour, and thus prevent the buyer from detecting what he was buying. Had the analysts been able to have their way, and put a stop to all manufactured cocoa, they would have done the greatest harm to the working population. As Dr. Normandy had said in his handbook, it was necessary to make a distinction, for many things were charged as adulterated, which, strictly speaking, were not so, and it was that question of what was and what was not adulteration which had caused the wrecking of the present Act. It was beset on all sides with difficulties. The analysts ought to have exercised more caution, instead of scattering broadcast, as they had done, charges of fraud, and placed honest men in the position of criminals. One of the most difficult questions was that of the introduction of colouring and flavouring ingredients, which was perfectly legitimate in confectionery, for instance, if they were wholesome. But, if carried beyond this, and used for the purpose of disguising the real thing, or imparting a false strength, then it was a fraud, and one which should be punished severely. Unhappily, as regards cocoa, it had been unadulterated mixtures of cocoa that had been the subject of prosecutions, not one single prosecution having taken place as regards adulterated cocoa. Fraud was the only talisman which could decide the question. Adulteration was a crime differing in magnitude and extent only, and therefore it was wrong not to insist upon a guilty knowledge as being necessary. Equally wrong was it not to be very cautious about instituting proceedings without sufficient grounds, as had often been done.

Mr. Dupré said that as an analyst he should like to see the blame put on the right shoulder. The appointment of analysts had been in the hands of tradesmen themselves, and it was their interest to appoint the men most notoriously incapable. And why? So that no analyses should be made. The appointment had frequently been forced upon some men, who, holding other public positions, were threatened with the loss of their other offices if they did not take upon themselves the duties of analyst, although they might have felt themselves incompetent for it. With regard to the notion that analysts were taking up the subject that everything should be chemically pure, nothing could be more absurd, as the chemist, of all the men in the world, knows that nothing is pure. As to the hardship which had been spoken of, out of 14,000 analyses made, 3,000 had been found adulterated, and something like from five to eight hundred prosecutions had taken place. But out of that number how many cases of hardship had taken place? He did not believe anyone could put his hand upon a dozen. Then much had been made of the difference of opinion among analysts. But why were analysts to have no differences of opinion? Judges differ, and frequently you have three deciding one side and four the other; and there is the proverb, "When doctors disagree who shall decide?" On the whole, he believed that much good had resulted from the working of the Act. To take the simple case of milk, he considered that a saving of something like £1,000 a day had been made by the people of London. He believed the public were much to blame in the matter themselves. If they were willing to pay a good price they could get a good article, but unfortunately they always tried to run everything down. It had been hinted that the analysts had some interest in keeping up the excitement about the Act. It was not true. The remuneration under it, in many instances, was not worth consideration.

[A proposal was here made that the meeting should adjourn, but owing to difficulties as to finding an evening on which to resume the discussion, it was not pressed.]

Mr. H. J. Helm could give some information about *Cocculus indicus* from the list of imports and exports published in Mark-lane, which showed that in 1873 between 500 and 600 packages were imported; each packet weighed about three quarters of a cwt., so that there were not above twenty tons of it, and what become of it? He had been amongst the German buyers, and then amongst the druggists, and the general opinion was that nine-tenths of it was exported. English buyers scarcely ever do anything in it. As regards what had been said about fusil oil there was another error. It was produced from the grain along with the spirit, and it was one of the difficulties of the distiller to get rid of it. He believed it to be a fact that much evil was produced by the drinking of new spirit, and particularly of the fusil oil which it contained.

Mr. Scott, in reply, said that there were very large quantities of what were called faint spirits, or weak spirits—weak as regards alcohol—strong as regards fusil oil—which could be bought at a cheap rate, and which formed a considerable part of the stock-in-trade of the peripatetic individuals who go about making up people's wines and spirits to the required flavour. He quite agreed with the observations, that the cheapness of some articles of food was the source of adulteration, and gave an illustration that had occurred under his own notice respecting some tea at Birmingham. As to the hardship which had been spoken of, he had the very greatest sympathy with the tradesman, who, when he thought he was buying a good article, was really buying an inferior one, and then selling it without knowing it. But in the new Bill they would be at liberty to put themselves into the witness-box and state such facts. As to the artificial excitement which had been spoken of, he could not agree with the observations in reference to it, neither could he see how an Act which had never been worked, as was the case with the Act of 1860, could exercise a deterrent effect. With regard to admixtures in the case of mustard. French mustard was very good

but it was always sold as mixed mustard. He had not the slightest objection to whatever might be sold, provided it was sold as what it really was. As to the remarks of Mr. Holmes respecting the adulteration of cocoa, he thought that gentleman had forgotten that, under the old Act, an analyst had no power or authority, and no certificate of his would have any force in relation to it. In reference to the proposal to allow an analyst to go into the witness-box, he was always very pleased when an opportunity was afforded him of doing so, which was very seldom; and he believed he might say the same opinion would be expressed by nine-tenths of the analysts of the kingdom.

The Chairman, in closing the discussion, said it was a subject that had been before him a great many years, his attention having been called to it by some proceedings he was asked to take twenty-five years ago by the Board of Inland Revenue. In his opinion there were three very distinct points. On the one hand there was the question of adulteration which was injurious to health, the introduction of foreign materials which were either poisonous or deleterious. To take a case in illustration. He was asked to examine a particular process of refining sugar which was then patented, and which was adopted in certain refineries in this country—the precipitation of albuminous matter by acetate of lead, and then getting rid of the solution of lead by a current of sulphurous acid gas. This process was worked in this country, although the pure crystallised sugar contained no greater appreciable quantity of lead than ordinary refined sugar; which contains a small quantity perhaps. Yet a very appreciable quantity was found in the treacle by Dr. Taylor, Dr. Alfred Roupell, and himself. They were asked to report whether it was injurious to health, and they reported decidedly that it would be a deleterious impregnation of the treacle. The liability to that amount of lead was quite sufficient in their opinion to justify a prohibition. Now that was a case in which there was something deleterious. Copper in pickles was another instance of the same kind. He was rather sceptical about the large extent of *Cocculus indicus* and fusil oil. There was a great disposition to throw off upon anything else that which he believed was the real result of injurious indulgence in intoxicating drink, and he would give them an instance of it. Some twenty-five years ago the attention of the medical profession was called to a remarkable work by Dr. Huss, of Stockholm, upon a disease very prevalent in Sweden, which he designated as *alcoholismus chronicus*—chronic alcoholic disease. It was supposed that this disease came from drinking bad brandy, and some of these symptoms were so like poisoning by metal that they were attributed to some metallic impregnation. Dr. Huss performed some experiments upon dogs, taking the precaution to obtain pure spirits, and he produced in dogs a disease in all respects corresponding with that he had seen. Attention had been called by the grand jury at Leeds to crimes of violence arising out of drink, but they seemed to have neglected to notice that the women had been drinking in the public houses with the men, and both parties were in a state in which they could not be said to have a control over their actions. He thought that could not be accounted for by *Cocculus indicus*. Another class of adulterations consisted of those which might be called admixtures, such as chicory in coffee, and there was no question that the public generally preferred a small admixture of chicory with coffee, and that a certain mixture could be sold at one shilling a pound which would be a more palatable drink than any pure coffee that could be sold at the price. But it would be extremely objectionable to allow any admixture to be sold as pure. If it was warranted as pure then it should be required to be pure. That should always be kept in mind. Then there was the case of substances like milk and bread, in which there was a mere lowering by the mixture of water or the introduction of large quantities of potato-flour, for the sake of cheapness simply. Those were the subjects to which he thought the attention of the Legislature should be directed chiefly; but the whole subject was in a tentative condition, and he very much deprecated the drawing of a hard and fast line, and saying that any article must come up to a certain definite standard of purity, unless the the article had been the subject of chemical examination by chemists of great ability. As to what had been said respecting analysts giving evidence, he thought it was a great mistake to bring scientific men into the witness-box to give evidence *pro* or *con*. He had himself been applied to to appear in the witness-box and give evidence on scientific questions, but he invariably declined, because he saw that in all legal procedures there was a tendency to make a scientific witness a partisan. He was called by one side or the other, and forced by cross-examination into a position which almost made him say things more strong, more explicit, more dogmatic than anything he would say in private. In his opinion, scientific witnesses ought to be called as assessors, to aid the judge, as was done in the case of ship captains sitting as assessors at the Trinity-house inquiries, and not as partisans. A board might perhaps be constituted, which should have authority to decide all these cases, and what should be the Act which should render a trader subject to penalties, because under any Act whatever he felt sure there must be a great number of hard cases. The British public has itself to thank for a great deal of what it suffers by its persistent preference for cheapness. If you want a good article you must pay for it. Things that were cheap were not good. He had known chemicals being sold which were adulterated to nine-tenths of their amount, because they were required at such a low amount, and he instanced the case of a firm requiring some bobbins of short lengths of 80 to 90 instead of 100, because they required them at a low price. But the firm with whom they had been dealing refused to supply them, and they went elsewhere and got them, but were very soon glad to return, as they found, although they got things cheaper, they were not so well served. That showed how it affected the manufacture, and they had no right to lay all the fault on the tradesman. In conclusion he proposed a vote of thanks to Mr. Scott for his paper.

MISCELLANEOUS.

VIENNA EXHIBITION REPORT.

(*Continued from page* 399.)

Mr. G. Phillip Bevan had a very difficult task set him in writing the report for the British Government on "Food Products." There is always a difficulty in dealing with such a subject, owing to the absence more or less of any metropolitan standard, by which the intrinsic value of, or improvement in, any exhibited article of food product or preparation can be judged. It is otherwise in almost all other exhibits of an industrial nature, the value of which can be gauged, and in which progress or retrogression is definitely marked by comparison with examples of previous periods, and of different countries. A report, therefore, of food products at an exhibition has a tendency to become little more than an examination of the articles exhibited, especially as a large proportion of them, at least of prepared food, are encased in glass, metal, earthenware, or paper. At Vienna the writer of a report had special difficulties to encounter; for in the first place the food products had no special place assigned to them, there being no food zone or section as at the great Exhibition in Paris and at South Kensington in 1873, but they were scattered all over the exhibition building, and a food inquirer had to walk miles before he could accom-

plish a general survey of these exhibits; and in the second place, the scarcity of information to be obtained which pervaded the whole exhibition, with the exception of the British Department, was particularly the case in reference to the food groups, not one fourth part of which were labelled at all, and the rest were labelled in a most general and commonplace manner, while personal explanation was equally deficient. Under these circumstances, therefore, Mr. Bevan, instead of describing each food exhibited separately, grouped his subject under the headings of different countries, which enables us to contemplate each through its food-producing sources and capacities and its food-preparation industries.

The United Kingdom display, especially of "manufactured edibles" and "concentrations," was admitted to be of a high order, the neat and tasteful manner in which most of the exhibits were "put up" being a marked feature. This, combined with their intrinsic merits, secure for them an exclusive sale on the Continent. English biscuits attracted much attention from foreigners, our productions being very popular in France and Germany, as indeed they are all over the world. Corn flours, baking powders, pickles, sauces, flavouring essences, extracts of coffee, prepared mustard, marmalade, and Scotch preserves, were largely exhibited. Preserved meats in various forms naturally held a conspicuous place, as did also the portable soup squares and tablets which have of late years become popular in our households. Altogether the British collection of food exhibits, though not numerous, kept up their reputation for cheapness and excellence combined. There was, however, no show of cereals, &c., except the well-known models of roots and vegetables exhibited by Messrs. Sutton, of Reading, and other similar firms.

The majority of the British Colonies and dependencies were well represented, especially in the way of cereals, and illustrated a commerce in food which has already reached enormous proportions. With cereals, preserved meat formed the staple portion of the Australian exhibits, and attracted much interest among the Germans and Austrians, who, like ourselves, are suffering from the high price of butchers' meat, "prime cuts" in Vienna costing as much as 2s. per lb. It is by no means improbable that one result of the Vienna Exhibition will be a large trade in preserved meats between Germany and Australia. In addition to cereals and preserved meat, the Australian Colonies exhibited sugars, fresh and preserved fruits, arrowroot, coffee, and other articles. To give some idea of the variety of food products which this colony alone exports, it may be gathered from the trade returns of South Australia, that this province exports sheep, preserved meat in tins, hams and bacon, bread and biscuits, butter, jam, fruit, flour, wheat, raisins, eggs, and honey; and it is to be noticed that out of the numerous samples of wheat from almost every corn-producing country in the world, none finer were to be seen than those sent from this province. New Zealand exhibited preserved meats similar to those from Australia, and an excellent assortment of cereals, cheeses of good quality, and chicory equal to that grown in England. Mauritius had a display of sugars of great size and beauty of crystallisation, though the exports of this commodity have declined somewhat during the last few years, owing to bad harvests and the ravages of insects. The Cape of Good Hope sent a collection of preserved fruits, and some excellent models of a variety of fruits of native production, such as oranges, mangoes, nectarines, figs, almonds, and grapes. India sent a long list of cereals, exhibiting maize, sorghum, millets, rice, peas, lentils, soy beans, coffee, ginger, pepper, sugar, preserves, curry, tea, edible birds' nests, fish "maw" (*i.e.*, dried sounds), and sharks' fins for soup-making.

America hardly did herself justice at Vienna, but the general display of many of the States was worthy of notice. Sugar was also shown, and there was a large assortment of "canned" shell-fish, such as lobsters, oysters, and clams, and of preserved fruits. California showed some fruits of enormous size, which had been galvanised over with a thin metallic coating for the purpose of preserving them. Brazil and other countries of South America were represented by the various products for which they are celebrated.

France, as might have been expected, was conspicuous in the display of articles *de luxe*, such as the more delicate vegetables in tins, Perigord truffles, and so forth, and well sustained the name so long enjoyed in this particular line. There were, however, only 19 exhibits of cereals and roots. Spain showed fruit, and Portugal the same and cereals. Italy sent cereals, rice in great variety, chesnut meal, macaroni of course, olives, confectionery, and a most choice collection of fruits. Switzerland called attention to her cheeses; Belgium to her cereals, butter, bread, cheeses, chocolates, and "tinned" foods; Denmark to cereals, of which she exhibited 125 varieties; Norway also to her cereals, and preserved meat, fish, vegetables, and milk; while Sweden, showing much the same as Norway, in addition exhibited "reindeer moss" which makes a very nutritious jelly, and has other economic uses. Germany was of course great in cereals, and exhibited bread, macaroni (in the manufacture of which she threatens eventually to rival Italy), beetroot, sugar, hops, salt, dried meat in a great variety, and the famous "Erbswurst," while Alsace sent an admirable collection of farm produce, and Strasburg its inevitable *patés de fois gras*. Austria naturally retained a very large area in her own exhibition, and as the empire may be called the granary of Europe, the display of cereals from all parts was magnificent, and forms perhaps the most important portion of Mr. Bevan's report. From the various districts of this heterogeneous empire were exhibited bread, pastry, honey, preserved provisions of all kinds, beetroot, sugar, olive oil, salt, and selections of fruits. Russia displayed cereals, confectionery, and preserved provisions; Greece cereals, honey, olives, and fruits; Turkey cereals, seed, and "manna;" Egypt cereals, flour, and dried fish; Persia chiefly fruits, preserved and otherwise; China cereals, tea, dried provisions, preserved eggs, and a variety of materials such as birds' nests, sharks' fins for soup making; and Japan, rice and wheat flour, mustard and potato flour, rice bread, macaroni, tea, fruit, and preserves of various kinds.

(*To be continued.*)

CORRESPONDENCE.

WEST COAST OF AFRICA.

Sir,—In the *Journal* of the Society of February 26th, I note under the "Correspondence" a letter from Mr. David Chinery, jun., commenting on a previous paper of Mr. Babington's. The paper referred to I have not seen, and therefore can express no opinion about it, though *à priori* I should be rather inclined to accept the views of a gentleman (Mr. B.) whose experience on the coast and rivers extends over as many years as Mr. Chinery's does weeks. However, my chief reason for writing at all is to correct Mr. Chinery's very incorrect assertions *apropos* of Liberian finance. I am not surprised that Mr. Chinery cannot make out Mr. Treasurer Dennis's report. It is certainly an extraordinary jumble of accounts. But, however, Mr. Chinery will find from it that the revenue was not 209,890 in the fiscal year ending September, 1873. He will learn that there was a falling off in the only reliable source of revenue—imports and exports—of something like 25,000 dollars! There is not the balance of a dollar in the Treasury. Not one cent of interest has been paid by the Liberian

Government, nor are they in a position to pay a cent. These are matters of fact, and are subjects of regret to me as much as to anyone, but on such matters I hold the truth to be imperative. Liberia has, I trust, a day to rise in, but it has not dawned yet, and will not be helped on by tortuous and exaggerated statements of her financial and commercial status.—I am, &c., H. C. C.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

April 7.—"Captain Liernur's Improved System of Town Drainage." By Adam Scott, Esq. On this evening Thomas Hawksley, Esq., will preside.

April 14.—"The Best Method of making Field Experiments practically useful to Agriculturists." By Professor John Wrightson.

April 21.—"The India Museum Question." By Dr. Forbes Watson.

April 28.—"The Protection of Buildings from Lightning." By R. J. Mann, Esq., M.D., President of the Meteorological Society.

May 5.—"Horse-shoes and Horse-shoeing." By George Fleming, Esq., Veterinary Surgeon, Royal Engineers.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

April 13.—1. "Remarks on Feudal Titles, Kafir Law, and Emigration Movements in Natal," by J. Bergtheil, Esq., late Member of the Legislative Council in the colony; 2. "The Probable Influence of Railway Construction in Natal upon the Trade, and upon the Civilisation of the Native Races of the Colony and adjacent Territory," by A. Browning, Esq. W. C. Sargeaunt, Esq., Crown Agent for the Colonies, will preside.

Indian Section.

Friday evenings at eight o'clock, the followihg arrangements have been made:—

April 2.—"Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India," by Robert H. Elliot, Esq., Author of "Experiences of a Planter," &c.

April 23.—"The Preparation and Uses of Rhea Fibre," by Dr. J. Forbes Watson.

April 30.—"The Growth of the Factory System in India, with especial reference to the Production of Textile Fabrics, and the Relative Advantages of the British and Indian Manufacturer," by Elija Helm, Esq., of Manchester.

May 14.—"The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East," by the Rev. James Long.

Chemical Section.

Friday Evenings, at 8 o'clock.—The followin[g] arrangements have been made:—

April 16.—"Recent Advances in Photograph[ic] Science," by J. Spiller, Esq., Vice-President of th[e] Photographic Society. On this evening Warren D[e] La Rue, Esq., D.C.L., F.R.S., will preside.

May 7.—"Alum Shale and its Application," b[y] Sydney Rich, Esq.

Cantor Lectures.

The Third Course of Cantor Lectures will be o[n] "Some Forms of the Modern Steam Engine," b[y] F. J. Bramwell, Esq., President of the Instit[u]tion of Mechanical Engineers. The Course w[ill] consist of four lectures, the dates for which w[ill] be as follows:—Mondays, April 5, 12, 19, and [26]. Tickets are issued with the present *Journal*.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. F. J. Bramwell, F.R.S., "So[me] Forms of the Modern Steam Engine. (Lecture I.)
Farmers' Club, Salisbury-square, E.C., 5½ p.m. Mr. [...] Neild, "Freedom in Farming."
Royal Institution, Albemarle-street, W., 2 p.m. Gen[eral] Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. W. G. Ferrar, "Practical construction in [the] Colonies."
Royal United Service Institution, Whitehall-yard, 8½ p.m. Mr J. Macgregor, "Recruits for the Army."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m. Mr. [...] H. Driver, "Iron as a Constructive Material."
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Dr. Challis, "The Relation of the Scripture Account of t[he] Deluge to Physical Science."
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. Bentley, "Classification of Plants. (Lecture I.)

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Pr[of.] Duncan, "Grander Phænomena of Physical Geograph[y]."
Civil Engineers, 25, Great George-street, Westmi[nster], S.W., 8 p.m. Discussion on "The Hull Docks;" a[nd] time permitting: 1. Mr. William Hackney, "S[...]" 2. Mr. Josiah Timmis Smith, "Bessemer Steel Ra[ils]."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m.

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Adam Scott, "Captain Liernur's Improved Sys[tem] of Town Drainage."
Microscopical, King's College, W.C., 8 p.m. Mr. H. C. Sorby, "A New Mode of Supplying Spectrum Analy[sis] to the Microscope, &c."
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thurs. ...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Dr. Freeman, "History and Use of the English Langua[ge]." (Lecture II.)
Royal Historical Society, 8 p.m. 1. Mr. George Ha[...], "John Bunyan." 2. Mr. Edmund Chisholm-Ba[...], "History of Priory of Beauly."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Seeley, "The Fossil Forms of Flying Animals."
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri. ......Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting 9 p.m. Sir William Thompson, "Tide[s]."
Civil and Mechanical Engineers' Society, 7, Westminster-chambers, S.W., Mr. J. W. Pegg, "Mining and Quarrying."
Astronomical, Burlington House, W., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.
Junior Philosophical Society, 6A, Victoria-street, S.W., 7½ p.m. Mr. H. W. Goodheart, "The Progress of Civilisation."

Sat. ......Royal Institution, Albemarle-street, W., 3 p.m. Mr. Geo. Smith, "The History of Assyria."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,168. Vol. XXIII.

FRIDAY, APRIL 9, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1875, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B. (now Sir Henry Cole, K.C.B.), "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufacturers, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to C. W. Siemens, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

The Council invite members of the Society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

MERCHANT SHIPPING BILL.

A meeting of this Committee was held on Monday, the 5th instant. Present—J. Scott Russell, F.R.S. (in the chair), R. Greaves, Dr. Sandford, Rev. J. Scarth, Captain B. Sharpe, R.N., Rev. R. J. Simpson, M. J. Riley, and Capt. H. Toynbee.

INDIAN SECTION.

A meeting of this Section was held on Friday last, Hyde Clarke in the chair.

The Chairman said—You will all of you regret the absence of Sir George Campbell, for whom I act on the present occasion, because he not only takes a practical interest in the subject that is to be brought before us, but from his great and extensive acquaintance with everything connected with it. No one regrets his absence more than I do. I will now call upon Mr. Elliot to read his paper.

The paper read was:—

MEASURES AND SUGGESTIONS FOR THE ADVANCEMENT OF THE WET AND DRY CULTIVATION IN INDIA.

By Robert H. Elliot.

Before beginning my lecture this evening I think it advisable to let you judge of the opportunities I have had of forming sound conclusions on Indian agriculture, and, seeing that of all the curses that afflict modern society much speaking is probably the most objectionable, I shall be as brief as I can. I went to India, then, nearly twenty years ago, and commenced coffee planting in Mysore on my own account, and since then the cultivation of the soil, and how best to maintain its fertility, has occupied my closest attention. During four years of the period in question I had on my estates an experienced border-farmer of unusual intelligence, and since then a brother of the gentleman in question has been carrying on the cultivation in conjunction with myself. Surrounding my plantations are numerous villages, so that we have had native agriculture under constant observation, and we not only hold fields, which are sub-let to native farmers, but I once cultivated some of these fields directly; and besides observing what was nearest to me in the wet climate of Mysore, I have carefully observed the cultivation in the dry plains of the interior of the province. In addition to this,

I may mention that I have been investigating problems in agricultural chemistry, with the aid and advice of the late Professor Anderson, of Glasgow University, and, in short, have brought everything to bear on the cultivation of the soil that a long experience, aided by the best advice in Europe, could suggest. And, in concluding this account of my opportunities, I have to add that my factor in Scotland, who is now a farmer on a large scale, originally farmed at the Cape, so that I have had the advantage of direct information—information which I shall make use of in the course of my paper—as regards cultivation in a climate approximating to that of India. Finally, it may not be superfluous to add, that I believe I have examined every available book, document, or report in the India-office that can throw any light on the very important subject that is to occupy our attention this evening. Thus much for my opportunities of observation. Now for what I have to say as regards improving and advancing wet and dry cultivation in India; and, first of all, as to the wet cultivation.

We have all heard so much of the blessings of irrigation, that I feel sure you will be pleased to hear that my remarks on this head are, firstly, to be largely devoted to considering how best we may remedy the undoubted curses it has brought with it in the northern parts of India. And, after having discussed that important branch of my subject, I intend proposing, secondly, a measure by which small irrigation works may be pushed forward in a way alike beneficial to the people and to the stability of our rule in India.

First of all, then, as to the curses of irrigation; and here, I may say, that if anyone wishes fully to understand what these evils are from every point of view, he cannot do better than refer to Colonel Corbett's work, which is entitled "The Climate and Resources of Upper India," but which might more accurately be described as a work concerning the curses of irrigation in that region; for, after enumerating the serious evils that have arisen from irrigation in Northern India, he exclaims, "the blessings of irrigation! Are these blessings or are they curses?" And he justly says that the evils he enumerates are curses. But he further infers that irrigation is necessarily not a blessing, but a curse. I admit the evils, but deny the legitimacy of the inference. Now let us examine the matter as thoroughly and as briefly as we can, beginning with the evils to the soil, the climate, and the country, which, under certain circumstances, are produced by irrigation, continuing with remarks which tend to show that the remedies proposed by Government are the wrong ones, terminating with suggestions for obviating all these evils, so that this irrigation, which in many cases is an undoubted curse, may in every case be an unmingled blessing for the people of India.

Let us, then, accordingly glance, in the first place, at these evils to the soil and climate which are caused by irrigation under certain circumstances; and here I may best, perhaps, aid your comprehension by stating the conditions of sound irrigation systems. These are, first, where the water flows on gradually from the surface of one rice terrace to that of another, and so by degrees into the rivers or water-escapes of the country; and where, when no longer required, it can be readily drained off. Secondly, where irrigation can be carried out by a gradual process of percolation, and applied in quantities about equal to heavy showers of rain—such application of water to be regulated in accordance with the absorptive power of the soil, and with reference to the depth to which it has been broken up. The first system of irrigation requires little explanation; but it may be as well to give an illustration of the second, as I shall show further on that the proper carrying out of this, as it may be called, dry crop irrigation, is the only possible solution for the difficulties connected with irrigation in Northern India. This illustration I have obtained from my factor in Scotland, and was the system carried out by him at the Cape. I give it in his own words. "The land I had to do with," he says, "is on the banks of small streams, having a gentle slope towards the river. The water is brought out by means of dams and stored in ponds, and when required is led by open courses along the top of the fields. What we call the riggs in Scotland are high in the middle, and about ten or twelve feet wide. Preparatory to ploughing, a scratch is made along the top of these riggs down which the water is turned, and a man stands with a spade ready to dam it to either side as may be required till each rigg is properly wetted. No water is wasted, it is all absorbed in the ground. In about twenty-four hours you begin to plough, and by that time the surface is almost dry. The seed is sown immediately behind the plough and harrowed in. The land gets, subsequently, another damping as soon as the plant begins to separate from the seed, and if this is done a good crop is insured. It is a curious fact," my informant adds, "that even in wet seasons when there is no apparent necessity to irrigate it generally pays to do so. And, indeed," he continues, "I have heard many say they never saw a good crop with rain alone, no matter how wet the season may be, on lands that can be irrigated." And it may not be uninteresting to add that the gentleman in question also says that he has "a strong opinion that irrigation would pay well in this country on well-drained land, or on land with a porous subsoil, if water could be conducted on to the land at a moderate expense."

Having thus seen what healthy irrigation is, and how valuable it seems to be even when the crops do receive a good supply of rain, we will now turn to the evils of irrigation in Northern India. These are of two kinds, firstly, what we may call mechanical; and, secondly, what we may call, for the sake of distinction, chemical evils. As to the former they are described at great length, and with many interesting particulars, in Colonel Corbett's book, and a very few words will suffice to explain of what they consist. What occurs, then, under our canal system in Northern India is, as described by Colonel Corbett, shortly this. A field of wheat, for instance, is sown, and when the blades are a few inches long the land is irrigated, and the surface soil turned into a mass of mud, and in a few days the water dries up, and the result is, a smooth, glazed surface, which splits up into yawning cracks. There is then another watering, when these cracks are at once filled up with soil in a state of semi-solution, and the land is thus completely plugged, and the result is that

after harvest you have a close, hardened soil, with a very small power of absorbing and radiating heat, or, in other words, you have converted the soil into a condition closely resembling a sun-dried brick; and it is hardly necessary to point out that, as the soil becomes more and more hardened by this process, it is more difficult to plough and work. The consequence of this needs but a few words of explanation, for, by rendering the soil harder, your ploughing became shallower, you add to the heat of the climate, and as your soil is less absorptive, you increase surface drainage, and consequently cause destructive floods, which pass away laden with valuable fertilising matter. Thus much for the mechanical evils of irrigation in our canal system of Northern India—evils which, to anyone at all experienced in the working of land, are too evident to require further remark; and, in Colonel Corbett's interesting little volume, we find evidence of what we might naturally infer, namely, that though such a system of irrigation may give you increased crops for the first few years, it ultimately reduces the productiveness of the soil to a level below what it was under dry cultivation.

Having thus discussed the mechanical, I will now turn to the chemical evils which have arisen from irrigation in Northern India. These, though extremely curious, are easily understood. It appears, then, that through considerable tracts of Northern India (how large there is no information) soda salts (mainly sulphate of soda) exist in small quantities right through the soil, while, when you get down to the spring level, they exist in such quantities that the water is distinctly brackish. Now, if you irrigate land of this sort, and provide no drainage channels, the spring level rises considerably, and these salts rise, of course, with it. If, then, you irrigate profusely, the water at the surface can only dry up by evaporation, and, as it evaporates, water is drawn up from below by capillary attraction, and brings with it an excess of salts, and as the water flies off by evaporation the salts are left behind; in short, by irrigation under these circumstances, you have introduced a system by which the salts are literally drawn to the surface, and accumulated there in such quantities that the soil is poisoned, and ultimately rendered barren; and if you add to this that the whole country, mainly I conclude from being water-logged, becomes extremely unhealthy, you will have a fair idea of what harm may be done by improperly applied irrigation. To what extent this injury has now extended I am unable to say, but as far back as 1858 I find a Government record of no less than fifty-nine villages marked down, with but few exceptions, as severely injured by irrigation. And in order to show how careful we ought to be in making experiments before committing ourselves to large irrigation schemes, or at least in carefully regulating the method of irrigation, I may quote the following account of the condition of the injured tracts, as described in the year in question:—"The people of the injured tracts," says the record, "have borrowed money at extravagant interest; they have become the mere bond slaves of some money-lender residing in their villages; they have sold the trees on their estates; they have sold their daughters, they have sold their silver ornaments and brass utensils, and as many of their cattle as it was possible to spare, and no conceivable source of means is any longer available. Affection of the spleen, engendered by the tainted water and malarious exhalations of the soil, is very prevalent, and whilst it produces in its victims a restlessness and lassitude in the ordinary occupations of life, it deprives them in many instances of the hope of a family, which, as is well known, is on religious grounds one of the most trying afflictions a Hindoo has to bear. The unfruitfulness of the women is a subject of common remark, and the consequent difficulty of inducing these Jāt families to give their daughters to the men of Paneeput, and the environs of the canal generally, is very great. . . . . The spectacle, too, of sick women and deceased chidren crowding amongst the ruins of their houses (for in many cases the rafters of them have been sold), of haggard cultivators wading in the swamps, or watching their sickly crops, or attempting to pasture their bony cattle on the unwholesome grass," completes the melancholy tale. And to this I may add, that a north-western Province official of long standing told me that the people had simply said to him, "You are killing us with your irrigation." And even in Southern India, where fortunately we have none of the evils of irrigation, it may not be superfluous to mention, in order to show the necessity for cautious experiment, that in the Trichinopoly district, the water supplied from a channel cut from an affluent of the Cauvery was found to be so injurious (but upon what account I have been unable to ascertain) that the Ryots would not allow it to flow upon their land, and the work had therefore to be abandoned. And it may also be worth while to mention here that I find it is stated in the "Bellary Manual," that the cotton growers consider irrigation to be injurious in the heavy, black soils, though for what reason is not stated.

Having thus seen what the mechanical and chemical evils of irrigation are under certain conditions, let us now consider what is being, and what should be done, to remedy the evils enumerated. And here I need not take up your time at much length as regards the remedies for the mechanical evils alluded to, for we have already seen, by reference to the Cape, what is the only true system of irrigating crops which require only partial watering; and if from any cause whatever you cannot apply the water in the way pointed out, then I have no hesitation in saying that you had far better not irrigate at all.

Now let us turn to the chemical evils arising from that saline efflorescence which arises from the accumulation of salts on or close to the surface. The Government is fully aware of these evils, and proposes to remedy them by drainage—in other words, it proposes watering the land and letting the water percolate downwards, and so through the soils into drains—in a way which will, in effect, act similarly to the agricultural drains in this country; and the Government hopes in this way to cure lands that have been injured by salts, and prevent any evil of the kind occurring in future, as the water will take them up in solution, and wash them down to a depth in the soil out of the reach of plant roots, or into the drains, and so out of the country. Now, there is no doubt this plan will be effectual as regards the salts (though it is not expected

that the evils will be entirely removed), but a very simple experiment will show that it must be ultimately disastrous, because the water will take up the valuable fertilising constituents of the soil as well, and so wash them down either to a great depth in the soil or into the drains, and so right out of the country, just as so much valuable manure, especially ammonia, is washed out of our well-drained lands in Scotland. And if Lord Salisbury wishes to form a sound opinion on this subject, he might easily do it in that central glass-covered square of the India-office which is devoted to Indian antiquities. He might form a deep cistern, with small holes at the bottom, and to the depth of the drains by which it is proposed to get the water out of the afflicted districts. He might then manufacture a sample of soil exactly similar to that of the districts in question, grow rice on it, and observe the gradual deterioration of the soil near the surface. But I need not detain you further on this point, as it is so evident that the remedy of drainage, though it will certainly remove one cause of barrenness from the soil, will certainly induce another, and a greater, because a more irremediable evil.

And now let me give you the evident conclusions that we must come to. These are, first, that soils which, under irrigation, produce a poisonous amount of saline efflorescence, are not fit soils for irrigation, as it is usually carried out in India; and secondly, that such soils can only be profitably watered by a system of wetting or damping, such as that described as being carried out by farmers in the Cape. And, further, I may add, thirdly (though I should not like to affirm it positively without actual experiment) that I am strongly of opinion that, whether liable to a saline efflorescence or not, all deep porous soils overlying a country with low spring level are unsuitable for any other than what I may call the damping system of irrigation. For does it not seem evident that if you flood your land, and pass the water downwards through the soil into deep drains you will be washing out of the soil its most valuable constituents? And does it not seem equally evident that, if you do not drain, you will water-log the country?

And here, before closing this branch of my subject, I have a measure to suggest which, I feel sure, would be of great value in accelerating the march of irrigation. This measure is that whenever an individual (acting of course with the sanction and approval of the revenue officers), by the construction of an irrigation work, turns dry into wet land, he should be given a fee simple tenure, or a permanent settlement of the land, and at the rate he formerly paid for his land, which I need hardly say is a rate much less than the rate levied for land under irrigation. Now, independently of the immense impetus such a measure would give to the advancement of the national welfare, and the safety of life, I may mention the following very important consideration. It is often regretted that natives will not invest much in our funds, and hardly at all in our railways, as it is evident that if they did so we should have a security for our rule in India, that we could never otherwise possess. But if they can be got to invest their savings in the Queen's land, it will be almost the same for us as if it was invested in the Indian funds, as, if our power was subverted, it i[s] obvious that no security would exist for the d[ue] fulfilment of the agreement on the faith of whi[ch] the people had invested their savings, so th[at] this measure would at once add to the nation[al] prosperity, and the stability of our rule [in] India; and, by strengthening our hold on th[e] people, I need hardly add that we could ea[sily] afford to govern more cheaply than we are [at] present able to do.

Having thus seen what can be done by way [of] removing irrigation evils, and suggested a mea[sure] for the advancement of irrigation in general, [let] us now turn our attention to that dry cultiva[tion] which must ever form the backbone of Indian ag[ri]culture. And here I feel sure you will underst[and] the very great difficulty there is in dealing satis[fac]torily with such a vast subject within the spa[ce at] my command, and what increases my difficulty [is] the want of information. And to give yo[u a] practical illustration of this I may mention th[at] when preparing this paper, I thought I wo[uld] look up the information at the India-office, [and] accordingly asked, in the first instance, for inf[or]mation as to the areas of India liable to sal[ine] efflorescence. There was, however, no inform[ation] whatever to be found on this point. I a[lso] asked for agricultural information. Man[uals,] gazetteers, and memoirs, were then called [for.] Two of the first were produced for my be[nefit] and given to me, one of the Nellore, [and] the other of the Madura district, both ha[ndsome] volumes; the first had a very good acco[unt] of the agriculture of the district, but th[ough] I found some particulars on the subject [in] other Government records, the second said not [a] word about it. About half a cart-load of si[milar] volumes were then produced, but, with [the] exception of the Nellore manual, there [was] either no information at all, or such m[eagre] accounts as to be of little or no value. H[ow]ever, if I am unable, from the want of in[for]mation, to give you as good a paper as I c[ould,] I trust to be able, through the medium [of] this Society, which has already done a vast [deal] of good, to call attention to the necessity for [ob]taining minute information as to agriculture [and] stock-feeding from all parts of India. And [it is] not only necessary that we should have this, [in] order that we may see what can be done tow[ards] aiding the natives to improve their agricultu[re in] those parts of India which are in a backw[ard] state, but because it is highly probable that [we] may learn from the natives facts and sys[tems] which may be of the greatest service to our Aus[tra]lian colonies. And, curiously enough, in [the] Nellore manual there is an account of a [com]bined system of timber-growing and stock-fe[eding] which I cannot help giving you, partly to ill[us]trate my argument, and partly because the sys[tem] is well worthy of the attention of farm[ers in] hot climates. This consists in a custom, in [the] Nellore district, of planting a certain propo[rtion] of the lands bordering on streams, or inters[ected] with watercourses, two varieties of the aca[cia] (*Acacia Arabica* and *A. Leucophlœa*). These shel[ter] the grass in hot weather, and their pods are u[sed] as food for cattle and sheep. The wood is [very] valuable, and when about ten years old it is [cut] down for timber, after which the land is put un[der]

crop, and another section is laid down under this admirably combined system of fodder and timber-growing. Nor was this the only fact of interest in the manual in question, for the natives had discovered the use of the nitrate of potash, a most valuable manure, which they used by the application of nitrous earth to the tobacco plants, either in the solid form, or dissolved in the water applied to the plants. So here we have two facts of considerable interest, and one of them of considerable value, from a single district, and, as it appears to be the only one that has been minutely examined, I think it is quite probable that we have still an immense deal to learn as to native systems of agriculture. But independently of the considerations hitherto given, I need hardly say how important it is that we should thoroughly master the whole of the agricultural difficulties and circumstances of India, because it is in consequence of our ignorance that a great deal of public money has been squandered in model farms, cumbrous English agricultural implements and machinery, and in exhibitions which have been at once a loss and a laughing-stock. And here, as I do not like making general statements without at least quoting some of my evidence, I may mention that a Madras civilian, in order to show me what a great deal of good had been done by the model farm of that station, sent me all the papers and accounts of the farm for several years. Well, I found that in five years, commencing from 1865, an average of about £1,450 a-year had been spent, and if they were spent at the same rate since, they must have at least spent a total of from £14,000 to £15,000 on the farm. Now, I should have considered myself highly paid if I had told the Government all that had been learnt, and got a fee of £500, or even £100. In short, they had discovered nothing of any practical value that was worthy of the name of discovery, or that any intelligent planter could not have discovered at very short notice; and it is sufficient to say that the facts which are held up as discoveries are, firstly, that green crops for fodder can be grown in the hot weather months; and secondly, that it was thought to have been proved that it paid better to steep rather than to boil grain.

And now, before advancing to a methodical consideration of this branch of my subject, I must not leave you under even the temporary impression that I am adverse to experimental farms, for I shall have much to say in favour of a large extension of them under certain conditions. And I wish clearly to say that my main object in making these remarks is to show how necessary it is that, India being a very big farm, those who are to have charge of it should be taught at least those elements of agriculture which, in conjunction with local experience, will enable them to form some sound opinions as to the best and most economical way of advancing Eastern farming.

Having thus insisted on the importance of teaching our future Indian revenue officers something of agriculture, I will now proceed to consider what we can do by way of improving Indian agriculture in general, and dry cultivation in particular. And here, as indeed in every other subject, it is very important that we should find out and firmly fix our attention on the leading point of the situation—the weak point, as it were, of the Indian agricultural wall—for it is hardly necessary to say that if we scatter our thoughts over the whole field of agriculture, we shall simply leave off with the idea that something requires to be done as regards a great many important points; and the very contemplation of such masses of considerations will be quite sufficient to induce such a feeling of the difficulties of the situation as will be utterly destructive of anything approaching to effective action. And, fortunately for you and for me, we have not very far to go to find this point, which I am happy to say has already been recognised by a very able Government officer (Mr. Clements Markham), who tells us, in the last annual report of Indian progress, that "the weak point of native agriculture is the want of manure;" and if you add to this the somewhat laconic remark in the Berar report for 1870, where Mr. Lyall, speaking of the native agriculturist, says, "He manures very little, but as much as he can," you have clearly before you the grand point of the situation. Now if we can surmount that point the rest will be easy, and Indian agriculture will be placed on a firm and enduring basis; and if we cannot surmount it, then I have no hesitation in saying that all our efforts as regards Indian agriculture must either fall entirely to the ground, or produce effects so trifling as hardly to be worth having. Let us then consider this matter very carefully and methodically, and for greater distinctness it may be as well to adopt the following order—

1. First of all, then, I purpose showing that there is every reason to believe that the Indian farmer does, with but few exceptions, manure as well and as much as he can.

2. I will show that all that he can do must fall far short of the requirements of the soil, and how it comes to pass that he is unable to do more.

3. I will show how, as more and more land is brought under the plough, the proportion of manure to the cultivated area becomes less, and how, owing to the vicious land system prevailing in Southern India, this evil is rapidly increasing.

4. I purpose showing what we can do by way of ameliorating the existing condition of things, or at least of preventing them going from bad to worse.

As to the first point, I need not detain you long, as from all I have been able to hear, read, and observe, I am quite satisfied that, with few exceptions, the Indian farmer does manure as much as he can. I shall, therefore, do little more than blow up an absurd delusion, the constant repetition of which must have cost the Government a considerable sum for paper and printing ink. This delusion consists in the belief that Indian agriculture suffers largely from the fact of cattle dung being used for fuel, and I hope you will attend carefully to what I have to say on this point, because you will then be able to see at a glance how very poor must be the manurial resources of India. What, then, is the value of the dung of grass-fed cattle? Well in England every 1,000 lbs. of the dung of grass-fed cattle contains only 11 lbs. of valuable manurial matter, 4 lbs. of nitrogen, 3 lbs. of phosphoric acid, and 4 lbs. of lime. Now, assuming that the dung of the greyhound cattle of India is as valuable, the loss of manurial matter in burning it is easily calculated, and comes to the almost infinitesimal quantity of

4 lbs. per 1,000 lbs. But this trifling loss is easily made up, and I am convinced far more than made up, from the very fact of cattle dung being used as fuel, for, in consequence, every morsel of dung that falls on roads and lanes, and the barren plain, is carefully gathered, and as the ashes of the fuel are always returned to the soil, you can easily understand how there may be not a loss, but a positive economy, brought about by the very circumstances which, by most people, seem to be the most unfortunate fact connected with Indian agriculture. And I may add that the late Professor Anderson, of Glasgow, whom I specially consulted on the subject, said that he could easily understand how this might be so; I may add also that another well-known chemist, Mr. Dupré, was of opinion that, in any case, there would be but the most trifling loss, as long as the ashes of the burnt dung were applied to the soil.

I have said that I would not detain you long on the first point I have selected for consideration, but it may be as well, and perhaps not uninteresting, if I give you a list of some of the fertilising matters used by the native farmer, when he can obtain them, which, I am sorry to say, is rarely the case. Leaves, then, when available, are used to add to the manure heaps; nitrous earth is also used in some parts of India; fish are applied to land on the coast; town sweepings are carefully used, and so also the refuse of oil mills and indigo vats. Crops to be ploughed in green are in some instances grown; salt earth is applied to cocoa-nut trees in Mysore; where flocks of sheep are to be met with the owners receive regular payment for every night they are folded on a farmer's field; while in the Madura collectorate I find that even bats' dung is collected from old and ruined buildings, and in some parts of the country, where the means of enclosing them exist, cattle are also folded on the land. In short, I am quite satisfied, as I said before, that, with few exceptions, the native farmer thoroughly understands his business, as regards fertilising the soil, and that if he does manure very little, he at least manures as much as he can. To this there is only one exception of any importance (I allude to night-soil), and it is an exception that, considering the difficulty we have in overcoming our own repugnance to it, is not very surprising.

Now, let us pass on to my second point, and observe how all that the native farmer can do must fall short of the requirements of the soil, and how it happens that, as things stand at present, he can do no more. And here, perhaps, I may best aid the comprehension of an English audience by remarking on the agricultural conditions that have fallen within my own observation in the province of Mysore. Throughout its western border, then, the country is well wooded, and the villagers have, therefore, important manurial resources at command. For, in the wet weather, the cattle have sufficient pasture, and in the dry season they browse on the partially swampy spots at the bottoms of the ravines, and along the margins and divisions of the rice fields, and also, to no small extent, on the foliage of the lesser jungle trees; and, in consequence of this, their dung is not only much larger in quantity, but also better in quality than that of the half-starved cattle of the plains. Then a greater number can readily be kept, and the farmers are enabled besides to collect from the jungle large quantities of leaves, which are broken down for manure by the cattle. Firewood is also abundant, and the ashes of many kinds of wood are of great value. It also fortunately happens that, from the climate being too wet for the growth of the dry crops of the plains, the agricultural area is necessarily limited, and as the manurial sources are ample, the crops, though limited in extent, are heavy and regular, and the land at the same time kept in good condition. But leave this frontier margin and travel thirty miles into the plains of the interior of the province, and you will find how different the conditions are. For the country is, for the most part, destitute of wood, and firewood having to be brought from great distances, is so scarce and dear that dried cattle dung is the usual fuel; the grass is short and scanty; the straw of the various crops is entirely consumed by cattle which, with the exception of the finer kinds of draft breeds, are necessarily lean; the proportion of cattle, too, to the cultivated area is small, and as the food is extremely deficient, the manure is not only poor in quality, but small in quantity. Whence, then, asks the practical agriculturist, is to be supplied the phosphoric acid, lime, and potash which he sees carried off, partly to be eaten by the farmer, partly to be exported to pay his land-tax, and whence that vegetable matter which is so necessary, not only for its constituents, but for the effect it has in maintaining the texture and absorptive powers of the soil? He examines the scanty manure heaps, which, with the exception of those rare instances where sheep can be hired to fold on the land, form the main resource of the country, and finds that they consist almost entirely of the dung of lean cattle, and of the ashes of that which has been used as fuel; and what the value of the dung of lean cattle is we have already seen. How, then, is the soil to be maintained even in a fair state of fertility? The answer simply is, that under existing circumstances the soil never can be kept in any other state than what we should describe as a very low and exhausted condition. It is, as we have seen, robbed of its vegetable matter because this is wanted to feed cattle, and, from the absence of trees, there is no means of procuring leaf manure. It is deprived of its phosphate of lime, which is very partially replaced, and of its potash, which can hardly be said to be replaced at all. And what is true of the interior of Mysore is, with few exceptions, true of all India as far as our information goes, and you will find ready evidence of it whereever you turn. Let me quote, by way of illustration, that from Madura, where a native district officer, in writing of the subject, says:—"I have not known a case in which, even with the greatest care, a Ryot would have been able to secure, by collecting the dung of his own cattle, sweeping, &c., of his house, a quantity of manure sufficient for his field; nor can any be purchased at any reasonable price, since everyone is careful to collect as much manure as he can." In Kurnool I find it simply stated that, "in dry cultivation manure is never used, as it is all required for the irrigated lands." And if you go far north to the Punjaub, you will find equal confirmation

f the melancholy agricultural condition of India. nd I find it stated that "no village there s enough manure for more than its best ." But in many instances the cultivator s not, in consequence of the scarceness of pas- re, even full command of his paltry manurial sources, and whereas in parts of the country e cattle are brought home every night to sheds, I find that in a great part of the llore district the bulk of the cattle have to be en off to distant pastures in September and tober, and do not return till the end of January, early in February. But the most astonishing ence of the want of manure is to be met with Bengal, where I find that, even with such an austing crop as jute, no manure in many in- nces is used, while in one district (and this is int I shall again direct your attention to when me to consider whether some check should be put on the growth of exhausting crops) it ated that no manure is considered necessary, as jute is mostly grown on newly reclaimed lands. , from what I have hitherto said, I think you ll see very clearly of what the grand difficulty the Indian agricultural situation consists. very ancient times it probably did not exist all, or only in a very limited degree, for if assume the population to have been much ller, the agricultural would have borne but a ll proportion to the grazing area, as it does the western border of Mysore now, the number attle to the cultivated area must consequently been greater, their condition better, the quan- and quality of their manure considerable, and general manurial resources of the country ample. as the population increased, and field was added eld by petty cultivators, who could afford to little more than raise food for themselves, total manurial resources would either become tively less, or, by being divided amongst a ater number of fields, gradually diminish in portion to the area under plough. And in e instances I find it stated that the total ual manurial resources have actually become , or, in other words, that with an increased ation you have a smaller quantity of stock. Having thus seen very clearly how these un- nate agricultural conditions came about, and it is that the agriculturist can do no more, l now observe, as my third point, and show , in the absence of remedial measures, the ulture of India must go from bad to worse. now I need not detain you long, seeing , as the same causes which brought India its present agricultural condition are still ating, it is evident that they must necessarily ase with the increase of the population. I ll therefore confine my remarks to observing t very vicious system of land management ch prevails in Southern India, and which may ail elsewhere, for all I know to the contrary, which not only diminishes the food for cattle, must lower by degrees the whole condition of uncultivated cultivable area. This system sts of allowing a farmer to apply for a grant pasture land, plough it up, take as many crops he can get out of it, and then hand it back to rnment, thoroughly exhausted, without a ticle of manure having been returned to the il during the period of occupation, or a single handful of grass seeds being put down with the final crop. Imagine a landed proprietor in this country letting grass land, however poor it may be, to a tenant on a five years' lease, that the tenant took as many crops of wheat in succession without putting in a particle of manure, and then handed back the bare exhausted soil to the land- lord, without even a blade of grass on it. But I need not detain you longer here. You have seen the evils of the Indian agricultural situation. Let us turn next to a consideration of those remedies which are practicable.

And now, in advancing to the consideration of what may be called remedial measures, I must caution you against supposing that I am prepared to suggest anything which can put Indian agricul- ture on a thoroughly satisfactory footing as regards keeping up an adequate supply of manure. If in- deed, I could put nine-tenths of the inhabitants to the sword, take their capital and hand it over to the survivors, then divide the best of the country into 200 acre farms, or farms of sufficient size to enable them to spare a considerable portion of the land for growing cattle fodder; and if, in addition to that, I could destroy the whole social system of the Hindoos, prevent the subdivision of the land, teach the people to emigrate, or get very few chil- dren, turn the whole of the people into meat eaters, remove their objections to killing off those old and worthless cattle which now help to starve the good stock; and, finally, overcome their equally strong objection to the use of night soil; if I could effect all that, I could easily put Indian agriculture on a satisfactory footing. But, in the absence of such a possibility, I will defy anyone to do more than produce, by slow and painful steps, some ameliora- tion of the existing state of things. Now, the first thing to be done is to prevent things from going from bad to worse. We have seen how they are doing so, and the remedy, obviously, is to prevent more grazing lands being broken up, unless they are to be brought under irrigation, or unless they are clearly beyond the requirements of each particular village. Having thus brought your evil to a stand- still, the next thing to be done is to see if we can- not lessen it in any way, for nothing can be more clear than that the manurial resources of the country are far below its requirements. Now, here I have a measure to propose, the value of which it is impossible to exaggerate—a measure which, in some degree, was initiated by Sir George Campbell, when, a great many years ago, he issued an order in his part of the Punjaub, that every man who cut down a tree should plant five in its place. That measure is that, wherever it is practicable, every village should be compelled (and the compulsion, I am sure, would be very popular) to plant, fence, and maintain a solid block of trees, varying in size in proportion to the land available and the general circumstances of the situation. Now the great advantage of this would be that you would have at hand supplies of leaves for manure, and especially for litter, for it is in consequence of this want of litter that nearly all the liquid manure—the most valuable portion of the excreta, I need hardly say —is lost. So that if you had abundant supplies of leaves, you would not only be adding a very im- portant manure in itself, but, I think it is hardly too much to say, you would be doubling the manurial resources of India. But there is another important

effect the supply of leaves would have; for the great defect of Indian soils is the want of vegetable manure to form that kind of padding which, by improving the texture of the soil, makes it run easily, and renders it deeply workable, and this, from increasing the absorptive and radiating powers of the soil, would produce an incalculably beneficial effect. Then you must further consider that, by having solid sheltering blocks so situated as to traverse the line of the most injurious drying winds, you would produce an important effect in improving the grass, and also the straw of various crops, so that not only would you, by using the leaves of the trees as litter, add largely to the manurial resources of the country, but you would be able to grow more green food of every kind, and so produce more and better manure. And, as regards this question of shelter, I am able to speak with the greatest practical experience, for my attention as a planter has been much directed to it, in order to save our coffee-trees from those parching east winds, that have an effect which, to an Englishman, is almost indescribable. And here, in addition to the effects alluded to, you must remember that trees modify nature in many other important particulars—that they economise rain by causing it to fall in gentle showers—that they prevent it disappearing rapidly after it has fallen—that they cause it to be distributed more equally in time throughout the year, and that, finally, by making the atmosphere more uniformly moist, they temper the heats of summer, and make the climate infinitively more healthy.

And now, before continuing my remarks on remedial measures, I must pause for one moment to notice a very important effect that must arise from placing some restriction on the breaking up of grazing land. The effect is that a better distribution of the people will be brought about. For, as most of you are probably aware, the population is inconveniently crowded on certain tracts, while others are, comparatively speaking, thinly populated. Now, if you limit your agricultural area in the way I propose, you must, in time, force the surplus population to emigrate into the more sparsely populated districts, and, in order to tempt them thus to emigrate, it would be well if the Government could be induced to give a permanent settlement on moderate terms, and every other possible encouragement, to those who had the enterprise to embark in new fields.

Having thus seen what can be done towards overcoming that grand defect (a defect which, if we could overcome, we might almost dismiss the subject) of Indian agriculture—the want of manure, I will now pass on to consider what subsidiary measure can be carried out that would tend to the improvement of agriculture. And here the first thing that seems to have occurred to us was to teach agriculture by establishing model farms in various parts of India. Now, to any practical man who understands agriculture, and knows the climate and social circumstances of the situation in India, this process of attempting, as it were, to teach our maternal ancestors the arts of oval suction, is ludicrous beyond description. And what did the border farmer whom I had on my plantation say? Simply this, "When I came here first I thought I could improve the agriculture of the natives, but I now find that I can suggest no practicable improvement at all, except a slight improvement in their plough." And I could give you ample confirmation of this from other parts of India, were I not afraid of taking up too much of your time. And, if any further way is wanted of proving that it is not the agriculture that is in fault, but the want of manure, arising from causes beyond the control of the farmer, and which he cannot remedy because the holdings are too small to spare land for green crops, all you have to do is to look at the crops, for instance, in the immediate vicinity of Bangalore, where I have seen even very short-strawed crops so heavy that, riding along the paths that lead through them, you could not see a particle of soil. In short, the crops could not be better; and they are good because, from the proximity of a town, manure is available, and as you go further back into the country they decline; while, again, in the more wooded countries, where, as I have explained, manure is available, they again became heavier. In a word, they rise and fall with the manurial facilities; and, so far from the people being behindhand as regards putting down and cleansing their crops, they not only rival our very best farmers, but are infinitely better agriculturists than the average of the English farmers. The drill husbandry of Mysore, in especial, I feel sure could not be excelled. The drilling machine sows thirteen rows at a time with the greatest regularity; and the bullock hoe, with blades which pass between the drills, eradicates weeds when the plants are a few inches high, and freely stirs the soil in a way which could not be surpassed. Nor is their ploughing, though with the inferior draught power at their disposal necessarily somewhat defective, by any means so ineffectual as people usually suppose; and, after repeated stirrings, they eventually get down to a depth of 4½ inches, or about half an inch less than an average lea ploughing in this country. Then as to labour-saving machines, it is evident that they would not pay as long as wages are as low as at present. In short the only improvement I can suggest, would be to borrow from the Chinese some modified form of the machine used by them for cutting up both the soil and the trefoil roots. This consists of a strong wooden frame with two cross-bars, into which are fixed two rows of strong concave knives. A bullock is yoked to the machine, and the driver standing upon it, it is urged through the soil in all directions. Now, if such a machine was used in conjunction with the native plough, it seems to me that the land could be worked more easily and deeply than it is at present. But, though I do not think we shall be able to teach them much of any practical importance in the way of agriculture, I think that if we had attached to the school at the head-quarters of each talook, or country, a combined agricultural, horticultural, and arboricultural farm, to be managed and worked by the schoolmaster and boys, with perhaps a little occasional outside aid, a great deal of good might be effected. The breed of stock might be improved, better varieties of native vegetables created, indigenous fruit trees be improved, and many valuable trees and medicinal plants, for both man and beast, grown and distributed. This was suggested to me about four years ago, and I believe something has already been done by Sir George Campbell to initiate such a system. Nor is there

anything novel in the idea of thus combining farming and education, and even trades as well, for such a system has been long carried out (for the last 70 years I think) by the Communistic Societies of the United States. And in the schools of these Societies the boys learn as much, and perhaps more than the ordinary farmers' sons, while they are also made good farmers, and given a thorough knowledge of some useful trade. Now as these Societies must have accumulated great experience, I need hardly say that our Government of India would do well to learn all they can from them as regards a system which seems to be so admirably suited to the wants of India.

And now, before offering some closing remarks, I wish to say something as to the importance of agricultural statistics, and also as to whether it is not advisable that some restriction should be placed on the growth of exhausting crops, and especially jute. As to the first, considerable attention has been paid to them, but it, unfortunately, happens that they are defective in that point, of all others, as to which we require the most minute information. And considering that agriculture is almost the sole resource of India, you will be surprised to hear that we have as yet no complete information as to the reserves of available, or rather culturable waste lands, that remain to be brought under the plough. There are, it is true, returns from some of the provinces to guide us towards the probable facts, but there are no reliable returns from either the Bengal, Bombay, or Madras presidencies. Now I need hardly say that till we have these returns, or in other words, till we know what the natural increase of the people has to depend on for subsistence, we cannot possibly realise the situation in India. Nor can we bring to practical account the labour and expense that has been incurred in ascertaining the number of the people; and to illustrate this I may mention that, after hearing an interesting lecture on the Bengal census, I asked the lecturer (Mr. Beverley, the gentleman under whom it was taken) what available culturable land the natural increase of the enormous population of Bengal would have to fall back on, and the answer was, that there was no information; and yet is it not perfectly obvious, that till you know what Bengal consists of, the statement that her population averages so much to the square mile conveys but a small comprehension of the situation? And what, for instance, to a ruler who wished to form an opinion as to the prospects of Egypt, would be the use of his being informed by the official classes that the population only averaged so much to the square mile, if it included in the square miles the 80 miles of sand between Cairo and Suez? And if we wish to place still more clearly before us the importance of this point, we have only to consider that, as far as our information goes, it is highly probable that, estimating the population as low as 240 millions, or 10 millions less than what it is supposed to be, we shall have 20 years hence about 293 millions, and in 40 years no less than 357 millions in all India. It would seem ridiculous to look on to a future period, but the question whether the Government should take over the Indian railways now or some 80 years hence, makes it worth while to point out that by that time the old and exhausted soils of India will have to support, or perhaps I should rather say attempt to support, about 530 millions of persons. But I have said enough to show you the very great importance of taking stock of our Indian estates, and these facts, as regards the probable increase of the population, will also show you, if any further argument indeed is needed, the urgent necessity there is for initiating such a system of land management as will enable the people best to maintain the fertility of the soil.

One point more as regards agricultural statistics. This consists of the necessity there is for carefully ascertaining the area of land subject to saline efflorescence, and also what lands are suitable for irrigation in any form, and what lands are suitable only for that wetting system of irrigation which I have recommended as the only system for lands where you have a deep and porous soil overlying a low spring level.

Let me next, and lastly, ask whether it is or is not advisable that some restriction should be placed on the growth of exhausting crops, especially jute. I am aware that this is a very difficult and delicate subject, but whether we can make up our minds as regards it or not, our time will not be wasted, for it will give us one more, and a very important illustration of that fatal weakness of Indian agriculture—want of manure. Well, on reading that very interesting and I may even say learned compilation, which resulted from the labours of the Jute Commission, I found that the crop which goes by the name of "jute," is in some instances described as scourging, and in others as exhausting; and that it is so you can easily understand when I tell you it is a fibre-yielding plant, which grows from six to ten feet in height, and that in many instances the cultivator allows it to run to seed before cutting it, because his time is very apt to be taken up by the other crops at the proper season for cutting the jute, which is just before it flowers. Such a crop therefore naturally requires much manure, if you do not wish to run your land out. Well, I find in the report that in some districts the land is manured for the crop, but in other districts no manure is used at all; while last, and worst of all, I find that in one district it is stated that no manure is thought necessary, because the jute is grown on newly reclaimed land. Would it be possible to have a more disastrous account of the prospect of agriculture in any country? Nor does the prospect look at all more cheerful when you read that the farmer being well aware of the scourging nature of this crop (which he is tempted to grow because it is so profitable) shifts it on from field to field. And what, let me ask, would be the feeling of a landed proprietor in this country if he found that his tenants were cultivating in their rotation, and without any manure, a scourging crop, the growth of which must inevitably, in the end, lower the whole average value of his property? And what, further, would be his feelings if he found that any newly-reclaimed land on his estate was being scourged down into a poverty-stricken condition by the growth of exhausting crops? But the proprietor here guards himself carefully against any such abuse of his land, and he in effect does so for the common good as well as his own. And it seems to me that the Government would do well to consider carefully whether, as

regards the lands it has full control over at least, something cannot be done to limit the number of times in a given number of years that a man is to be allowed to take a scourging crop from his land. But it is not only on account of jute that this subject requires the careful attention of Government, for I am quite convinced that, in consequence of the facilities for export, farmers are being tempted into growing heavy crops of oil-seeds and cotton, which, considering the manurial resources of the country, they have either no right to grow, or which should be grown very seldom. It may be said that the interests of the cultivator will place a check on this, but there is in human nature such a strong disposition to believe what we wish to believe, that even people who ought to be far better informed than the native farmer are often taken in as to the capabilities of the soil; and they do not, unfortunately, find out their mistake till it is either too late, or till such a time that enormous expense has to be incurred to restore the fertility of the soil. And this is a point on which I can speak from an unfortunate practical experience, for we planters in Southern India, seeing that we had virgin soils of fine quality and great depth, thought we could go on, at least for a good many years, with little or no manure. We soon, however, found out our mistake, and had to make up for it by a great expenditure on artificial manures before we could put our land again into good condition. But I need hardly say that such a method of resuscitation must ever be far beyond the means of the poor Ryot of India, and I think it, therefore, of very great importance that the attention of the Government should be immediately directed to the very important point we have just been discussing.

And now for a few concluding remarks. I have sketched this evening a plan for the land management of India which should, in my opinion, be carried out in all parts of the country where such a method would be practicable, and that it would be eventually successful I have not the slightest doubt. Nor need we look forward to a very great stretch of time for carrying out such a scheme as the one I have proposed. And if, for instance, the land management of the Province of Mysore had, forty years ago, been handed over to some of our most intelligent Scotch factors—men without prejudice, and who would have acted in concert with the most intelligent native agriculturists—I have not the smallest hesitation in saying that the country might by this time have been studded with plantations, its climate vastly improved, its capacities for keeping stock of all kinds increased, its manurial resources almost doubled, and that with a system of giving a permanent settlement at a low rent to protect individuals who, at their own expense, turned dry into wet land, you would have had considerable sums of money which are now lying comparatively idle profitably employed, and in a way which would have added at once to the prosperity of the people and the stability of the Government. And although to our ideas the carrying out of that one part of the scheme which relates to growing trees might seem the height of despotism, it is just that kind of despotism which, in an Eastern country, would carry with it unbounded popularity and unbounded belief in the wisdom of the ruler. And every year we put off, remember, our difficulties will be increasing; for, as the manurial resources diminish, the soil will be steadily going down and down, while the population will be rising on us, not, indeed, with arms in their hands, but, what is worse, with open mouths, which will tax all our resources to fill. But it is needless to say more, for here, as in every other instance, history will be sure to repeat itself. It has always happened that every danger that has come on us in India has been foretold by a considerable number of persons. It has always happened that these warnings have been neglected, and it will be so in this case. Hitherto by the length of our purses we have been enabled to overcome those bursts of famine, which sweep like tempests over vast tracts of our Eastern dominions. But, far above these periodical paroxysms, we have looming, in the not very distant future, the picture of vast multitudes of rapidly-increasing people relying on us like children on a father, and toiling patiently for bare subsistence on soils which are year by year becoming more exhausted, and which, under the continuance of existing circumstances, must eventually be utterly unable to maintain the numbers, which threaten, one day, to cumber the very ground. It may be that manufactures may come to their aid, and that education, by diminishing the terrors of the ocean, and, perhaps, by teaching them the necessity of limiting their families, may also be of some assistance; but it seems no exaggeration to say that, to all these aids, we must bring the careful management of the lands of the State, if we ever hope to steer safely through those rocks ahead, on to which, unless timely measures be taken, we must, sooner or later, assuredly drive.

DISCUSSION.

Mr. Cassels, in rising to open the discussion, in response to the invitation of the Chairman, said he was very ignorant of practical farming, but he entirely agreed with Mr. Elliot as to the necessity for obtaining better statistics bearing upon the subject under discussion. He was happy to say that the present Government were fully alive to this necessity, and that measures were being taken now to obtain far better statistics bearing upon agriculture than ever they possessed before, and the whole question was receiving most careful consideration. They saw the great necessity of improving the agriculture, and were fully alive to the great wants of India as regards manure and other matters of importance. Having made these few remarks, as he was not prepared with a speech, he would prefer giving place to others who had a more extensive and practical knowledge of the subject.

Dr. Burn said that, as a Government servant, having had charge for seven years of an agricultural department, he could speak with certainty on the subject. He superintended the experiments which were carried on there for several years, for the purpose of introducing the American cotton plant. Detachments of men were sent to each of the Presidencies with a view of introducing it, and he had charge of that in Bombay. The American cotton plant was, however, almost a complete failure, except in those parts of the country where the climate was the same as that of America. The Indian cotton plant and the American plant were totally different. The one sends its roots into the ground five or six feet, sometimes even five or six yards, in the black soils, while the American lies along the surface, and re-

quires the assistance of rain every ten days, fortnightly, or three weeks. That was sufficient to account for the failure of these experiments, the conditions of the soil and climate were so different, though it was extremely difficult to get the native to believe this. Experiments were conducted in different parts of the country at an enormous expense, and some millions were spent in this Indian cotton experiment before it was given up. The experience Mr. Elliot had had there had given him a knowledge of facts which would be of immense value to the Government of India if they would pay proper attention to it. The question of agriculture was one of the deepest interest to the country. It was the chief source of the revenue. They had seen what could be done when agriculture and horticulture were properly attended to in India by the successful cultivation of opium, which supplied a revenue of £10,000,000, he believed, annually. That was chiefly superintended by Europeans. The production of silk was being extended and greatly improved, and he had no doubt when they became acquainted with the best means of cultivating it, and how to introduce eggs from foreign countries, and preserve them during the hot weather, that they would grow the finest silk. The great reason why the natives did not succeed in this was their incapacity to maintain the insect through the hot season. He had done this in Guzerat, but it was extremely difficult to teach the natives all at once matters of this sort. The few people who learnt the method died out, and the knowledge of how to do it died with them. That was the case in Guzerat. As to the question of irrigation, there was no doubt it had been greatly overrated by people who did not understand the facts. They all knew the unhealthy state of the districts affected by the Ganges Canal, and the natives themselves were perfectly aware of the injurious effect. They knew from experience that the natives would not take the water from the canal. The land was destroyed unless there was perfect drainage made before the irrigation. The water must be able to get out of the land as well as into it with equal facility. Knowledge had now been acquired in respect to it, and the canal was more cautiously regarded. It was very dangerous indeed to irrigate large districts without previous knowledge of the necessities of the soil, and so forth. In many parts of India there was a very extraordinary knowledge and capability for agriculture, and there were classes of men there who had as perfect a knowledge on the subject as any of our best farmers. It was one of the most beautiful sights to see the drills they made, which were perfectly straight and even, and stretched in all directions. They were fully alive to the value of manure, for he had known in a village of Guzerat that it had been kept in the house for fear of its being stolen. He thought agriculture might be gradually increased and extended if the securities for the people to deposit their money were greater—but there were no bankers in India like we have here. They must trust the Banyan, and every one knew the consequence of that. They generally went to goldsmiths, and if they had not enough to have gold bangles then they had silver bangles, and thus the goldsmiths really became the bankers. There was no part of India where wheat could not be grown, and of the finest quality. They were now paying some thirteen or fourteen millions for wheat imported here, very little of which came from India, and he would have the whole of that from India if it were properly managed. He would have wheat farms the same as they had for the special cultivation of opium and indigo; and he thought, to manage such farms, they could not have better men than some of the Scotch factors. He would not trust the Civil servants with them. They ought to be thoroughly and practically taken in hand, and agriculture and meteorology combined, for without a knowledge of meteorology they could get no crops. A few days' delay in sowing made all the difference of success. He considered that was the cause of the success of the village system. The people were able to devote their whole attention to the matter, and to sow their seeds in the right time.

Mr. Peterson felt very great interest in the question, having been a farmer in India. As to the question of irrigation, it was perfectly clear that if they made a swamp they could grow nothing, but a judicious application of water in a country where the sun was so hot must be good. For the rubbee crop water was actually necessary. For the main crop of Bengal rice there was no crop without water. It was all very well to talk about a beautiful, gently-disposed dew or vapour being thrown over the land, as might be done in some places, but they must take the water as they could get it. He had never seen, during a period of twenty-seven years, a plentiful rice crop without a plentiful supply of rain in July. And if they did not get from the 1st of September, while the seed was setting, a copious supply of water, they got no crop at all. The famine of 1873 was caused entirely by the want of it. As to the question of the canal, he had taken the trouble to go up the canal twice, for the sake really of investigating and seeing what it was. He had, of course, conversed with the cultivators, but no information could be got out of them, as they always suspected you had come for the purpose of raising their rent. Although they complained of the Ganges Canal he found they used it. He had, however, seen men hoisting water by the bullocks, in many cases 120 feet, and flooding their land with this, while there was the canal water which they would not take. In the years of the famine, 1873 and 1874, in the neighbourhood of the canal, where they had its influence, the crops were good, which showed that it was beneficial. He thought they were giving irrigation a bad name unjustly. Water like fire was a very useful servant, but a dangerous master. If they made a swamp they must pay the penalty of doing so, and if they made a desert they must suffer for it. The native knows the cultivation of his own soil far better than we could tell him. As to manure, it was quite out of the question. They had got the same thing in India that had occurred in Egypt 5,000 years ago. The population had increased too largely, but it was not by any extravagant outlay that they would increase the producing power of the soil; it was only by a well considered system of irrigation. Allusion had been made to the population. No doubt it was enormous, but in some parts of India there were not three souls to the square mile. But there was plenty of room for improvement, and by a judicious system of draining there would be the means afforded for a larger population through all the hills in the jungle district. There was a red ferruginous soil which would grow anything with water. But if the Bengalese would not do as other races had done, and go out and find some better soil, they must pay the penalty and die out. It was our duty to afford them the best means we could. He did not agree with Dr. Burn as to sending Scotch factors to superintend the farms. He was not aware of a single beegah of opium or indigo that was grown under the superintendence of a European. The remedy for everything as far as India was concerned, with its hot sun and fertile soil, was a well-laid scheme of irrigation. They could not go into the question of manures, and that would not be a sufficient remedy if they could. He had seen a large tract of soil growing rice for twenty years, but it had depended upon the state of the rain on getting the plough into the ground, and the state of the rain when the seed was put in.

Mr. Vesey Fitzgerald said that the ancient enterprises undertaken by native princes had generally succeeded, so he supposed experience was what was chiefly wanted to carry out irrigation in each particular locality. The same difficulty as to land being swamped and flooded by irrigation occurs in this country, though in less degree;

and here this difficulty is always overcome by draining, as well as irrigation, when necessary. Generally speaking, artificial irrigation in India had been profitable, and was so now, and the reason why it was so much more prosperous than the Ganges Canal must be that experience had been brought to bear in the one case and not in the other. It was the most common thing to irrigate the land, and to make it into a swamp, but no irrigation ought to be carried out under such circumstances. Any farmer ought to drain the land before he threw water over it, or see that the soil was of a sandy or gravelly nature. On the question of efflorescence of the land he doubted whether there was sufficient evidence on the subject, but he strongly suspected that efflorescence would arise as the particular salts were washed out of the land. Nothing was more established in the native mind than that, generally speaking, public works of this nature were useful, and they were very commonly disposed to consider that the devotion of effort to carry out such works was rewarded in a future life. The existence of this feeling would, in itself, prove to his mind that these works have for the most part been useful; but he ventured to appeal to the gentlemen well acquainted with India who were present, as to the fact that ancient works of irrigation have often, perhaps almost universally, been highly profitable. Possibly the notion that Government officials derived profits from the use of the canal might make the Ryots indisposed to avail themselves of it as much as might be desirable. But experience might be left to bring it about. Irrigation, he knew, had been attended with the very best results. The limits of the famine in Orissa were bounded by the limits of irrigation, and enormous good had been done by it.

The Chairman said he must renew the expression of his regret that Sir George Campbell had not been able to take part in the discussion, because he was so well acquainted with it in all its bearings. His mind had been a little perplexed at what he might call the paradoxes of Mr. Elliot, though he had given himself an answer to some of the remarks he had made. After what they had heard, many of them must be in the same state of perplexity that the Marquis of Salisbury was with regard to irrigation. Still, the more the subject was discussed the better. There must be limits as to the application of irrigation. The chief defects of the schemes, he thought, were that they had been the works of engineers who had not taken the practical experience of farmers and agriculturists. It was no use devising great schemes unless they could be brought into practical application by those for whose benefit they were intended. Mr. Elliot had told them that model farms and agricultural schools were of little use, and they had heard the statement from practical authorities that agriculture in India had reached the highest pitch of perfection; and if that was so and it was the fact that with regard to particular crops they could not be produced under higher conditions, need they therefore jump at the conclusion that the agriculture of India could in no way be improved, and that it was not necessary for the Government or the people to apply themselves to its improvement? From the evidence it appeared to be of great importance that the minds of intelligent men should be applied to this subject, for it was clear that the whole of India was not under such favourable conditions. He thought a school must be of some good in teaching them the best processes of agriculture. Then with regard to the manure question, they could not come to the conclusion at present to trust to irrigation alone to improve the land. The question was one of transport more than anything else. You got good cultivation because you have got good manure; and so he believed in other parts of India when they were in a situation to supply various kinds of manure beyond those directly referred to by Mr. Elliot, and when by means of railways, and river navigation, and canals, you could better distribute the manure, of course the productive power of the land must be increased. The manure question could no more be neglected than the irrigation. As to the labour question, labour-saving machines must be introduced in time. It had been said that labour-saving machinery was of little value when the wages of agricultural labourers were at 6d. a-day. But the object of all the administrators of India was to come to a day when the price of labour was no longer 6d. a-day, but more. Everything was improving, and in the end the cultivator would be able to obtain that which was at present beyond his reach. In conclusion he thought the lessons to be learnt were that the more the Government and the people of India could apply to this important subject the intelligence and experience that was to be gained not only in India, but throughout the world at large, the more they would promote the advancement of the empire, and the benefit of the whole native population. He had felt it his duty to make these few remarks as chairman, and he would now invite them to return their best thanks to Mr. Elliot for his valuable paper.

Mr. Elliot thanked the meeting for listening so patiently. Some of the speakers had possibly misunderstood him, for he had said nothing against irrigation. He had pointed out certain evils arising from its misapplication, and proposed what some people might call an extraordinary measure respecting it. He had simply pointed out the means by which the defects might be remedied. As to efflorescent salts, as far as he had been able to understand, it was only after irrigation had been extended over a series of years that these salts rose and accumulated on the surface. It was a subject that had excited a great deal of interest, and he was surprised to find what a large amount of correspondence had taken place with the India-office regarding it. As to model farms he was not at all against them under certain conditions. But they ought to be carried on under such principles that they should confer the greatest benefit to the people, and cost nothing to the country. It should be a garden for the improvement of vegetables, with a department for plants, and another for breeding stock. He was entirely against any system of introducing Scotch factors wholesale into the country. In conclusion, he thanked the meeting again for the patient attention with which they had listened to his paper.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 7th, 1875; Thomas Hawksley, C.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Bergel, Samuel, 68, Kensington-gardens-square, W.
Boor, George C., Leonard-house, Green-lanes, Stoke Newington, N., and 1, Artillery-lane, E.C.
Hainsworth, James, 10, Upper Phillimore-gardens, W.
Wood, Ebenezer, 11, Rood-lane, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Abbey, Richard, 48, Essex-street, Strand, W.C.
Adderley, Captain Mylles B., 27, Bedford-place, Russell-square, W.C.
Baines, Vincent T., 3, Storey's-gate, Westminster, S.W.
Barry, John G., 8, Old Jewry, E.C.
Bayes, William, M.D., 58, Brook-street, Grosvenor-square, W.
Bickerstaff, Lieut.-Col. Robert, Belgrave-mansions, S.W.
Bishop, James Watson, Messrs. Powell and Bishop, Hanley, Staffordshire.
Bugg, F. J., Quay, Ipswich.

Chevalier, Nicholas, 5, Porchester-ter., Hyde-park, W.
Coulthurst, Edmund, 59, Strand, W.C.
Edwardes, Thomas Bulstrode, 64, Westbourne-park-road, W.
Elliott, Joseph, jun., 1, St. Andrew's-crescent, Cardiff.
Gilbertson, Edward, 8, Upper Phillimore-gardens, Kensington, W.
Harrison, Joseph Henry Hayward, Eagle Brewery, Arundel, Sussex.
Lewinton, Alexander Bellamy, 14, Cleveland-street, W.
Luckenbach, F. A., C.E., New York, United States.
Maxwell, Captain Sir John Heron, Bart., R.N., 64, Warwick-square, S.W.
McGregor, William, Willow-view, Ashburnham-road, Bedford.
Ramsden, Reynolds, "The Jerusalem," Cornhill, E.C. and Railway-arches, Blue Anchor-road, S.E.
Remington, Samuel, New York, United States.
Turner, George, Horton-grange, Bradford.
Ward, Thomas, F.C.S., Arnold-house, Blackpool.
Willink, William Williamson, 3, Hyde-park-street, W.
Wingfield, Lewis, 8, Maida-vale, W.

The paper read was—

CAPTAIN LIERNUR'S IMPROVED SYSTEM OF TOWN DRAINAGE.

By Adam Scott.

Public opinion is daily growing stronger and stronger in favour of legislation to prevent or lessen the scourge of disease that arises from defective drainage, and to stop the pollution of our streams. It is particularly fitting, therefore, that through the medium of this Society attention should be drawn to a system of drainage which, it is averred, is the complete solution of the much-vexed problem, sanitarily and technically, and it is anticipated financially also.

It is especially fortunate that the only part of the Liernur system, the practicability of which originally admitted of any doubt, has now been extensively in operation upon the Continent for between three and four years. The fact that it is successful in the highest degree will be apparent when I mention that everywhere it has been put into operation it has received the highest approbation, testified in a practical way by its extension, and that amongst the evidence that may be referred to are such reports as those of the Medical Commission appointed by the Kingdom of Saxony, the International Medical Congress of Vienna, and the whole of the twelve Medical Inspectors of Holland. These last, in a report to the Minister of the Interior, declare unanimously that "sanitarily and for the convenience of the inhabitants, the Liernur system is the best of all systems hitherto known." This favourable evidence has now been confirmed by numerous deputations and commissions from England.

My object, however, to-night is not to string together such evidence, but to give to the Society a description of the principles and technical details of the system.

The end and object of sewerage works is, or should be, to remove the liquid refuse of a town in such a way that there cannot possibly be any pollution, by deleterious matters, of soil, air, or stream, and in such a way that no offence is given to sight or smell, and no habits imposed upon the people which are likely to be neglected by even the lower orders of the population.

It will be readily admitted that the systems in use in this country cannot pass the standard thus laid down. The fault of all of them is that in one great common sewer there is an indescribable and unmanageable mixture of nastiness, which pollutes both soil and atmosphere, and which, with the exception of those few cases where effective irrigation-farming has been introduced, pollutes streams as well. Irrigation has been pointed to as the great panacea of the sewage evil, forgetful of the fact that it leaves untouched the two great evils of polluted air and soil, which, as much as anything, affect the health of the people.

The Liernur system, on the other hand, is founded on the old Napoleonic maxim, "Beat the enemy in detail"—"Divide and conquer." In other words, never allow any nuisance to get such accumulative power that it cannot be kept under perfect control.

Primarily, Captain Liernur lays down the principle that nothing of a seriously polluting character should ever be allowed to enter the common sewers. For this purpose it is evident that not only must night-soil, and the waste refuse of trade be kept out, but also the fatty and sedimentary products which find their way down kitchen sinks, and the *detritus* from our streets. If this be done, it is evident that the sewer-water by itself, though not bright and sparkling, will contain in it no materials of disease to contaminate either soil or air, and will scarcely be dirtier than that which flows from every brooklet in the country after a rainfall.

To keep street *detritus* entirely out of sewers it is necessary that the gullies should be provided with apparatus to detain it. Such an apparatus, it will be seen by this drawing, consists simply in an iron bucket, into which the water, coming from the street, can enter only by a funnel, and from which it can only escape into the sewer by filtering upwards through a thick, loosely-woven straw mat, the mud in suspension being simply cast down into the box.

This mud can be easily removed by scavengers, the bucket in which it is contained being lifted and emptied into a cart. According to the pavement employed will be the frequency of this emptying process. In the ideal town of which I am speaking, Captain Liernur would select the improved wood pavement, as being noiseless, affording a good foothold for the horses, offering a free scope for evaporation and percolation, and as being easily scavenged by machinery. On such a pavement the *detritus* would be necessarily small.

To those who would advocate letting the mud into the sewers I would say, remember that it must be dealt with somewhere, either by separating it from the sewage at the outfall, or dredging it out of the river. Is it not better, therefore, to deal with it at the start, and prevent not only its depositing, choking, and fouling in the sewers, but its complicating the sewage problem thereafter. At Belfast, for instance, they have periodically to break open the sewers to clean out the mud.

Next, it is requisite to keep out of the sewers all the waste products of industry. For this purpose it is absolutely necessary that legislation should compel all manufacturers to clear their water before passing it into the sewers. The reason for

this, on the principle "divide and conquer," is obvious. It is easier to deal with substances of which we know, or can easily ascertain the component parts, and the different variations that may occur, than when mixed with sewage and waste of all other kinds. In the latter case it becomes an indescribable mixture no man can master, and for which if one day a golden receipt were found, the next day's variation would render it useless. The question as to who should bear the cost of separate purification is one between the manufacturer and the authorities, in no way affecting the principle laid down. As a rule, and as has now been found out by practice (see the working of the Alkali Act and the purification of dye and bleach works, as exemplified by Mr. Thom at the Society's Rivers' Pollution Conference), I believe it would pay the manufacturer, and unless legislation compels him to do the work, there is no possible solution of the sewage problem.

The question for the engineer is, how to test the obedience to the law. Captain Liernur's plan is simple. On the drainage-pipe from the factory a bend is made, in which some of the water flowing off must always be present. From that bend to the surface of the side walk is an upright pipe, covered by a lid. Through this pipe, by means of a small hand-pump six inches long, the inspector of nuisances can at any time take a sample for analysis.

The sewage problem is not always complicated by the question of manufacturing refuse, but all towns have in some way or another to get rid of human excrement, which is the most dangerous, and at the same time the most valuable, part of sewage. That it is absolutely necessary for sanitary perfection that it be kept out of the common sewers I think no one will deny, if its separate collection can sanitarily and conveniently be effected. To be perfect, such collection involves a great many conditions, which have been well expressed by the Senior Medical Inspector of Holland. A review of them is necessary in order to understand what the pneumatic subdivision of the Liernur system really accomplishes:—

"In the first place, a form of closet had to be constructed for use in combination with this system, really perfect in a sanitary and æsthetic sense, inoffensive to sight and smell, and simple and cheap enough for all classes of society, including the poorest and most thoughtless, and yet permitting to the rich those luxuries to which they may be accustomed —qualities which the water-closet, as is well-known, does not possess.

"Secondly, the use of the water-closet for those who could afford the expense of it and desired it, had to remain possible. This demand has been, among many others, a stumbling-block to the introduction of every pail-closet or tub-closet system ever known.

"Further, no labourers had to enter the houses, nor waggons and horses to be seen in the street to remind people of the work of removal, and thus be a nuisance. The work had to be accomplished without necessarily coming to the knowledge of anyone, or attracting undue attention.

"But there is another point. As hygiene prescribes a daily removal of fæcal matters at the least, the work had to remain possible from a financial point of view; that is, a great many closets had to be emptied by but one single operation. This involved a very difficult problem; one closet of a row of houses containing much, another a little, and many, perhaps, nothing at all; there were resistances to be overcome, having the greatest differences, by the application of but one motive power at one given moment, and this without failure or faltering. And, notwithstanding this difficulty, the work had to be done without requiring a complicated mechanical apparatus. Finally, no gases could be allowed to escape during or after the process. The pollution of the soil had to be absolutely prevented, and all danger whatever from infection avoided, without, however, destroying the agricultural value of the manure."

To the conditions above stated I would add another most important one. It is, that when from accident, neglect, or as in the case of solitary houses from convenience, the emptying process does not take place daily, the material must be so confined that in no way can anything escape to contaminate air or soil. And further, I would add, that the fatty and sedimentary products of kitchen sinks, which are the same in substance as fæcal matter, with this difference that they are not by several days so far on the road to decomposition, should also be removed under similar conditions to fæcal matter. In Holland, where these matters find their way fresh into the canals at once, and form good food for the fish, they will not trouble to adopt the Liernur system of collecting them, but in this country it is desirable to exclude them from the sewers for two reasons. First, that in time they would give off organic matter in solution and be polluting; and secondly, that their valuable manurial qualities would be lost to the town.

Captain Liernur's pneumatic subdivision for the collection of excrement and sink refuse is the most novel part of his plan of town drainage, for although the other subdivisions have many novel features and improvements, it was the only part about which, previous to its being tried, there could be any doubt as to its being technically possible. These doubts have now been removed by four years of successful operation. As remarked by the Senior Medical Inspector of Holland, "it is due to the inventor to state that the works executed by him in Amsterdam and Leyden show that he has overcome all the difficulties completely;" and the Director of Public Works supports this by stating that "never has there been in the history of applied science an invention which has come to such perfection in so short a time as the Liernur system."

I will now draw your attention for a while to the technical details of the pneumatic system.

Any large town would be divided into districts of from 250 to 1,000 acres according to local circumstances. Each district would be separate and as independent from any other as if it were an isolated town. Each such district is again divided into small drainage complexes or areas varying from 10 to 50 acres, also according to local circumstances. Each of these little drainage areas is provided with one air-tight cast-iron tank, built in sections so as to be easily enlarged, and with spherical ends to resist atmospheric pressure. This tank, which for distinction sake I call a street tank, is placed at a convenient spot, generally where two or more streets meet, and about three feet under the pavement. From the tank along the several streets extend air-tight cast-iron main pipes five inches in diameter, each perfectly separate and independent of each other. These pipes are connected by branches with the closets of the houses, and are preferably placed in the rear, so as to prevent as much as possible the tearing up of pavements, and to get at closets by the shortest route.

It will be understood that if a vacuum is made in the street tank, a motive power is stored up, which can be let loose upon any given street pipe,

and will literally suck towards the tank the contents of the closet pipes. A new vacuum can then be created, and the emptying into the tank be completed.

The question then occurs, how is the vacuum made, and how are the contents of the tank removed. To this I must answer that while the system is being put into operation, that is before the central pumping station and its connections are complete, both the vacuum and emptying processes are the operation of a movable air-pump engine and an air-tight tender, which once a day visit the street tank for the purpose. This mode is merely temporary, and enables the system to be begun in any number of places at the same time without inconvenience. It is largely used in Bohemia, where the system is extensively in operation in barracks and large factories, the demand for the manure in its undiluted fluid condition for the cultivation of beet being very great, the price given being equivalent to 5s. per head per annum. Even this temporary method is without any annoyance to sight or smell. Professor Volger says, speaking of the works at Prague:—

"I have repeatedly witnessed the operation with real pleasure. Once an elegantly-dressed lady with her servant came close to me, and I noticed how she stooped down over the mouths of the reservoir, watching carefully, with warm-hearted interest, the various manœuvres, without the slightest trace of the loathsome substance which was being handled."

The travelling air-pump, engine, and tender, however good as a temporary measure, are undesirable as a permanence, nor do they form part of the system when complete. A central station is chosen in which are erected two or three air-pump engines, the aggregate horse-power being only what is required for working purposes, and the division into two or three engines being for convenience in case of cleaning, repairs, or accident. Under the building are air-tight cast-iron reservoirs, in which the engines maintain a vacuum of about three-fourths atmospheric pressure. From the reservoirs are laid, by the most direct routes, air-tight pipes, called central pipes, about five inches in diameter, passing by, and by a couple of connections communicating with, each street tank. One connection is with the top of the tank, and by it air only can be sucked out. The other connection goes down into the well of the tank so as to suck up its contents and remove them to the central reservoirs.

The operation, then, is the following:—The air-pump in the central building maintains during the day a vacuum in the reservoirs underneath, and in the whole length of the central pipes connected therewith. Patrols of two men each parade the district like turnkeys. Coming to a street tank they open the lids, by which access is given to the cocks which shut off each pipe from the tank. One man fixes his key upon the cock connecting the central or vacuum pipe with the tank, and the other has his upon the cock belonging to one of the street main pipes leading to the houses. The moment the first man turns his key he opens the connection between the central station and the tank, the air contained in which is at once exhausted, and a vacuum established, the extent of which is indicated by a small vacuum meter. He then shuts the cock, while the other man, by turning his key, lets loose the force upon one of the pipes leading by its branches to the houses. This action repeated once or twice brings the fæcal matter into the tank. In Amsterdam, for instance, there are as many as 138 houses whose closet pipes are thus cleaned out at once. In the same way a second, third, and fourth pipe, each leading to different streets, may be dealt with, and the whole fæcal products of the little drainage complex belonging to the tank be thus collected in it. Before leaving the tank the matter must be despatched to the central station, and this is done by simply opening the second connection of the vacuum pipe, which dips into the well of the tank, when all the matter is at once sucked up and dispatched towards the central station.

So the men patrol the district from tank to tank, simply turning a few cocks; and such is the wonderful simplicity and ingenuity displayed by the inventor, that, with the exception of these cocks, which are of the simplest possible construction, and can be taken up and examined at a moment's notice, there is nothing movable, or which could get out of order, in the whole system of pipes, from and including the closet to the reservoirs of the central building.

The theoretical difficulties to be overcome were great—some closets would be much farther off from the tanks than others, and some might have received no material during the day, and other unequal quantities. It might be imagined, therefore, that by reason of these variations the vacuum might be destroyed and the emptying process prevented. To explain why this is not the case, I must first tell you what cannot be done. It is impossible to propel liquid any great distance through a horizontal pipe by air pressure. The piston of air would break through the column of water, cast it down on the lower segment of the pipe, and passing over would destroy the vacuum. It is evident, therefore, that Captain Liernur could not use horizontal pipes. What, however, can easily be done, is to raise fluids vertically, as in a pump, and bring them to the top of an inclined plane, down which they will flow by their own gravity; consequently, all Captain Liernur's pneumatic pipes are a succession of wave lines, being composed of inclines varying from 1 in 5 to 1 in 250 before the street tanks are reached, according as the fluidity of the matter increases. I may here say, that before reaching the street tanks, and even where water-closets are not used, the matter is reduced, by the powerful action of the atmospheric shock, to a consistency resembling that of the thinnest of chocolate. Now, Captain Liernur gives to every branch pipe from the houses to any one street main the same aggregate of vertical risers, breaking them up to hop over an intervening gas or water-pipe, or according to convenience. Now, a pump can never empty all the water contained in the receptacle pumped from. There is a minimum that it can never remove. In the same way in these risers, which act like pumps, there must always remain a minimum quantity of fluid just sufficient to fill the riser. In a state of rest this minimum is partly in the riser and partly in the lower end of the gradient of the pipe, forming a complete lock-off of one gradient from another, and a perfect resistance to the vacuum being destroyed even

though any particular pipe may have received no additions since last the emptying process took place. The best example I could give of this would be to take two branches from one main pipe, and opposite one another, as in the rough sketch. Suppose the riser to be in each case one foot and the branch 100 feet long, with a gradient of 1 in 100; the branch on the right leads, we will say, to the house of a small family, producing one foot of fluid matter, or just enough to fill the riser, and that on the right to a barrack, where more than a hundred times as much may be expected. We have, therefore, in the barrack pipe a mass filling both pipe and riser, and ready, on the slightest force, to discharge into the main or street pipe. On the other hand, in the branch pipe of the small family, there is the minimum quantity collected at the foot of the riser. The sucking action is now put in operation in the main pipe. What is the result? The pressure of the atmosphere begins to act, and the barrack pipe rapidly discharges into the main pipe, while the smaller quantity is simply climbing up the riser, and before it has got to the top of the riser to be in a position to discharge, all the surplus quantity in the barrack pipe has gone, and that which is left is simply equal to that minimum which, as I said before, cannot be withdrawn. In this way the fullest pipe always begins to discharge first, the next more full waiting for it, and so on, until the minimum is reached, when simply air breaks through. It is thus that Captain Liernur turns natural laws to his own purposes, and contrives that the minimum quantity gives the maximum resistance, and the maximum quantity the minimum resistance.

As I mentioned before, one of the great advantages of the pneumatic system is that it does not forbid the use of the water-closet to those unwilling to give up the use of that expensive and oftentimes troublesome luxury. As, however, all the water added has hereafter to be got rid of, Captain Liernur stipulates that, if economy is to be studied, it is absolutely necessary to have a form of closet, of which there are several known, which only allows of a limited quantity of water being used. His own improved water-closet, by which a quart of water is and must be used at each sitting, independent of the will of the individual, has been greatly admired, as being simple in construction, and not likely to get out of order, or to allow of freezing in winter. It would take up too much of your time to describe this, especially as I wish to draw your attention to the Liernur closet without water. This is intended for the working classes, who cannot afford the more expensive luxury, and who would abuse it if they had it. These form 75 to 80 per cent. of our population, and the Liernur closet suitable for them has been declared to be as inoffensive as the ordinary English water-closet, and, but for the prejudice existing in favour of that convenience, as well-fitted for the rich as for the poor.

The pneumatic privy has no movable mechanism at all, and is used without any water for flushing. The excreta falls into the bottom of a deep funnel, but the size and position of the seat opening is so arranged, and the shape of the funnel is so made, that the extreme area in which the excreta can fall is practically as much limited as would be the case in an ordinary chamber-pot. The effect is that the excreta falls and is collected in a pocket below of but small compass, without touching the sides of the funnel, offering to the air a surface of only five inches. The pocket referred to is one arm of a short bent tube or syphon trap, discharging in a soil-pipe. This discharge is effected by the weight of the excreta, fluids and solids, themselves, each new deposit forcing the former out. Thus the older matter is automatically shut off from further communication with the outer air, and it being well known that no fermentation capable of generating elements dangerous to health takes place within the first thirty hours after production, it is evident that the small surface of fresh substances exposed to the air could at the utmost only throw off offensive gases. To carry these off, however, the funnel is in the upper part made double, the space between being provided with a two-inch ventilating pipe placed close under the seat and leading to the outside of the roof of the house, and finished on top with a so-called Wolpert's air-sucker. This little contrivance, scarcely known in this country, is very simple, having no movable parts whatever, but is singularly effective; the slightest and almost imperceptible motion of air (which in towns is never quite still) causes an upward current in the pipe. The result is that when the lid is removed from the seat opening a current of air strikes at once downwards into the funnel. From this it is evident that under no circumstances can an offensive smell escape from the funnel into the apartment. The funnel itself being of a dark colour it throws no reflected light on the excreta below. It is plain, therefore, that there can be nothing to offend either the sense of sight or the sense of smell, and this is all that can be expected from the best water-closet.

Attention must be called to the fact that the pocket of the soil-pipe into which the overflow of the privy funnel proper takes place is also ventilated. This pocket, being a bent tube discharging into the branch-pipe, is the real receptacle from which the fæcal matter is permanently removed; all the same, whether it belongs to the water-closet or the pneumatic privy of the system. The pipe provided for the ventilation alluded to serves at the same time for admitting the atmospheric air for the pneumatic process. Hence the air does not enter through the seat opening, nor is the matter in the closet itself removed by pneumatic force.

I have now to describe how it is that the sedimentary products of the kitchen sinks are separated from the rest of the house water, and carried off by the pneumatic pipes. That they are thus separated is due to an exceedingly ingenious apparatus Captain Liernur employs for separating them from the household water running off to the common sewer. It is a trap placed at some suitable spot in the open air, into which all the kitchen and household water on its way to the sewer discharges. In order to flow off into the sewer, all this water must pass upward through a close grating, which acts as a strainer. The sediment is thus thrown down into a sort of pocket, which stands in communication with the privy-soil pipe. When now the pneumatic blast takes place, the pocket of the

tank is cleaned simultaneously with the closet pipes, the air to do this, which enters through the opening, blowing it clean at the same time.

Before coming to the treatment of the matter collected at the central station, I wish to say a few words as to the remedies for accidents and stoppages. Remember that the motto of the system is "divide and conquer," and see how this is carried out in every detail. To prevent foreign substances being thrown down and stopping up the pipes, the throat of the privy funnel you will see is made narrower than the pipes are, so that practically everything passing the throat will go further, and the most extraordinary things do go through in practice. As a further precaution the closet syphon is crossed by an iron bar, dividing it into two equal spaces. Anything that is small enough to go through will never create any stoppage. Larger articles simply stop up the closet itself, and give the person who transgressed the trouble of removing them, a lesson found in Holland among the poorest people to be quite effectual. Further each branch pipe from a house is provided with a stop cock accessible to the officials, by which any house can at any time be shut off from the rest of the system. Presuming a stoppage possible, the whole pneumatic power could be concentrated on any particular house pipe. Such things as leakages again do not occur, and if they did they would be closed up by the earth or substances drawn in by the suction power. In fact it would be impossible to keep a leak open even if desired. But what would be done in case of breakage, is an inquiry I have heard, and the answer is that one would do the same as if a water pipe burst—Mend it! There is this difference, however, between the two cases, a water pipe is much more likely to break as the pressure is outwards. In the pneumatic pipes the pressure is inwards, quite a different thing. Supposing, however, a pipe did unaccountably break, a thing that has not occurred in experience in the shifty and uncertain soil of Holland, how far would it affect the system? If in the house, the repair could be made at once with or without shutting off the house. If in the branches or main pipe, it would at the utmost affect the houses upon that pipe. Now on account of the risers, the pneumatic pipes never need be deeply laid; below frost depth, which is about three feet, is quite sufficient, so there is no difficulty there. A more serious affair would be the breaking of one of the central pipes communicating the vacuum to the street tanks. This will not fail to be discovered, localised, and repaired at once. Suppose, however, an extreme case, in which the repair could not be effected for a whole week. Then there are two ways open. You can go back for the time to the movable air-pump, or you can simply not perform the emptying process for a week instead of daily as required by the system. This delay has often taken place at Amsterdam through the intentional negligence of an opponent of the system who was in authority. Remember it is the pipes only, not the closets which are emptied by pneumatic force, and there is room in the pipes for a week's product. Indeed, in applying the system to isolated houses on the outskirts of a town or in the country, without any tanks or street pipes, the closet pipes are only intended to be emptied once a week.

In case anyone should think that fermentation would set in in the closed pipes during that period, I may mention that the Dutch authorities tried the experiment for thirteen months, and found no change.

I have especially dwelt upon the chance of accidents and their effect upon the system, as I have found the subject quite a bugbear in the eyes of many.

I have now to describe what is to be done with the matter collected at the central reservoir, namely, its conversion into *poudrette*. This part of the Liernur system has not yet been tested on a large scale, although the practicability of it has been sufficiently proved both by actual trial and by experience in sugar-refining, in which a similar process is carried on.

It is a well ascertained fact, that of the heat contained in the steam of a high pressure engine, employed in working the air-pump engine for collecting the matter, but 7 to 8 per cent. are converted into power, the remaining 92 per cent. escaping with the exhaust steam. It is this steam, superheated by being passed through a Green's economiser, and made dry again, that Captain Liernur uses for the drying process. It is conducted through pipes in an upright hermetically closed boiler, into which the fluid manure, after being mixed with a little sulphuric acid, is conducted, and in which by the heat thus imparted a rapid boiling takes place. This is assisted by the fact that a partial vacuum exists in the boiler on account of the vapours of the evaporation being condensed in another receptacle. This other receptacle is engaged in the second or drying process, and consists of a hollow drum of thin red copper, fifteen feet long, and two feet in diameter. This drum revolves in a trough of the already thickened matter, and is itself placed in a hermetically closed vessel, in which a vacuum is maintained. What with the heat imparted to the drum from the inside by the vapours from the first boiling which pass through it, and the vacuum outside, the thin layer of fæcal matter it takes up is thoroughly dried in the course of one revolution, and is scraped off by a fixed knife, falling in little shavings into a box below.

Now, whatever manurial ingredients there are in the sewage must be in the *poudrette*, the air, or the vapours. They cannot be in the vapours, for these come out as pure distilled water, nor in the air, for a vacuum is maintained in the vessel; therefore they must all be in the *poudrette*.

As the *poudrette* has not yet taken its place as an article of commerce, I will not enter into any estimates as to the revenue to be derived from its sale. I would merely point out that it is the pure undiluted material, in a strong concentrated state, and capable of being stored for any length of time, and that I firmly believe that in a town moderately densely populated the revenue would be sufficient not only to cover the annual expenses but to pay the interest of, and redemption on, the cost of the works. In other words, that the pneumatic system would practically cost the ratepayers nothing.

For a similar reason I will make no estimates of cost, as this, as in all drainage works, varies immensely, according to local circumstances.

The sanitary view of the pneumatic system is

best described in the following sentences from the account by the Senior Medical Inspector of Holland:—

"Sanitary.—The excreta are, from the moment the closets are emptied to the moment when the process is finished and they are converted into dry powder, absolutely deprived of all chance of doing harm, being locked up from first to last in air-tight vessels. The powder itself is harmless, because fermentation in a dry state is impossible. The water of the excreta has also become harmless, because, being driven out by evaporation end condensed again (the vapour passes through an ordinary condenser), it returns to the public streams as distilled, and consequently, pure water. And the gaseous products of the evaporation, perhaps still containing germs of disease, are blown by the air-pump engine, with the rest of the air sucked up out of the tubes and pipes, into the fireplace of the boiler, and there are completely burned. No matter, therefore, how infectious the excreta may have been, their power to work evil is stopped for ever."

In support of this, I may add that official statements at Leyden aver that the district where the system is applied was formery noted for the prevalence of typhoid and diphtheria, and that these diseases have now disappeared entirely. Similar evidence is given by the Amsterdam authorities.

Having described the pneumatic subdivision of the Liernur system, I must now shortly state how Captain Liernur would provide for the ordinary drainage, as distinct from the sewerage, if the town were perfectly virgin in this respect. This part of the system is of less interest in England, because most of our towns are sewered, or at any rate have the rudiments of sewers, which they would be unlikely to displace for his improved sewers. In their case he would simply apply the pneumatic system, and, if they liked, his mode of removing street *detritus*, thus relieving the sewers of all dangerous matter. But in a town entirely new as to drainage, he would never adopt the present system, by which not only is great cost incurred, but pollution of soil rendered unavoidable. He would construct the ordinary sewers of vitrified earthenware, so as to be practically impervious, and then nothing would get either in or out except through the proper channels. To provide for the drainage of the subsoil, for which at present the common sewer serves by its porosity, he would follow the farmer's plan of laying agricultural drain-pipes, these emptying at intervals into the ordinary sewer below. These subsoil drains would be laid so as to keep the subsoil water permanently at its lowest level, thus preventing the fluctuations, which cause the alternate inhaling and exhaling by the earth of the atmosphere. The sanitary results of such fluctuations are thus described by Dr. Alfred Carpenter:—

"In a porous soil, which easily allows of the rise and fall of the water-line, an amount of air finds entrance and exit equal in volume to the quantity of water which occupies the interstices of the earth. If the soil is impure from cesspool soakage and other sewage abominations, the air drawn into those interstices, as the water-line falls, becomes naturally loaded with the results of sewage decomposition. As the water-line rises this air is expelled and adulterates the purer atmosphere above. If the area is an inhabited one, much of this finds it way into the basement of the houses built upon such a foundation (it gets out more easily there), and the inhabitants naturally suffer from the effects of foul air. If the subsoil is drained by sewer pipes, and the latter are not ventilated in the most efficient manner, another evil also arises. The sewers which were pervious, and allowed leakage into the subsoil of both air and water, which passed downwards, are now sealed to some extent, and all sewer gases find their way into the houses direct. But this is n[illegible] all. The rise of the water-line is attended by certain evi[illegible] Typhoid, and its allied diseases, become prevalent, but [illegible] the water-line falls again another set of diseases become pr[illegible] valent also, the intermittent class—ague, neuralgia, rheuma[illegible] disorders, are rife. It is found in ague districts that [illegible] drying, which naturally follows upon the fall of the wat[illegible] line, is accompanied by epidemics of intermittent fever a[illegible] its allies, with all those acute sufferings which are called [illegible] brow ague, megrims, *et id genus omne*. So it becomes [illegible] interest of the inhabitants of such a district to keep [illegible] water-line as nearly as possible at the same level, for its r[illegible] or fall is always followed by damage to public health."

Besides the sanitary advantages, there [illegible] technical advantages which effect such a saving [illegible] cost that these subsoil drains, and the sew[illegible] proper, can be constructed for about as much [illegible] the present imperfect system. The sewers [illegible] made much smaller without fear of bursting, [illegible] when full, because of the permanent pres[illegible] outside of the higher subsoil water. T[illegible] current in them will at all times be more sw[illegible] and hence more cleansing in its action, and if [illegible] water contained in them, deprived by Capt[illegible] Liernur's plans of putrescible matter and manu[illegible] turing waste, be allowed, without further tre[illegible] ment, to enter streams, his sewers can take [illegible] most direct route to the nearest water course, t[illegible] saving the enormous expense of huge main [illegible] intercepting sewers now so much used to ca[illegible] the whole of the sewage out of town.

The above description of the Liernur system [illegible] necessary brief and imperfect. Anyone wish[illegible] for minuter details, I would refer to a l[illegible] technical account written by me in the *Sani[illegible] Record* of 21st November, 1874.

In conclusion, let me say that to strangers to [illegible] system a number of theoretical objections wi[illegible] sure to arise, the answer to which is that in pra[illegible] they do not arise. The subject, however, is of [illegible] paramount importance for England, that a Gove[illegible] ment official inquiry into the system is very desir[illegible] In this I am sure every one will agree with me, [illegible] as I hope, in the preceding remarks a *prima f[illegible]* case has been made out.

DISCUSSION.

Mr. A. R. Abbott said he had seen some scores [illegible] closets described in the paper, in some of the p[illegible] localities in Leyden, Amsterdam, and Dordrecht, [illegible] was much surprised to find that they were p[illegible] sweet and pleasant; in fact, superior to the averag[illegible] rangement to be found in middle-class houses in [illegible] land as regarded freedom from all kinds of effluvi[illegible]

Mr. R. Rawlinson, C.B., said he had been inform[illegible] the engineer from Southport, who went specially [illegible] Leyden to examine this system, that he had seen [illegible] of these closets choked up to the top. He had n[illegible] slightest wish to throw cold water on Captain Li[illegible] system, or to say a word which would prevent any [illegible] or district in England taking it up, nor did he m[illegible] disparage it by what he said, because he knew [illegible] well that it was impossible for human ingenuity [illegible] devise anything which, at some point or anoth[illegible] would not fail. Water-closets were of course liable [illegible] get choked, and so were any other kinds. Still, know[illegible] what he did of sewerage, water supply, and drainage, [illegible] did not think there was much likelihood of this sys[illegible] being largely adopted in England, simply on account [illegible] its cost; nor did he approve of all the disparaging rema[illegible] which had been made in reference to the present syst[illegible] with which no one was better acquainted than the ch[illegible]

... was costly enough to begin with, and if it were to ... supplemented by a system of iron pipes so complicated ... that which had been described, and requiring a set of ... to keep them in order, he feared that even if ... town adopted it, very few others would follow its ... ple. He held that the existing system might be ... to work so as not to pollute either the subsoil, the ... or any dwelling in contact with the drains, and that ... foul air obtained access to a house, the fault was ... in the system, but in the construction or manage... With regard to the fouling of rivers, if Captain ... nur's system were adopted in every town he did not ... that it would diminish the amount of pollution ... for it had been shown in the recent report ... the Rivers Pollution Commission, headed by Dr. Frank... that the effluent water from towns with no water-... was scarcely distinguishable from that where they ... universally used. Captain Liernur admitted that ... must be drained, and though he condemned the ... system, he was probably not so well acquainted ... it as our own engineers, and therefore he would ... done better to confine himself to setting forth the ... of his own method without disparaging others. ... doubt there had been many instances of imperfect ... and sewer systems, but they were not necessary ... the water system. He was by no means certain ... a perfectly air-tight system of drains was desirable, ... though the lower half of a drain should be water-... he did not think the upper half should be. He ... not think Capt. Liernur's system would diminish the ... tion of rivers—it would increase the operation neces-... in getting rid of human excreta; and as to the ... collected paying the expenses and in-... on the capital outlay, whatever might be ... statements put forth, he had no hesitation in ... that not one-fourth of them would be ful-... In the town of Holland which he had referred ... the excreta taken from the reservoirs was sold in ... at the rate of about 33 gallons for 1s., but the ... was put forward that this refuse was worth 8s. ... head per annum. The laboratory experiments of ... men as Lawes, Hoffmann, and other chemists, did ... it higher than 5s. 6d. or 6s. 9d., or something of ... kind, and they all knew that the value assigned in ... laboratory could never be commercially realised; at ... rate it never came out, as many unfortunate persons ... found to their cost who had invested their money in ... for making vast profits out of human excreta ... ically treated. No one need deny that there was a ... in human excreta, but it was nothing like what ... often represented. The system of drying was not ... in any town in Holland, but only in the ... tory, and he would strongly advise Capt. Liernur ... attempt it, as it would only complicate the system ... and probably the product would be less ... as a manure than in its present concentrated ...

Mr. Gray said it was clear that very long pipes would ... to be employed, and it appeared to him that in case ... leakage, the whole length would have to be taken ... order to discover where the fault lay, which would ... very troublesome and expensive.

Mr. Abbott had only just returned from Holland, ... he had gone, as a member of a Local Board of ... to inquire into the merits of this new system. ... appeared to him that there were insuperable practical ... in the way of its adoption, even considering ... the necessity for separating the excreta from the ... of the houses. Granting this were necessary ... able, it could be accomplished by the pail or tub ... for which this pneumatic dispatch was only a ... and a much more expensive and complicated ... fluids were to be excluded as much as possible, ... slops must be otherwise disposed of, and as ... include a large proportion of the urine, the ... which reached the reservoirs would have lost from half to two-thirds its manurial value. It would, however, practically be impossible to get servants to do this, and therefore the pipes would be burdened with a much larger proportion of fluid refuse than was the case in Holland, though there it came into the reservoir in a liquid stream, and contained so little valuable properties that at the present time in Amsterdam only about 2d. per 100 kilos. was being obtained for it. Considerably more was given at Leyden, but he understood it was expected that a smaller amount would be offered at the next auction. As to the sanitary part of the question, it could not yet be said that they had any trustworthy information, because both in Amsterdam and Leyden it was only introduced in certain districts, and sufficient data to form an opinion had not yet been obtained. He hoped, therefore, that people would not rashly adopt a new system which must be very expensive, and might prove very difficult in operation, and uncertain in results.

Mr. Shelford said he once heard an enthusiastic manager of a sewage manure company say that there was a good time coming, when the whole sewage of London would be treated at Barking, and so efficiently that the effluent water would be supplied over again for drinking purposes. He hoped that would not happen while he lived in London, and the plan now proposed certainly seemed more practicable, or probably Mr. Hawksley would not have countenanced it, even to the extent of presiding. At the same time, his experience had taught him that the greatest difficulty in dealing with sewage in this country was connected with manufacturing refuse, and this Captain Liernur did not take any account of. He said, in effect, that the manufacturers must wash their dirty linen at home; but to this there were great, and sometimes insuperable, obstacles. If this kind of refuse could be got rid of, the present system of drainage would be amply sufficient to meet the case of house sewage; if intermittent filtration, irrigation, or precipitation were adopted, in which great improvements had been and still were being made. Holland being naturally a flat country, there were difficulties in the way of water drainage, and therefore such a system as this was much more applicable than in England, where he believed it would be difficult of introduction, owing to the inequalities in the levels.

Mr. Scott said difference of level was no objection at all, though in extreme cases it might add to the expense.

Dr. Sandwith cordially seconded the remark, that they should not rush rashly into new systems of drainage the evils of which had been well illustrated by past experience. Some 40 years ago the cesspit system was in vogue, but it was liable to abuse from neglect, and the consequence was that water-closets had been introduced, as the result of which there was one large cesspool, miles in length, instead of a vast number of separate ones, and the whole population was thus placed at the mercy of a drunken or dishonest workman. Impure gases, conveying disease, penetrated into houses through the smallest chink, and the consequence was they had mysterious outbreaks of typhoid fever in every direction, and notwithstanding that the water companies went farther and farther up the river for their supplies, it was by no means uncommon for distinct traces of human excrement to be found in drinking-water. Therefore, while this showed that they ought not to rush inconsiderately into new schemes of drainage, it also afforded ample reasons for carefully examining any suggestion which appeared less open to objection, and Captain Liernur's certainly seemed worthy of examination.

Dr. Buchanan said he was at Leyden in January last for a short time, when he had an opportunity of inspecting the operation of this system. He did not see more than thirty closets, but having regard to the class of houses and the character of the people, they were in as good sanitary condition as any to be found in England.

They were not in all cases inodorous, and some were slightly besmeared, but he did not see any choked up. His visit was quite unexpected, and the engines being out of order were not at work, nor were there as yet any statistics showing the sanitary advantages, but, from the description of the process, it might be expected that there could not be any such decomposition of excreta as to affect the public health at any rate; and if there were any danger of infection in particular houses, the diseased excreta could be much more easily treated in an appropriate manner than a large volume of sewage. He thought, moreover, that the report of the Rivers Pollution Commission, to which Mr. Rawlinson had referred, was not quite understood generally, because in every case where the sewage of a midden town or district had been examined, and found to be equally offensive with that from water-closets, the middens themselves drained into the sewers, and therefore all the urine and soluble matters would naturally get into the sewage, so that he should not have been at all surprised to find it even stronger than in water-closet towns, where it was more diluted. The stuff left behind in the middens must under such circumstances be the veriest rubbish for agricultural purposes, and could not be at all compared with the concentrated material obtained by evaporating the excreta under Capt. Liernur's system.

Mr. G. Redgrave said he had carefully perused the article in the *Sanitary Record* to which Mr. Scott had referred, and there he found many statistics which were altogether omitted in the present paper. Amongst other things, a careful estimate was made of the composition of the sewage, and it was stated that in an average town one pint of water per head per diem would be used in the bedrooms for washing purposes. This seemed a ridiculously small quantity, but it was arrived at by assuming that five-sixths of the people would wash in the kitchen or basement, and that the remaining sixth would each use three quarts per head per diem; but this made no allowance for the use of baths, &c., which would require an entirely separate system of internal house drainage. The total amount of liquids and solids carried into the reservoirs was estimated at 63oz. per head per day, from which 6oz. of dry *poudrette* was to be obtained; but, according to the careful estimate made by the Rivers Pollution Commission, the amount of dry powder was given at 2¾oz., so that the remainder must come from the kitchen or road refuse. The cost of this system was given at something like £4 per head, the interest on which, apart from working expenses and maintenance, would be about 4s.; but the excreta could be removed by the pail or tub process at a cost of 1s. per head, which would therefore seem to be far preferable in a financial point of view. There was another point to which attention had already been called, viz., that the sewage matter was but a small percentage of the whole refuse—not more than one-fourth—so that some kind of precipitation or irrigation works would have to be employed, adding greatly to the cost. The evaporation to produce the *poudrette* was to be effected by the waste steam, which, though it looked very well in theory, would, he thought, prove very different in practice. If the steam could be utilised in the way suggested, he believed Capt. Liernur would do well to come to England to teach our manufacturers how to employ their waste steam.

Mr. Birch thought it would be well if Mr. Scott were to give more detailed information as to the populations which were really served by this process, and how long it had been in operation, because he believed many persons were under the impression that Amsterdam, St. Petersburgh, and many other large towns were being treated on this principle, which was of course a guarantee of its complete success. The closet described seemed very similar to the common syphon closets in use in villages and places where there was not a good supply of water, only enough being used to keep the pan clean, and if it were so he did not see the necessity for adopting the pneumatic process. Then again, both water being excluded, he should like to know what would be the effect in a place where there was an epidemic; was the water from the baths to flow back into the river to be used by those lower down the stream? Again, with regard to the effluvia, he did not see why it should go up the pipe from between the two funnels, rather than through the large central opening into the room. He should also like to know the quantity of water which would be required; in midden towns the usual quantity was 7 or 8 gals. per head per day, but putting it at 5 gals., with a population of 20,000, that would amount to 500 tons of water per day, which it would take, he believed, about 50 tons of coal to evaporate. If it could be done by the waste steam, he thought the engines must be worked very uneconomically.

Mr. Rawlinson said he was quite aware of the facts stated by Dr. Buchanan, but the excreta from Midland towns were mixed with ashes, which acted as a kind of sponge, and became saturated. To show that the excreta and urine became absorbed to a great extent in this way, he might mention that towns like Liverpool or Manchester, which expended £200,000 per annum on the removal of the sewage, obtained about half that amount back again by the sale of the manure. A comparison might therefore be fairly made between the effluent water from such towns, and that from those in which the whole sewage matter went into the drains.

Major-General Synge remarked that in the same report it was stated that the addition of the ashes had a strong tendency to depreciate the value of the resulting manure, and, therefore, it would appear as if the drainage of the valuable portion into the sewers, to which Dr. Buchanan had referred, was accelerated by this means.

Mr. Shoolbred asked how the *poudrette* was disposed of, and in what way the material was removed from the reservoirs.

Mr. Flynt said he had visited and inspected Capt. Liernur's works in Holland, not as an engineer, but as a journalist, to report the results; and he had been perfectly satisfied of their success. In Amsterdam the system was in use in eight or nine different districts, and as they probably commenced at only one, this was strong evidence that it was satisfactory. He had gained his information not only from the Government officials but also from the inhabitants, who stated that it was very successful, and this was confirmed by an inspection of the closets, which, though often placed in close proximity to the kitchens, and not much larger than an eight-day clock, were not in the slightest degree offensive. This was not only the case in private houses, but in a large public establishment where a great number of old people and children were located, and where, consequently, there would be more probability of unpleasantness arising. He had also visited the works, and found nothing at all offensive. The system had been introduced at Dordrecht, which was a poor town, in consequence of its great success in the neighbouring cities, and machinery was being constructed for converting the material there into *poudrette*. At Leyden 2s. 8d. per head had been obtained for the manure, and he was told that its value was rising. He was satisfied that such a town as Dordrecht would not have adopted it unless they had been satisfied of its value, and he was informed that where it had been introduced the death-rate and disease had perceptibly diminished.

Mr. Scott, in reply, said time would not allow him to go at length into all that had been said, and Dr. Buchanan had already answered some of Mr. Rawlinson's remarks. He was under the impression that some of the chemists named by that gentleman had put the value of human excreta higher than he had stated; but there were great discrepancies on this point, some authorities placing it at

high as 11s. or 12s. per head. Capt. Liernur had taken 9s. as a mean, and that amount had actually been obtained in Bohemia, where there was a great demand for this kind of manure for the cultivation of beet. It was there the system was first applied to a large barrack, under the sanction of the Austrian Government, who appointed an engineer to watch its operation daily for a month, at the end of which time he recommended its introduction into all the military establishments in Prague. This was done by a small private company, at their own cost, their only remuneration being the resulting manure for fifteen years, at the end of which time the works and plant were to become the property of the Government. They afterwards sold the whole apparatus to a Vienna company for double the cost. In Holland the material was decanted from the reservoirs into barrels, and taken away by the contractor, who was a farmer. No gas or foul air was allowed to escape, two pipes being used, so that the air from the barrel passed back into the reservoir, from whence it went into the furnace, fire being, he believed, as was stated at the International Sanitary Congress at Vienna, the only known effectual disinfectant. The gentleman who had suggested that Captain Liernur should come and teach English manufacturers how to utilise waste steam, was evidently unaware of the fact that the method used for drying the sewage was not a theory, but was practically adopted in sugar boiling. He could not give the exact number of the population where the system was in use, but in Prague he believed the number was about 16,000, congregated however in isolated barracks. It had also been introduced in Brunnen and Olmutz. These closets were also shown at the Vienna Exhibition, where they were highly approved by the Emperor, who knighted Captain Liernur for his invention. At Amsterdam about [illegible] people were using the system, and at Leyden about [illegible], and it was so successful that the financial commission of the Town Council recommended its extension to the whole town. The Public Works Commission had made the same recommendation, and so had the Mayor and Aldermen, and the whole of the Professors of the University. At Dordrecht its universal adoption had been resolved upon, and the *poudrette* manufacture was also to be introduced, and he believed it would be in operation in June next. No water was required to be added, but if it were used of course it must pass away with the excreta. The price paid for the manure at Leyden was 2s. 8d. or 3s. per head, that being an increase of 25 per cent. on the previous contract, and the contractor had a clause in his agreement enabling him to continue it for another year at a further advance of 15 per cent. The report made by the analyst to the North Holland Government as to the value of this kind of manure showed that for three crops it was equal to guano, and for three others superior; stable manure being far inferior.

The Chairman said he could not be expected to commit himself to a strong opinion as to the merits of this system. Mechanically, he was perfectly satisfied it would succeed, but he was not so sure of its success commercially, and in this country, where the social conditions and arrangements were so different to those obtaining on the Continent, he did not think there was much chance of its being introduced. Still, it was no doubt applicable in particular cases, in large hospitals and barracks, for instance, and in many other situations where large communities were not congregated together under the conditions which prevailed in cities and towns. It was well worthy of attention, and in some cases of adoption, he had no doubt. As to the value of the resultant material there would be great differences of opinion, and he might here explain how mistakes had been made by chemists on this question. They generally assessed the value in proportion to the quantity of ammonia and alkaline salts which they found by laboratory experiments to exist in the solids and liquids, and it was quite true that ammonia was worth an enormous price, about £70 a ton. In the same way, the metal in a needle was worth £400 or £500 a ton, but no one would suppose a needle in the middle of a haystack was worth the trouble of searching for it. So with the ammonia in sewage; it was there, no doubt, and if it could be separated and utilised it would be worth all the chemists stated, but they could no more bring the ammonia out of the sewage than the needle out of the haystack, and consequently its real value was very small. Probably this would be found to be the case to some extent with Captain Liernur's product; no doubt the *poudrette* would be valuable, but it would be small in quantity, and expensive in preparation; and considering the conditions under which agriculture was carried on in England, he doubted if its manufacture would prove remunerative, though it might be so in Holland. At the same time they were much indebted to Mr. Scott for his clear and able exposition of this system, and he begged to propose a cordial vote of thanks to him for his paper.

The vote of thanks was unanimously passed, and the proceedings terminated.

MISCELLANEOUS.

PHILADELPHIA EXHIBITION.

Her Majesty's Government having accepted the invitation of the President of the United States to take part in the International Exhibition, to be held at Philadelphia in 1876, have placed the British Section under the Lords of the Committee of Council on Education, and the Lord President of the Council has appointed Mr. Philip Cunliffe Owen, C.B., Executive Commissioner. While the Executive will do all in its power generally to assist and advise British exhibitors, it will be understood by exhibitors that, in accordance with the precedents of previous International Exhibitions, they or their agents must be responsible for the packing, forwarding, unpacking, and reception of their goods, as well as for their safety during the continuance of the Exhibition. The salient points of the general regulations affecting foreign exhibitors, and the special regulations governing the free importations of exhibits as determined by the Centennial Commission are, so far as at present decided, as follows:—The Exhibition will open at Philadelphia on the 10th May, and close on the 10th November, 1876. Before 1st May, 1875, the British Executive must state whether the space allotted is sufficient or deficient, and should therefore receive the demands from proposing exhibitors before 25th April, 1875. Before the 1st December, 1875, the Executive must send in plans in detail showing individual allotments, with all catalogue information. There will be no charge for space. No charge will be made for a limited quantity of steam and water power. The quantity to be arranged at time of the allotment of space, and any excess of power to be applied for at same time, and to be furnished by the Centennial Commission at a fixed rate. Goods for exhibition are to be considered as bonded and exempt from customs duties. The usual noxious and explosive substances are prohibited. Exhibitors or their agents are responsible for the packing, forwarding, receiving, and unpacking of their goods, at both the opening and the close of the Exhibition. The owner, agent, or consignee must be present to receive goods. Reception of exhibits will commence on 1st January, 1876, and no articles will be admitted after 31st March, 1876. The installation of heavy objects requiring special foundations or adjustment should, by special arrangement, begin as soon as progress of works will permit. Space assigned and not occupied on the 1st April, 1876, will revert to the director-general for re-assignment. All goods must, under penalties, be removed before 31st December, 1876.

The objects exhibited will be protected against piracy of inventions or designs. Sketches, drawings, photographs, or other reproductions of articles exhibited, will only be allowed upon the joint assent of the exhibitor and director-general. The Centennial Commission will take precautions for the safe preservation of all objects in the Exhibition, but will not be liable. Facilities will be arranged by which exhibitors may favourably insure their goods. Special regulations will be issued concerning the exhibition of fine arts, the organisation of international juries, awards of prizes, and sales of special articles within the buildings, and other points not touched on in these preliminary instructions.

Mr. Owen will proceed to America early in June, returning in the course of July, in order that he may become personally acquainted with all matters of local detail of interest to exhibitors. He will be accompanied by Colonel Sandford, R.A., one of the official delegates appointed to assist in the Executive work, who will remain in Philadelphia, representing the Executive until Mr. Owen is able to take up his residence there in the early days of 1876, in order to superintend the labours of the installation, and to render to the exhibitors in the British Section all needful assistance.

Messrs. Cook and Son have been appointed Passenger Agents to the British Section, and will make, on behalf of the British Executive, the whole of the arrangements with the Atlantic steamers and railway companies for the conveyance of the exhibitors, their assistants, and workpeople, and also for the conveyance of the goods to be exhibited.

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the month of March, 1875. When they are counted by sight the words "by sight" are used, when by turnstile the word "machine":—

	Voted in 1874.	Number of Visitors. How counted.
1. British Museum	£102,442	return refused.
2. National Gallery	6,346	91,088 (by sight).
3. Kew Gardens and Museum	17,862	52,238 (by sight).
4. South Kensington Museum	38,024	...
5. Bethnal-green	5,810	...
6. National Portrait Gallery	1,748	...
7. Geological Museum, Jermyn-street	8,998	5,277 (by machine).
8. Patent Office Museum	1,490	28,148 (by machine).
9. Edinburgh National Gallery	2,100	7,124 (by machine).
10. Edinburgh Museum of Antiquities	...	5,876 (by machine).
11. Edinburgh Museum of Science and Art	9,824	34,968 (by machine).
12. Edinburgh Botanic Gardens	1,750	...
13. Royal Dublin Society	1,823	...
14. Dublin Museum of Natural History	1,672	5,209 (by machine).
15. Glasneven Botanic Gardens and Museum	2,148	11,027 (by machine).
16. Dublin National Gallery	2,380	...
17. Geological Society, Dublin	500	...
18. Museum of Royal Irish Academy, Dublin	2,084	...
19. Zoological Gardens, Dublin	...	6,805
20. Tower of London	2,236	11,615 (by sight).
21. Royal Naval College, including Greenwich Painted Hall	1,416	27,836 (by sight).
22. Royal Naval Museum, Greenwich	...	2,589 (by sight).

The Council of the Social Science Association has fixed October 6th to the 13th as the period for holding the Congress at Brighton this year. It has also authorised an Exhibition of Sanitary and Educational Appliances and Apparatus to be held at the same time in connection with it.

A committee of the French National Assembly appointed to consider the Channel tunnel question has appointed M. Martel, deputy from the Pas-de-Calais, its president. M. de Clercq has also been nominated secretary.

The number of colleries in the kingdom in 1872 was 3,001, in 1873 they had increased to 3,527; 252 have been opened in 1874.

MANUFACTURE AND USE OF VULCANISED INDIA-RUBBER.*

After practical desiccation the juice of the india-rubber tree is exported in the form of pears, balls, sheets, &c., which always contain a large proportion of water, and generally a considerable quantity of foreign matters, as earth, wood, resin, &c. When thoroughly pure, caoutchouc is solid, and of the specific gravity of 0·925, unattackable by alkalis or acids, but yet acted upon by sulphuric and nitric acids at the boiling point, or by a mixture of these two acids cold. It is more or less soluble in turpentine, liquid coal oils, sulphuric ether, sulphuret of carbon, and some other substances. At the ordinary temperature it possesses considerable elasticity, which it loses at a temperature below zero Centigrade, and above 50°.

Articles made of the ordinary india-rubber, in spite of all their advantages, possess the inconvenience of hardening with cold and softening with heat; besides, this substance would never have been so largely used but for the discovery of vulcanisation.

If a proper proportion of flowers of sulphur be mixed with caoutchouc properly washed, dried and worked up, and the product thus obtained be placed under conditions suitable for the sulphur to crystallise, a complete change will take place. The product was soft and brittle, it now becomes tenacious and elastic; it was adhesive, would stick together, and was easily dissolved in spirit, it now no longer sticks together, and is completely insoluble by all the well-known solvents; lastly, it hardened with cold and became soft to heat; it now preserves its elasticity from the lowest temperature to that which is very near its point of decomposition, about 180° Centigrade. The caoutchouc thus transformed has received the name of "vulcanised india-rubber."

M. Ogier passes in review the different methods employed for effecting vulcanisation; the use of a solvent of the caoutchouc, capable of being mixed with a sulphurous compound, which easily becomes decomposed, giving up its free sulphur; the use of a bath of moist sulphur; and, lastly, the introduction of sulphur direct, mixed mechanically with the caoutchouc during the grinding and working up, followed by the moulding of the piece afterwards heated in a boiler, a stove, or a liquid bath, at a higher temperature than 112° Centigrade, the point of fusion of sulphur. This last method is that generally adopted.

Inasmuch as for every variety of caoutchouc it is possible to vary, in every way practically possible, the weight of sulphur introduced, the temperature and the duration of the operation, it will easily be understood how manifold are the preparations of this substance. It should be added that the caoutchouc, during its manufacture, may besides receive, as accessory mixtures, the most various of substances, the use of some of which is justified by the exigencies of manufacture, but of which others are added with the intention of effecting a saving in cost. Among the most frequently employed of the latter are the *débris* already vulcanised, or old pieces of vulcanised india-rubber. This valueless waste is reduced to a fine pulp, and mixed with the new caoutchouc in indefinite proportions; articles are thus produced, the elasticity and tenacity of which are reduced in proportion to the amount of old materials added. This is an adulteration which defies detection by the hydrostatic balance and the most minute analysis.

M. Ogier next enumerates the various foreign substance required by the manufacture. In order to give certain tints more pleasing to the eye than the natural colour, zinc-white, lamp-black, vermillion, &c., are employed; to counteract a too high degree of elasticity, chalk, talc, kaolin, or the *débris* of textile fabrics, reduced to powder, are added; lastly, to facilitate the vulcanis-

* Paper read by M. Ogier, before the Society of Civil Engineers of Paris.

...ium, the salts of lead, dissolved lime, calcined magnesia, &c., are introduced.

In the preparation of what is called "mineralised" india-rubber, there is applied to it during vulcanisation the reciprocal action of sulphur and the metallic salts, by the use of certain sulphurets, such as the sulphurets of lead.

The conclusion arrived at by the writer of the paper is that the consumer is almost at the mercy of the producer, and that in the majority of cases chemical analysis would be powerless to furnish him with the means of ascertaining the quality of the articles supplied; but there are, fortunately, mechanical means, indicated by the very applications of india-rubber, which permit of determining whether any article made of this substance is in a condition or not to fulfil its object. These means consist of submitting the articles to tests, which show their elasticity and tenacity compared with the elasticity and tenacity of similar products obtained from caoutchouc of equal quality, perfectly pure and vulcanised, to the point of indefinitely preserving the properties determined by experiments. As an example of these tests, M. Ogier gives the programme of trials prescribed by the French Marine:—

1. *Proof by damp heat*, which consists in cutting up the samples into sheets, which should remain for forty-eight hours in a steam boiler at a pressure of five atmospheres without losing their suppleness.

2. *Proof of clacks after being boiled.*—After undergoing the first test, these boiled clacks, placed on the valve-seat of a clack-box, should stand 9,100 beats at the maximum rate of 100 per minute.

3. *Clacks not boiled* should stand 17,100 beats.

4. *Test of boiled strips.*—Strips (200 × 20 × 20 millimetres) after having stood the test of the damp heat, are first stretched to one and a half times, and then to twice their original length, and this alternation is repeated twenty-two times a minute for twenty-four hours.

5. *The strips not boiled* should stand the same test for 100 hours.

Under these conditions, bands of caoutchouc of first quality, perfectly pure and well vulcanised, break after 150 to 200 stretchings to eight times their original length. Bands equally free from any mixture, but made from caoutchouc of second quality, break after being stretched from 50 to 60 times.

M. Ogier next touched upon driving belts made by folding cloth coated with india-rubber over and over upon itself. In consequence of the adhesive properties of the latter substance, the superposed tissues, after vulcanisation, form a homogeneous substance that will bear comparison with the best curried leather.

Experiments made by M. Ogier to determine the co-efficient of friction of these belts on cast-iron pulleys showed that it varied from 0·42 to 0·84, that of leather being 0·28.

The presence of fatty substances also exercises on these belts an action contrary to that on leather belts. By coating them with a thin varnish, composed of half tallow and half olive oil mixed together, the adhesion is increased, but the use of this varnish is not recommended.

The results of a series of experiments on both classes of belts, in order to determine their resistance to rupture, are:—

1. The resistance to traction of the cloth and india-rubber belts is, at least, equal to that of leather belts.

2. This resistance according to section is independent of the dimensions of length, breadth, and thickness, a condition that cannot be realised with leather belts; a preference must therefore be given to the former in all cases where the conditions of the power to be transmitted require the use of belts of great length, breadth, and thickness.

3. The rubber on the exterior of the belt in no degree increases its resistance, and consequently it is best to employ belts with the cloth outside, which, for great weight and price, possess greater strength.

4. Subjected to the same strain, the lengthening of the leather belt is double that of the cloth and india-rubber belt.

In fine, the present state of the manufacture of leather and india-rubber, it may be said that for equal useful effect the price of a cloth and india-rubber belt is the same as that of a leather one, but the expense of maintenance is insignificant, as compared with that of leather belts of large dimensions.

CORRESPONDENCE.

ENDOWMENT FUND.

Sir,—The idea of forming an Endowment Fund for the Society of Arts seems to be attracting some notice, and such an object, if practicable, is a most deserving one. I question, however, whether, if the members are to be asked for contributions, it would not be more advantageous to devote any sums which might be collected to the erection of a suitable building in which the labours of the Society might be carried on in a way more satisfactory than at present. There is certainly not in the existing building the accommodation required. Even the existing reading-room has sometimes to be given up to committees, and the consequence is that a member visiting the establishment has not the accommodation he has a right to expect. The fact is, that the work of the Society is outgrowing its present buildings, and while the whole annual income is—and most properly—expended in preserving and increasing its sphere of usefulness, there can be no funds available for such a sudden expenditure as that required for building. Here is an object for which the Council might freely ask the members to co-operate with them in raising the funds required, and for which I am sure such funds would soon be forthcoming. I enclose my card, and remain, sir, yours obediently,

A Constant Attendant at the Meetings.

INSURANCE.—HAZARDOUS RATES.

Sir,—I was glad to see by the letter on the above subject published in your valuable *Journal* last week that the extortion (for I can give it no better name) that is being carried on by the various insurance companies is at length being brought under the notice of the various parties concerned.

I feel certain that if the directors of the said companies would but listen to reason, and try to consider their own interest, they would at once see the necessity of revising their exclusive rates of insurance.

I, for one, do not insure any of my property (unless where I am obliged by ground leases), entirely owing to the exorbitant charges attempted to be made, and have thereby saved several thousand pounds in insurance.

If others would only act in a similar manner I have no doubt the insurance charged on pianoforte-makers' stock would soon be reduced to a reasonable risk charge.

Wishing Mr. Brooks every success in his laudable undertaking.—I am, &c.,

Thomas Molineux.

Kean's-villa, Park-village East, London,
1st April, 1875.

Sir,—Mr. Brooks's letter, published in the *Journal of the Society of Arts*, March 26th, is written under some strange misapprehensions. There is no "arrangement among the London fire-offices" in reference to "pianoforte manufacturers and branches

connected therewith." The "Fire Insurance Committee" of which he has heard has never approached this subject, nor fixed or proposed to fix any rate of premium on these trades. The "arrangement among themselves," which he twice refers to, has no existence whatever, nor is there, finally, any lack of competition among the very numerous fire-offices in England, as their shareholders know only too well.

The Association of Fire-offices and the London Salvage Corps, of which your correspondent probably has heard, does not include all the fire-offices, nor even all the leading offices, in London; but even those thus associated have issued no such rules or rates of premium as Mr. Brooks supposes.

As I do not desire to advertise my own company, but simply to put your correspondent right, I beg to subscribe myself only

A Fire-office Manager.

P.S.—Captain Shaw's annual reports of fires in London fully explain the high rate charged on pianoforte makers.

ADULTERATION.

Sir,—Time compelling the curtailment of my remarks on Mr. Scott's paper, I omitted what was of most importance as bearing upon the working of the proposed Act, and therefore would briefly trespass on your columns.

I greatly fear that if the new Act is passed in its present form it will, in sanctioning admixtures, pass by the main question of fraudulent and fictitious adulterations, and not prohibit the use of disguising adulterants which, although perhaps *per se* innocuous, are yet used to give a false appearance of strength and quality to such mixed articles of food. If so, adulteration of this kind will be increased, and, being sanctioned by the Legislature, will compel honest manufacturers to follow in the wake of their less scrupulous rivals.

On the other hand, it is of the highest importance that not only should the new Act not be unwisely stringent, but also be worked with discretion and moderation. It will then become a powerful weapon against fraud, while not unjustly harrassing trade; but if these points be not attended to, it can only be overtaken by the same failure which has attended the Act of 1872.—I am, &c.,

John Holm.

Lifford-house, Barnsbury-park, N.,
April 1, 1875.

THE ROMAN ALPHABET FOR INDIA.

Sir,—As Dr. Leitner and myself have now both had our say in your columns, and as I feel that there must be some limit to the space you can afford for the discussion of the details of the subject we are interested in, I will no longer dwell on those branches of it in which Dr. Leitner differs from me, but will join in advocating his proposal for a practical, if limited, trial of the Roman alphabet for Indian languages.

That there should be pressed upon Government the advisability of fixing (if not once for all, at all events with the expectation of some degree of permanency) a system of transliteration for the various native alphabets to the Roman is, I think, a proposal well worthy of the consideration of the Council of the Society. And, without going beyond their proper functions as a Society of Arts, they might also press for the application of such a system as should be fixed on, to certain definite purposes—those to which the present multiplicity of alphabets gives the greatest hindrance.

For the Society itself to attempt to determine the best system of transliteration would, I think, be a mistake. That they could, by inquiry, throw light on the subject there can be no doubt, but their decision would not carry the weight that is necessary, it would only add another to the different systems, whereas what is wanted is a system which, both by its essential excellence and from the authority with which it is promulgated, shall eclipse all others. Now, for the element of "authority" in matters connected with India we must go to Government. The Society of Arts would be justified in their action by the fact that already a system exists (partially used by Government departments) that is good enough for the general purpose, the question being whether it could be improved upon, and that question might stand over for the present.

The first objects for which the Roman alphabet should be brought into use, and to which the attention of Government should be drawn, most of us would agree about. The advantages of using it in the Courts are obvious to every Englishman who knows India. For the telegraph service its adoption would do away with the scandal that now exists of a native not being able to telegraph in his own language, except by paying as for a cipher message. Proclamations and notices by Government could well be given in Roman character. Other uses for it would be found as the knowledge of it extended. The more Government did with it the more quickly would their first measures be justified; the greatest difficulties in the way of its adoption would be in the beginning, before many had learnt its use; these difficulties would best be got over by making a good beginning—by taking a bold step at first.

And not less important is the educational side of this proposal. Dr. Leitner's suggestions on these points are exactly suited to the present stage of the question. That pupils in permanent schools should be allowed to learn to read their own language in the Roman character if they wish it, is a thing that might be arranged without either hurting or frightening anyone. The growth of a literature adapted to the same medium would at first have to be encouraged, but would before long increase of itself.

These measures are simple; the adoption of them can hardly be said to be difficult; a full justification of them is to be found in the present inconveniences. Such measures as are now proposed can be joined in by many whose ultimate expectations are not the same, by those who look only to the partial advantages above indicated, as well as by those who, like myself, will consider them as first steps in the journey that will lead to uniformity of writing in the whole area of India.—I am, &c.

Frederic Drew.

28, Jermyn-street.

Sir,—As I gather from the report of your proceedings of the 19th February, that there has been some misapprehension of the part I am supposed to have taken in conjunction with Sir C. Trevelyan in his early efforts at Romanisation in India, as well as in regard to my opinions on these subjects, then or now, I beg to submit for the consideration of the Society of Arts my latest impressions on the points involved, which were printed as an introduction to the new edition of Marsden's "Numismata Orientalia," before the discussion took place in your rooms.

I may mention, in reference to the general controversy at the meeting in question, that I look upon the Drávidian, or old Indian alphabet, which the Sanskrit-speaking Aryans adapted to their own needs on their domestication in India, as the most perfect alphabet the world has yet produced. But it is a singular compliment to the Roman alphabet, filtered as it was through independent media, that with subordinate diacritical modifications it can reproduce in full integrity all that is really and truly "Aryan" in the severed tongues.

You will also see in the *brochure* herewith forwarded, that to my ideas, difficulties of reconciliation only commence with the complications of the Arabic alphabet.—I am, &c.,

Edward Thomas.

47, Victoria-road, Kensington, W., April 2, 1875.

A NEW PORTABLE BLOW-PIPE.

Sir,—As it is often very difficult to obtain a mechanical blow-pipe where gas is not to be had, I beg to describe the following apparatus, which I have found to answer every purpose, and which, as far as I am aware, is an original idea. Pass a stream of compressed atmospheric air through "benzole," using a Wolfe's bottle with two tubes for the purpose of applying the blast. The light of a spirit lamp should be placed at the mouth of the other tube, when the current of air will become ignited, and will furnish a steady reducing flame of eight inches in length; the intensity and strength of the blast depending upon the amount of pressure applied. The chief advantage of this instrument is that, of course, it can be used whenever there is any atmospheric air to pass through the benzole, which spirit scarcely suffers any loss, even after some hours' use.—I am, &c.,

James Leatherbarrow.

OBITUARY.

W. C. Aitken.—The death of Mr. W. C. Aitken, which took place in Birmingham on Wednesday, March 31, removes from among us one who had been long and intimately associated with this Society. Though never a member of the Society he was closely connected with very much of its work, and during a period of twenty-five years he took an earnest interest in its proceedings. On two occasions he read papers before the Society, on February 15, 1854, on "Ancient and Modern Metal-working and Ornamentation, with some allusion to the newly discovered art of Nature-printing," and as recently as April 22, 1874, on "Progress made in Ornamental Processes connected with Metallic and other Industries." Besides these papers he contributed many communications—some anonymously, and others signed with his name—to the *Journal*. In connection with the visit of artisans to the French Exhibition in 1867, he did much service, and exerted himself to collect the amount contributed in Birmingham and its neighbourhood. On the occasion of the Vienna Exhibition, in 1873, he followed out the same idea by organising a visit of Birmingham artisans. Such are a few of the principal matters in which he appeared before the Society, but of the many ways in which he, from time to time, came forward to promote the objects at which the Society has been labouring, both by his own individual efforts, and by his exertions in concert with the Society, it would be difficult to give any account. It may at least be said that at no time was any assistance required from Mr. Aitken without his being ready and anxious to afford it. Mr. Aitken was born at Dumfries, in 1817, and it was in that town he received his education. At an early age, however, he migrated to Birmingham, and here he spent the rest of his life. Till about three years ago, he was employed in business connected with the brass-foundry trade. His connection with international and other exhibitions was intimate. Before 1851 he had assisted in organising local exhibitions, and after that time he was associated in one way or another with all the great exhibitions. It is, however, in connection with Birmingham and its industrial records that Mr. Aitken's name will perhaps be best remembered. He was a principal contributor to the volume which remains as a lasting monument of the visit of the British Association to Birmingham in 1865, "Birmingham and the Midland Hardware District," and his articles in that book alone are sufficient to preserve his reputation alive for many years. In so brief a sketch as this, only a few salient points can be noted, but it should not be forgotten that Mr. Aitken was one of the original founders of the Midland Institute, and that, only a few weeks back, he was nominated a trustee of Sir Josiah Mason's New Scientific College.

GENERAL NOTES.

Lighting of Railways by Locomotives.—A new system of lighting railways by the locomotives was tried in Russia, on the Moscow and Kursk Railway, on the occasion of the recent journey of the Emperor, and gave satisfactory results. The apparatus consists of a battery of 48 cells fixed on the locomotive, the electric light illuminating the railway for 450 metres (492 yards) ahead. The system was designed by the chief of the telegraph service of this railway, who conducted the experiments in person, and received the congratulations of the Emperor for an invention which it is hoped will have the effect of preventing the collision of trains in the dark.

French Commerce in 1874.—The foreign trade of France for 1874 contrasts most favourably with that for 1873. According to the official returns which have recently been published, the aggregate exports during 1874 amounted to 3,877,753,000 frs. In 1873, the total export trade was estimated at 3,787,306 frs, thus showing an excess in favour of 1874 amounting to 90,447,000 frs. If we turn to the import trade of France during 1874, it will be found that an improvement has taken place also. The total imports during 1874 amounted to 3,749,011,000 frs., whereas the official returns of 1873 estimate the imports of that year at 3,554,789,000 frs., showing an excess in favour of 1874 amounting to 193,222,000 frs. With respect to the items composing the aggregate total of importation into France during 1874, the greatest difference, in point of value, is to be found in the articles of glass ware and cotton thread. The importations of glass into France during 1874 amounted to 10,116,000 frs., while during the corresponding period of 1873, the total importation was only 5,121,000 frs., thus showing an excess in favour of 1874 of 4,995,000 frs., or nearly double the previous year's business. The item of cotton thread imported in 1874 was estimated at 30,885,000 frs., against 21,600,000 frs. during the previous year, showing an improvement in favour of 1874 amounting to 9,285,000 frs. On comparing the total exports with the imports in 1874, we find the excess of exports over imports amounted to 129,742,000 frs. In 1873, the excess of exports over imports amounted to 222,517,000 frs., forming a total for the two years of 352,259,000 frs. The fact of France being a creditor to foreign nations during the last two years for so large an amount goes far to explain the continuous stream of gold which has been pouring into France for some time past. The world owes France money, and as gold is the most profitable remittance, it naturally insists on being paid in hard metal.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Smithsonian Contributions to Knowledge, Vol. 19, and Miscellaneous Collections, Vols. 11 and 12. Presented by the Smithsonian Institution.

Minutes of Proceedings of the Institution of Civil Engineers, Vol. 39. Presented by the Institution.

The St. James's Magazine, Vol. 14, edited by F. W. Chesson and S. R. Townshend Mayer. Presented by the Editors.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

April 14.—"The Best Method of making Field Experiments practically useful to Agriculturists." By Professor John Wrightson.

April 21.—"The India Museum Question." By Dr. Forbes Watson.

April 28.—"The Protection of Buildings from Lightning." By R. J. Mann, Esq., M.D., President of the Meteorological Society.

May 5.—"Horse-shoes and Horse-shoeing." By George Fleming, Esq., Veterinary Surgeon, Royal Engineers.

May 12.—"River Pollution, and the Impurities of the Water Supplied to our Towns." By Jabez Hogg, Esq., Surgeon to the Royal Westminster Opthalmic Hospital, President of the Medical Microscopical Society, Fellow of the Royal Microscopical Society, &c.

African Section.

Tuesday Evenings, at 8 o'clock. The following arrangements have been made:—

April 13.—1. "Remarks on Tribal Titles, Kafir Law, and Emigration Movements in Natal," by J. Bergtheil, Esq., late Member of the Legislative Council in the colony; 2. "The Probable Influence of Railway Construction in Natal upon the Trade, and upon the Civilisation of the Native Races of the Colony and adjacent Territory," by A. Browning, Esq. W. C. Sargeaunt, Esq., Crown Agent for the Colonies, will preside.

Indian Section.

Friday evenings at eight o'clock, the followihg arrangements have been made:—

April 23.—"The Preparation and Uses of Rhea Fibre," by Dr. J. Forbes Watson.

April 30.—"The Growth of the Factory System in India, with especial reference to the Production of Textile Fabrics, and the Relative Advantages of the British and Indian Manufacturer," by Elija Helm, Esq., of Manchester.

May 14.—"The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East," by the Rev. James Long.

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

April 16.—"Recent Advances in Photographic Science," by J. Spiller, Esq., ice-President of the Photographic Society. On this evening Warren De La Rue, Esq., D.C.L., F.R.S., will preside.

May 7.—"Alum Shale and its Application," by Sydney Rich, Esq.

May 21.—"Explosive Compounds." By Alfred Nobel, Esq., the founder of the Nitro-glycerine Industry.

Cantor Lectures.

The Third Course of Cantor Lectures will be on "Some Forms of the Modern Steam Engine," by F. J. Bramwell, Esq., President of the Institution of Mechanical Engineers. The Course will consist of four lectures, the dates for the rest of which will be as follows:—Mondays, April 12, 19, and 26.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. F. J. Bramwell, F.R.S., "Some Forms of the Modern Steam Engine." (Lecture II.)
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned discussion on the Home Secretary's Bill for Facilitating the Improvement of the Dwellings of the Working Classes in Large Towns.
Royal Geographical Society, University of London, Burlington-gardens, W., 8½ p.m. 1. Mr. J. Forrest, "Journey across the Centre of Western Australia." 2. Rev. C. New, "Route Overland from the Pangani to Mombasa." 3. Mr. J. Kemp, "The Upper Nile between Regiaf and Duflé."
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Bentley, "Classification of Plants." (Lecture II.)
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. G. W. Hastings, "The Law of Compensation for Damage by Riot, with suggestions for Amendment."
Birkbeck Scientific Society, Southampton-buildings, W.C. 8 p.m. Mr. J. H. Shirley, "The Halogens." (Part I.)

Tues. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Mr. J. Bergtheil, "Tribal Titles and Kaffir Law." 2. Mr. A. Browning, "Railway Construction in Natal."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Duncan, "Grander Phenomena of Physical Geography."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Mr. William Hackney, discussion on "The Manufacture of Steel." 2. Mr. Josiah T. Smith, "Bessemer Steel Rails."
Photographic, 9, Conduit-street, W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C. Professor Rolleston, "The People of the Long Barrow Period." Mr. Bertram F. Hartshorne will exhibit articles of Pre-Helenic age from Troy.

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Professor John Wrightson, "The Best Method of making Field Experiments practically useful to Agriculturists."
Geological, Burlington House, W., 8 p.m. 1. Mr. J. Thomson, "Descriptions of New Corals from the Carboniferous Limestone of Scotland." 2. Mr. J. M. Wilson, "The probable existence of a considerable fault in the Lias near Rugby, and of a new outlier of the Oolite." 3. Mr. J. M. Wilson, "A Labyrinthodont from the Coal Measures." 4. Mr. J. L. Tupper, "*Cruziana semplicata*." Communicated by Mr. J. M. Wilson. 5. Prof. H. Alleyne Nicolson, "*Favistella stellata* and *Favistella calicina*, with notes on the affinities of *Favistella* and allied genera."
Graphic, University College, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Archæological Institution, 16, New Burlington-street, W., 8 p.m.

Thurs...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Prof. Oliver, "List of Plants Collected by Dr. Meyer in New Guinea." 2. Rev. Thos. Powell, "The Atolls in the South Pacific." 3. Papers on the Botany of the *Challenger*.
Chemical, Burlington House, W., 8 p.m. 1. Mr. J. W. Thomas, "The Gases enclosed in Coal from the South Wales Basin, and Gases evolved by Blowers, and by Boring into the Coal itself." 2. Mr. G. H. Beckett and Dr. Wright, "Narcotine, Cotarnine, and Hydro-Cotarnine." 3. Dr. Armstrong, "Note on Isomeric Change in the Phenol Series." 4. Prof. Maskelyne, "Andrewsite and Chalkosiderite." 5. Mr. Walter Flight, "An Examination of Methods for effecting the Quantitative Separation of Iron Sesquioxide, Alumina, and Phosphoric Acid."
London Institution, Finsbury-circus, E.C., 7 p.m. Dr. Freeman, "History and Use of the English Language." (Lecture III.)
Royal Institution, Albermarle-street, W., 3 p.m. Prof. H. G. Seeley, "The Fossil Forms of Flying Animals."
Numismatic, 13, Gate-street, W.C., 7 p.m.
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.
Royal Colonial (at the Pall-mall Restaurant, Waterloo-place), Mr. T. B. Glanville, "South Africa."

Fri.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. Spiller, "Recent Advances in Photographic Science."
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m. Prof. Gladstone, "The Progress of Science in Elementary Schools."
Philological, University College, W.C., 8 p.m.

Sat.......Royal Institution, Albemarle-street, W., 3 p.m. Mr. George Smith, "The History of Assyria."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,169. Vol. XXIII.

FRIDAY, APRIL 16, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SCHOOL DRILL.

On Monday, the 12th inst., a deputation from the Society had the honour of an interview with his Royal Highness the Duke of Cambridge, the Commander-in-Chief. The deputation consisted of Major-General F. Eardley-Wilmot, R.A., the chairman of the Council; E. Chadwick, C.B., Sir Henry Cole, K.C.B., Colonel A. Angus Croll W. S. Fitzwilliam, Captain O'Hea, Admiral the Right Hon. Lord Clarence Paget, K.C.B., and Seymour Teulon, attended by P. Le Neve Foster, Secretary.

General Eardley-Wilmot, in introducing the deputation, said the Society of Arts had for some time been promoting the adoption of drill into schools as an important element in the education of the young. They advocated it especially as tending to the carrying on of the work of any school, by engendering habits of discipline and obedience, as well as being at the same time conducive to health, and inasmuch as they hoped it might form a considerable feature in the military system of the country, the Council ventured to seek the aid of the Commander-in-Chief in furthering the object the Society had in view.

Sir Henry Cole, K.C.B., said although the Education Department of the Government had within the last few years introduced drill as one of the subjects for which it offered some slight pecuniary encouragement in the schools under its inspection, yet it was only this year that they had introduced it as "military" drill. Still, however, a great deal was required to be done to get drill introduced generally into the schools. Drawing formed part of the curriculum laid down by the Education Department, but until the subject was specially placed under the charge of another department to look after it—the Science and Art Department—little progress was made. So he believed would be the case with drill unless some other department could be made to take an interest in it, and it was with that view the Society desired to interest the Horse Guards to take it up. Surely if the Government were prepared to spend, and did spend, upwards of £10,000 a-year in promoting the study of drawing, he thought there ought to be no difficulty in finding funds to promote the introduction of military drill into our schools. He ventured to think, however partial he might naturally feel in favour of drawing, that the promotion of drill in schools was still more important. It would promote recruiting and would answer economically.

Mr. E. Chadwick, C.B., stated that the insufficiently superintended expenditure of money on drill by the Privy Council had been complained of as productive of very loose and inferior results. This was in accordance with his own observation in several towns, where, in the interest he felt in education, he had visited the schools. These inferior results were only to be expected from the officers of the education department of the Privy Council who, as a rule, knew nothing, and did not pretend to know anything, of physical training as part of education. Where this system had been properly carried out as part of the half-time school system, the proved economical result, with even a lower sort of teaching power than in the common schools, had been to impart to every two pupils the efficiency of three for productive industry. The war department might be asked to give their aid to this work in the civil interest of the country alone. But experience, properly consulted, was equally conclusive, that the result of the early military exercises as part of the combined and physical and mental training on the half-time principle was to give to two the efficiency of three for military service. The aid of the war department might be invoked in the military interests of the country at this time, in spreading throughout the population a predisposition to the much needed high order of recruitment. It was the experience of the district schools of the metropolis, on the half-time principle, that the lads volunteered in very large proportions for the army. Unfortunately, the children reared in those schools were of the lowest type, and very few of them came up to the army standard of height, but those who did were found, as a rule, to make excellent soldiers. The Chelsea School for the orphan children of soldiers, and the Royal Hibernian School were on the half-time principle of mixed physical and mental training, and the outcome, in the large proportion of non-commissioned officers they produced, and in discipline and moral results, might challenge comparison with any civil elementary schools in the country. In every way, the application of the expenditure sought, it might be confidently stated, would be the most remunerative of any public or private expenditure.

Mr. E. Carleton Tufnell said, as an old school inspector, it had always been his aim to introduce drill into all the schools under his inspection, having had experience of its great value in every way. He had also, with a view to the military service, added music to the course of training. The schools under his care supplied largely the military bands of the Army. The difficulty in the London schools was the inferior stature and physique of the children, but in the country this difficulty did not arise.

General Eardley-Wilmot said that for his Royal Highness's information he had placed in writing the definite proposals the Society had to make, which he then read as follows: "1. That as schools obtain a grant on certificate of attendance at drill, the assistance of the War Department is requested to furnish effective instruction and to ensure its usefulness for military purposes by a periodical inspection. 2. The Council believe that the establishment of the Depot Brigades over the country will furnish ready means of affording this instruction and inspection if the War Department will consent to bear the expense involved—viz., in travelling between the various schools, and, if necessary, some allowance to the sergeant or non-commissioned officer employed on this duty. 3. The Council earnestly request his Royal Highness the Commander-in-Chief to support these propositions, and to obtain the sanction of the Secretary of State to the necessary expenditure, which would be small compared with the national importance of the object in view."

His Royal Highness said he sympathised entirely with the views which had been put before him by the Society, but a question of finance was involved in the subject, on which he must speak to the Secretary o State for War. There could be no two opinions as to

the advantage of drill in a national point of view. At Christ's Hospital the discipline had been greatly improved by the introduction of drill. If, by accustoming lads to drill, they could be induced to take to the Army as an occupation, it would, no doubt, aid the recruiting very largely, which was now much interfered with by the state of the labour market. There was, however, some difficulty in obtaining instructors. Non-commissioned officers even for the Army were not so readily obtained in sufficient numbers, and, if to this be added the instruction of lads in schools, he feared it would add to the difficulty. As far, however, as the Horse Guards could aid in the matter which the Society had at heart, they would be glad to do so.

The deputation, having thanked his Royal Highness, then withdrew.

INDIA MUSEUM.

A meeting of this Committee was held on Friday, the 9th inst. Present—Sir Henry Cole, K.C.B. (in the chair), Andrew Cassels, Major Donnelly, R.E., and Seymour Teulon. The Committee agreed to the following Memorial, which has been sent to the First Lord of the Treasury:—

To the Right Honourable Benjamin Disraeli, M.P., First Lord of Her Majesty's Treasury.

The Memorial of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, established in the year 1754,

Sheweth—

1. That your Memorialists heartily congratulate her Majesty's Government upon having, through the Marquis of Salisbury, the Secretary of State for India, taken steps to enable the valuable East India Collections, which were chiefly brought together by the Hon. the East India Company, to be exhibited to the student, the merchant, the producer, and the public generally, in spacious, well-lighted, and airy galleries, easily accessible at South Kensington, where they may be favourably inspected.

2. That your Memorialists, in the interests of Arts, Manufactures, and Commerce, for the promotion of which they are incorporated, express an earnest wish to see these collections rendered a complete representation of the past and present civilisation of India, embracing illustrations of the Arts, Sciences, Archæology, Ethnology, Natural History, and Industrial Products of that country—the greatest possession of the Empire.

3. That your Memorialists consider that such collections would be of the highest value in cementing all the interests of this country with those of India, and prove generally most important to Public Instruction and Commerce: also that careful measures should be devised to render the general management of such a Museum progressive in its character, and that the Museum should have at its command ample space for its development and varied arrangements.

4. That it appears to your Memorialists that as such a Museum would not only benefit the people of India, by drawing public attention to her raw products and manufactures, but would at the same time be conducive to the instruction of the people of this country in the Arts, Sciences, Archæology, Ethnology, and Natural History of our Eastern Empire, it would be only equitable that the United Kingdom should be at the cost of providing suitable buildings, capable of extension, in a situation where there may be found ample light and air; also that the British Government should defray the cost of management, whilst India should only be at the cost of making the necessary collections in India upon a proper scale and upon scientific principles.

5. And your Memorialists venture to suggest that, i order to insure proper responsible and active manag ment, it would be most desirable that for this Museum as well as all similar institutions, some Minister of h Majesty's Government in the House of Commons shoul be charged to answer for the expenditure of public mon voted for its support.

Signed on behalf of the Council,

F. Eardley-Wilmot, Major-General, *Chairman*.

April, 1875.

MERCHANT SHIPPING BILL.

A meeting of this Committee was held o Monday, the 22nd inst. Present—Captain Sir Heron Maxwell, Bart, R.N. (in the chair), Greaves, Captain B. Sharpe, R.N., and Rev. R. Simpson.

AFRICAN SECTION.

A meeting of this Section was held on Tuesd evening last, W. C. Sargeaunt in the chai Before reading the following paper,

Mr. Bergtheil, alluding to the debate on the affairs Natal in the House of Lords on the previous even said that if the rules of the Society did not prohibit political discussions, he thought he could show that b the Government and the Opposition were in the wr not for want of goodwill, but of personal experienc the colony, without which no amount of official d patches or verbal communications could suffice to conv an adequate idea of the real state of affairs in a colo like Natal, containing within itself so many differe tribes and nationalities. It was rather astonishing find that throughout the whole debate not a word w said by either party to account for the fact tha colony which had grown up under the fostering care the mother country, should, after a life of some fo years, be found in its present position, nor had a attempt been made to point out what remedies were be applied to prevent a recurrence of such misund standings as had taken place in the case of Langalibal

The first paper read was:—

REMARKS ON TRIBAL TITLES, KAFI LAW, AND EMIGRATION MOVEMENTS I NATAL.

By J. Bergtheil,

Late Member of the Legislative Council for the Capital Cit the Colony.

In the year 1838 a small party of emigra farmers, from the pastoral districts of the Ca of Good Hope, came suddenly, in their eastwa wanderings, upon the mountainous edge of th inner table land of the continent of Africa, so 800 miles beyond Table Bay, and thence look down upon a beautiful undulating country, sloping from the mountainous height towards the sea, well wooded, well watered, and covered with everlasting verdure. With the strong religious sentiment with which their race is imbued, these emigrant Boers called out, in the language of Israel of old, "This is the goodly land the Lord has given us."

The history of these adventurous African pioneers, and of the circumstances which had led to their seeking out a new home in the wild, is so notable and interesting that I can but hope that

the narrative will some day be told as one of the chapters of African progress, by an adequate authority, in this Society. In the meantime, it is only necessary to my present purpose to say that this party of explorers descended the slopes of the Drakenberg Mountains to the pastures they had gazed out from above, and, to their unspeakable surprise, they found that they were entering what seemed to them to be an altogether unpeopled, though everywhere luxuriant, wilderness.

There was not anywhere a single human habitation. There were no signs of herds or flocks. They moved slowly along into the maze of green valleys and pastures, keeping to the prominent ridges and natural causeways as they advanced. After a time they came upon indications of burnt huts and devastated fields, and then they became conscious that the land must assuredly at one time have been densely peopled. As they moved cautiously along they were constantly under the impression that some hidden force of native population must certainly at length burst out from its concealment upon them. No such force, however, appeared: and only when they had marched on until they were within a few miles of the sea, some half-starved women and old men came creeping out from their tangled lurking places in the dense bush, and told a woeful tale of destruction and death. The cause of this condition of things has already been spoken of in this room, in a paper by Mr. Shepstone, on the "Early History of the Zulu Kafir Race," a communication which was printed in the *Journal* of the Society on the 29th of January last. In that paper it is told how the country had at that time been recently desolated by the ravages of Chaka, the warlike chief of the Zulus, and how the native population of the district had been scattered and destroyed. When the party of Boers came to the actual shore of the sea, they found at the small inlets of salt water which, even then, constituted the harbour of Natal, five or six Englishmen surrounded by a settlement of some eight or ten thousand natives who had gathered round the white men for protection. The Boers from this place opened negociations with Dingaan, the brother and successor of Chaka, who had drawn the frontier line of his kingdom thirty miles farther towards the north, and, after a lengthened discussion of terms, finally succeeded in getting a cession of Natal from the Zulu chief for a consideration. They then established a government of their own, adopting the old Roman Dutch law, with which they had become familiar, as the law of the land. They, however, still had to engage in a hard struggle for existence, and only after severe fighting with Dingaan, and marvellous endurance and perseverance, at last, in the year 1840, established themselves in something like security. They had made a pledge when they started from the Cape that the first house they would erect in any new land of their adoption should be a Dutch Reformed Church for the worship of God. This pledge they redeemed; and the next building that they raised was a court-house, wherein they administered justice between man and man, applying the same law whether for white or black. The natives soon discovered that they were safe under this government, and their numbers accordingly soon rose in Natal to 20,000. They were, however, given to understand that in consideration of the protection they received they were expected to adopt the habits and to comply with the laws of their protectors. The natives proved to be peaceable, honest, and submissive members of this growing community, and showed great capacity for improvement. Many of them, living in the Dutch families, learned to speak the Dutch language, and took part in the religious observances of their masters. I, myself, at this time lived among these people in a house without a lock or key to its doors; and frequently left property of the value of a thousand pounds for days at a time in the care of a native, without missing anything, or having to complain of a single act of negligence. I never heard of a case of theft, or of any act of violence committed by a native in these early days; nor, on the other hand, of any complaint that a native had not received the due meed of his service.

This state of affairs did not, however, last very long. One fine day the Governor of the Cape Colony landed a company of British troops in Natal, and issued a proclamation to the effect that the settlement was thenceforth a British colony. Many of the Boers, under this contingency, were afraid of the renewal of the state of perpetual vacillation and change which they had seen in the government of the Cape, where each successive governor had brought some new pet scheme of his own for the management of the mixed community, which entailed upon them Kafir war after Kafir war, and devastated their families and homes. They preferred rather to abandon their newly acquired land, than again to encounter the risk of life in a colony administered in such form. The white inhabitants were by this secession reduced from some 6,000 to about 2,000. The colony then remained pretty much in this state until 1844, when it was formally annexed to the Cape, under a Lieutenant-Governor of its own.

The English authority up to that time was represented by one officer and a few soldiers, residing at the seaport. Successive disturbances in the Zulu country had in the meantime driven many thousands of the natives into Natal, which remained open to them in all parts, and there these new comers squatted down, at their own good pleasure, without any stipulation, and without the slightest knowledge as to the law by which they would have to be thenceforth governed. There was no increase of European population concurent with this great influx of the blacks. In the year 1847 I visited Europe, resolved to exert whatever personal influence I could bring to bear to establish a European emigration to Natal, and to impress upon the British Government the paramount importance of at once taking some steps for the control, civilisation, and improvement of the natives. I then urged, as I now urge, upon the Secretary of State for the Colonies in England, the advisability of allotting to each native family a small plot of ground, to be held in its own right, and of establishing native schools, and giving these people to understand that the prime condition which the Government attaches to the protection which it affords is, that they shall permanently settle down upon their allotments, and send their children to school. I pointed out especially that the cost of the enterprise, although somewhat

beyond the reach of the sparse white population within the colony, would be comparatively small, and that before any very large European immigration had set in the natives would be prepared, in this way, to go hand-in-hand with the white man; but that, if they were not so prepared, their contact hereafter with a large mass of white colonists could only be the destruction of this interesting race. The reply to my communication was to the effect that my proposal involved some money expenditure on the part of the Home Government, which could not be found, and the existence of a law for compulsory education, which would not be tolerated in England, or in an English dependency.

I was equally unsuccessful in England in my attempts to establish an English emigration to Natal. I, therefore, directed my steps to Germany, and after a great deal of difficulty, induced thirty-five poor families, mostly journeyman weavers, with a minister, a schoolmaster, and a doctor, to accompany me to Natal. These people were extremely poor, and quite unable to provide themselves with a passage, or, indeed, any other requirements. They sailed from Bremen, in a vessel called the *Bertha*, which I took up for their conveyance, in November, 1847, and each family received, on arriving in the colony, an allotment of land, a plough, some oxen, and a cow, a certain quantity of building materials, and maintenance for a time. At this distance of time I still vividly recollect a visit I made to this young settlement on the first anniversary of the embarcation from Bremen. A spot of ground that so short a time back was an absolute waste, had been, within the brief twelve months, converted into a pleasant picture of thriving industry. On the day of the actual anniversary, the echoes of the church bells were heard reverberating from the hills around, and the German families, with their numerous children, were seen flocking into the central station from their comfortable homesteads; and as a new chapel was to be opened on the occasion there were also numerous visitors coming in various directions from more distant places. The chapel had been built within six months, by the settlers themselves, and was very tastefully decorated by garlands of natural flowers. It still comes back to me, at this distance of time, that the excellent pastor of the settlement, the Rev. Mr. Posselt, took for the text of his address, on the occasion, the impressive words, "If I forget thee, O Jerusalem, let my right hand forget her cunning."

In a letter which I received from my friends in the settlement, just one year ago, and which is signed by 24 heads of families of the original settlers who went out in the *Bertha*, there occurs the following passage, addressed to myself:—

"You have been the means of raising us, one and all, from a state of dependence to that of a happy and prosperous existence, and we have never had cause to repent leaving the land of our birth. We are now glad to take an opportunity of pouring out our heartfelt thanks and acknowledgments. We have worked in the sweat of our brow, the Almighty God has blessed our labours, and we and our children are prosperous and happy."

I have been induced to make this passing allusion to my own experience in founding the settlement known under the designation of New Germany, in Natal, not only on account of the striking illustration it affords of the kind of management which is required in colonies of this sort in planting immigrant communities, but on account of the light which it inferentially throws upon the course which should have also been pursued, perhaps with some modification of detail, in the settlement of the natives. Here, in this instance, was a new settlement, of some 200 souls, so effectually started upon its career of colonisation, that it has continued to grow and to flourish from that day to this. It still holds a position of assured and increasing prosperity in the colony, while the history of the rebel chief Langalibalele, who has attracted so much notice recently in this country, most clearly indicates that the native race in Natal is virtually and morally in a worse position now than it was in 1848, although it may possess more cattle, and some of its leading men may have more wives. It was shortly after the arrival of my little band of Germans in the colony that this petty chief escaped from the grasp of the Zulu king, and very nearly involved the colonial authorities in a Kafir war. Upon a rumour of a Zulu invasion, at that very time my German settlers had surrounded the Pakhuis or principal house with a palisade and moat to serve as a place of refuge and rendezvous in case of emergency and danger. I may, however, be allowed to speak with some gratification and pride of the arrangements which had been made in connection with this German fortification, or Laager, extemporised for the protection of the young settlement, as I had been commissioned by his Honour, the Lieutenant-Governor, to act as captain of my own men. The enrolment of a volunteer corps was so efficiently prepared, that I found a complete list of the men able to bear arms, indicating those amongst them who had already seen service, and even providing for the establishment of a band, ready prepared for me.

In the meantime nearly all the Dutch settlers had trecked again over the mountains to the high inland district, which is now known as the Free State; and yet more and more natives had come into the colony from the surrounding lands, and were living there virtually without superintendence or control. The white population was limited to something less than four thousand individuals; the black population had grown to 100,000. This inflowing native horde had been allowed, in the first instance, to settle upon large tracts of ground in different parts of the colony, and were, so to say, managed by the Secretary for Native Affairs without any fixed law. In 1848 instructions were sent from the Home Government in England that thenceforth Kafir law was to be administered to the black population, in some measure by their own hereditary chiefs, who, in this way, were accepted as a power in the state, and that large Kafir locations were to be permanently set apart for native occupation and use. This proceeding was partly the result of a small money advance having been asked for by the colony to enable them to complete the organisation of its Government.

In regard to the "Kafir law," to which allusion has been made, it is to be here understood that it is not a written code, but that it is a sort of tradition of custom and practice, which has grown up with the progress of events, and with

the lapse of time, and which has accordingly become intimately interwoven with the habits and the thoughts of the people. It hinges entirely upon the supremacy of the chief, and upon unquestioning and implicit obedience to his orders and authority. The chief's word is the law, and his power is absolute; but he is assisted in his administration of the law by a council of his principal men. When this traditional law is wielded with judgment and rigour it is unhesitatingly obeyed. The royal instructions in establishing this mode of governing the natives provided that the Governor of the colony, for the time being, should be paramount chief, and supreme over all the subordinate administrators and chieftains. The most serious offences, such as murder, treason to the state, disobedience to the chief, desertion from the tribe, poisoning, and superstitious practices with evil intent, were to be punished by death, confiscation of property, or fine, under the provisions of Kafir law. There were thus, consequently, established within this narrow colony two distinct systems of law side by side. A few hundred white people were to be governed by Roman Dutch law, and many thousand black people were to be ruled by the Kafir law, which, as we have seen, was merely the will of the paramount chief or governor.

Some material accession to the ranks of the white section of the community was now made by the arrival of sundry parties of immigrants from England. But the black population was still increasing in much larger proportion. On the 1st November, 1851, the Lieut.-Governor, now Sir Benjamin Pine, and the subject of some recent severe animadversions, wrote to the Secretary of State:—

"Another evil of the present system is that although the natives have large quantities of land in common, they have no individual rights to any. It is perfectly true that the native in his barbarous state has no notion of individual property in land; but it is, nevertheless, most desirable to impart to him that notion, the most powerful means, except sound Christian and moral education, of truly civilising him."

On the 14th of February, 1859, Earl Grey, the able statesman who at the time was her Majesty's Secretary of State for the Colonies, remarked in a despatch to the Lieutenant-Governor:—

"I think it of the greatest importance that the natives should not be kept isolated and apart from the inhabitants of European descent, the effect of doing so would inevitably be to produce, sooner or later, a deadly strife between the two races, and would cause all the progress which the natives might make in a knowledge of the arts of civilised life to be only the means of rendering them hereafter more formidable enemies."

Nevertheless, in 1875, the natives of Natal are, not 100,000, but considerably over 300,000, and they are still ruled by native law, and all this for want of a comparatively trifling money expenditure, and of an authority inflexibly resolved to have its own insight into the necessities of the position efficiently carried into practical effect.

In 1856 a Royal Charter conferred upon the colony an elective council. The only reference that was made in that Charter to the position of the natives was that a small money-reserve was provided out of the general revenue for their use and advantage. As soon as the representatives of the white population of the colony had taken their places in the Legislative Council, attention was directed to the unsatisfactory state of what was termed the native question. In 1861 a select committee, of which I was myself chairman, was formed for the general consideration of the subject, and, in simple justice to the white inhabitants of Natal, I feel bound to draw attention to the general tenor of the report of this committee, which, with my own signature attached, was sent in to the Lieutenant-Governor by the Legislative Council, to be forwarded to Her Majesty's Secretary of State for the Colonies. In this report a strong and unqualified protest was made against land grants to the natives in tribal tenure, or trusteeship, on account of the influence this would have in perpetuating the organisation of the coloured population, in building up the power of the chiefs, in increasing the distinctions of race, and in postponing the period, so much to be desired, "when land shall be divided among the Kafirs, and secured to them by free and unfettered individual titles." The following extracts, which are made from this report, will sufficiently indicate the spirit in which the proposals of the committee and Legislative Council were framed:—

"Your committee concurs in the proposition of giving to the Kafirs in Natal possession of lands under a form more binding than permissive occupation under which they now hold them; indeed, the granting of individual documentary titles to land has ever been a prominent feature in the policy advocated by this council for the improvement of the Kafirs, and for the maintenance of peace in this colony.

"Your committee are of opinion that the granting of individual titles would, on the other hand, make the Kafir feel that he had an interest in the colony, and create attachment to his homestead; that he would not, as under tribal titles, feel that he was as heretofore dependent on his chief—a state which, among other evils, has checked intercourse between the black and white population, and produced natural estrangement between the two races.

"What, in the opinion of your committee, should be aimed at in the land tenures is that the Kafir should be made to realise individual property and responsibility, in contradistinction to the loose and savage tribal responsibilities to which he is now accustomed. . . . The chief objects for the consideration of the colonists is not the amount to be realised by the sale of the land, or the sacrifice of its value, to be granted away on this account, but the very serious question, what steps are best calculated to secure safety to life and property through the improvement of the condition of the black population in Natal?"

A second report, of an altogether similar character, was also drawn up and submitted to the Legislative Council, and adopted in the following year, namely, in 1862. Notwithstanding these reports, and the strongly expressed desire of the Legislative Council in the matter, the result, nevertheless, was the vesting of the large Kafir localties in the hands of trustees, consisting of the Lieutenant-Governor, the Bishop, and, I think, the Secretary for Native Affairs. In connection with this part of my argument I especially desire to urge, and to bring into prominent attention as a fact too important to be lost sight of at this time, that a white population which has so steadily and consistently asked for the breaking up of the tribal system of barbarous rule, and which has so steadily and consistently advocated the superseding of that barbarous system by the education of the natives, and the granting of land on fixed tenure to individual natives, cannot by any possibility be held to have ever been indifferent to native progress and improvement. The action of the Legislative Council of Natal in the matter of tribal titles must always

stand as uncontrovertible evidence upon this point. One important and most mischievous consequence of the arrangements which I have described, and of the adoption of tribal, instead of individual responsibility, has been that whenever a petty chief commits any offence against the state, the punishment of necessity falls upon his tribe. Fine, or confiscation of property tells, not individually upon the chief, but upon his people. In 1846, the Chief Fodo disobeyed the orders of the Supreme Government; his tribe was broken up, and its cattle seized, and the chief escaped from the colony. The Chief Isidoi offended in a similar way in 1856, and a similar result followed. In 1857 the Chief Matyan resisted the Government, and his tribe was impoverished and dispersed. The home authorities were duly informed of all these occurrences, and even had the treasury accounts of the value of the confiscated cattle audited in England; but the transactions were allowed as a matter of expediency, and to save some outlay in money.

Langalibalele, the rebel chief of recent notoriety, made himself obnoxious to his own paramount chief while he was residing in Zulu-land, and escaped from his vengeance by finding a refuge in Natal. He is a man of a higher order of intellect than the general run of the Kafirs, and he has managed to employ his superior intelligence in playing upon the superstition and credulity of the tribes around in such a way that they believe he can bring or stop the rain. There is also no doubt in the mind of any honest and unprejudiced person in the colony that this petty and refractory chief has had other more objectionable and dangerous purposes in his mind than the mere bewitching of the clouds, and that he was unquestionably feeling his way to use his influence as a necromancer in bringing about a combined and organised resistance to the authorities. For myself, I have no shadow of doubt that whatever may have been the mistakes that have been made in the technical method of proceeding, much of which must be immediately ascribed to the anomalous sanction of native customs as law which I have described, the removal of this mischievous and dangerous man was indispensable to the peace of the colony, and that if he were again returned into the colony, although no very grave results might immediately follow, the evil effects of such a step would be grievously manifest in years to come.

The point is now reached at which I can definitely state the conclusions at which I have arrived from my own personal experiences in regard to the matter that I have endeavoured to bring under notice in this communication. During thirty years various attempts have been made to introduce a stream of white settlers into Natal, and these attempts have all ended in comparative failure. In the meantime the black population has grown of its own accord to, I believe, nearly 400,000. I have myself not the slightest doubt that this rapid growth of the black population, and the absence of all efficient organisation of it to play its due part as an element in a civilised community, has been the main reason why the white population within the colony has not augmented in a somewhat analogous degree. But I am also thoroughly convinced that this very element of mischievous stagnation might, under different management, have led to the training up of an industrious, peace-loving, and useful community. Had the Amahlubi tribe, under its chief, Langalibalele, been broken up, and had the people been settled as holders of land, having a stake in the good order and prosperity of the state, and their children placed in schools, when they entered the colony in 1848, I am assured that thriving Amahlubi settlements could now have been shown, vying with the settlements of my own German people who began their colonial life in the same year; and I am morally certain the Secretary of State for the Colonies would not have had to write to the Lieutenant-Governor in Natal in 1874, in reference at least to this particular case, to the effect:—

> "There was, as might be expected, little, if any, feeling of allegiance visible to their nominal supreme chief, the Lieutenant-Governor, and no symptom of unwillingness to follow their own tribal chief wherever he should choose to lead them. Their only fear would seem to be for his safety; and to preserve this they were ready to leave their homes, and sacrifice their lives."

The remedial measures in which I am myself inclined to put trust, it will be observed, succinctly are—

1. The allotment to each Kafir family of an apportionment of land, as has been done with the white settlers on their arrival, with an individual right and title to its holding.

2. Compulsory education, in civilised language and habits, of the children of the native population.

3. The definite and absolute stipulation that natives shall only be allowed to settle and remain in Natal upon condition of their submitting themselves to the same laws and the same mode of government that are administered to the white colonists. I am perfectly aware that there are considerable difficulties on technical grounds in administering either Roman, Dutch, or Kafir law among the natives; but these would all soon disappear if each native family was brought under the influence of education and civilisation, and lived in its own homestead.

Had such been the spirit and practice in 1848, we should never have seen what we now have to contemplate, a fine colony occupied by a small discontented white population, and by an overflowing mass of uncivilised and untutored savages, not by any means the better for the uncertain and unstable sprinkling which it contains of so-called half-civilised Kafirs, whose half-civilisation, in the main, means the possession of a gun and an introduction to strong drink, and to some other of the vices of Europeans.

I have finally to express, with some personal satisfaction, my opinion that it is not yet too late to furnish the remedy for this great evil if the work be at once set about in the right direction, with a firm and strong hand, and without too narrow an estimate of the money-value of the remedy, and too niggardly a counting of the cost which it must entail. If the work is not now entered upon in that spirit, and the present confusion is left to settle itself as it may, the end can only be the entire destruction of a large and very interesting race, which, under good handling and management, might assuredly be raised to a very satisfactory state of civilisation, comfort, and usefulness. Holding these views, and impressed

with this conviction, I trust I shall be forgiven if I express, in this meeting, my unqualified gratification at the strong gleam of promise and of hope that appears in a passage of a recent despatch of Lord Carnarvon to the Lieutenant-Governor of Natal, which has been published. In this passage his lordship says:—

"I am glad to be enabled to express the Queen's appreciation of the general kindness and justice with which the natives of Natal have for many years been treated by the white population. The large and increasing numbers of the natives within the colony is itself a refutation of any general charge of unkindly treatment, and nothing can be more undeserved than any allegation that the European colonists have been in the habit of acting with cruelty or oppression. The system under which the natives are governed has, in fact, depended too much upon the maintenance of friendly relations, and too little upon a firm enforcement upon the natives of the obligations of individual citizenship. If, as I hope, I am able hereafter to propose some material improvements in the system of native administration, I shall do so in full reliance upon the ready co-operation of the Legislature and people of the colony."

I most earnestly wish that the promise which is foreshadowed in these gracious words may be destined to meet with an auspicious season of realisation and harvest, instead of being nipped in the bud as have been the beneficent purposes of other distinguished and well-meaning statesmen who have preceded the present chief of the Colonial Administration in Downing-street. In the meantime, I hold that nothing will more surely remove the possible need of employing such a large force of military in the colony, as was alluded to by Earl Grey in the House of Lords last night, than the rapid creation of a railway system through the colony.

Dr. Mann stated, in allusion to the German settlement in Natal, spoken of by Mr. Bergtheil, that he was intimately acquainted with this settlement and its fortunes, and it so happened that he had in his possession a copy of the letter sent to Mr. Bergtheil by the people last year, which it was his intention to read to the meeting in full, without troubling Mr. Bergtheil for his consent. The letter most notably and emphatically confirmed what Mr. Bergtheil had said, and stated that the writers had taken the opportunity of replying to kind messages received from their good friend by the return of their minister from a visit to England, in order that they might assure him of their continued happiness and prosperity; and then, in addition to the passage which Mr. Bergtheil had quoted himself in his paper, there occured the following allusion to the recognition of the substantial benefits they had personally received:—"From the day on which we left our Fatherland, until the time when you returned to Europe (therefore from 1847 until about 1866) you were a truly parental friend; always ready with advice and assistance, both by word and deed. We came to Natal penniless, and without anything in the world, and you for the first few years of our sojourn clothed and fed us, and provided us with a minister and our children with teachers, and when eventually it proved that the scheme for which we had been brought to the colony would not succeed, you nobly cancelled all our agreements with, and our indebtedness to, you, and allowed us to take and retain our lands on the most equitable terms." There might be a very good reason why Mr. Bergtheil should himself have omitted these paragraphs, but the meeting would certainly feel that it is only right that the whole truth should be told in the matter. The allusion to the failure of the original scheme which led to the cancelling of the first arrangements meant simply that the idea in the first instance had been that cotton should be grown at the settlements, but for some reason this particular branch of industry did not answer as it had been hoped it would. During the first ten years the Germans worked steadily and hard, but at the end of that time their fortunes were gloomy and sad; they had contracted large responsibilities and debts to the projector of their settlement, and saw small chance of clearing themselves of this drag. Their debts were then forgiven them, and an arrangement was made that they should be allowed to purchase their holdings at a fixed price of from fifteen to thirty shillings an acre by payments extending over ten years. The result was that in three years almost every tenant upon the estate had cleared his farm of debt, and, as one of the men very expressively and proudly remarked to the narrator of these facts, they then had "the title deeds, with some cash, lying in their coffers." Dr. Mann, in continuation, said that when he was last at the settlement, that was in March 1866, shortly before leaving the colony, he questioned one of the settlers named Sander, regarding his position at that time, and he told him that he had lost £500 by epidemic disease attacking his cattle, but that nevertheless he possessed, free of all incumbrance at that time, 150 acres of land, worth £300; 40 cattle worth £240; implements and live stock worth £120; and buildings and furniture worth £145—in all making up above £800, and he added that although he might have some neighbours poorer than himself, he was by no means one of the richest of the community. In the year 1862, the original chapel spoken of by Mr. Bergtheil was replaced by a larger and more substantial building, at the cost of nearly £1,000, and this chapel he had seen in full use. In the foundations of this structure there is deposited, inclosed in a Kafir pot and an iron safe, a history of the first establishment of the little community, and over these documents lies a stone bearing a Latin inscription which records that the "History of the introduction of the Germans (*Germanorum importatorum Historia*) by Dominus Bergtheil, in 1848," lies beneath.

Mr. Bergtheil said that having advised the abolition of the Kafir law, and the administration of one law only to all the inhabitants, whether black or white, he should probably be met with the remark that it would be very difficult to administer either English or Roman Dutch law amongst the natives, on account of its technicalities. He was quite aware of those difficulties, but it was worth while trying the experiment, and he belived those difficulties would vanish as soon as each native family was possessed of its own home, and brought more directly under the influences of Christianity and civilisation. At any rate, considering there were some 300,000 native population, it was worth while making some effort to improve their condition, and secure the well-being of the whole colony. In the meanwhile some precautionary measures must be adopted, though he had no apprehensions of danger, even if Langalibalele were sent back. The only course he could recommend would be either the rapid extension of railways, so that a small body of troops could be rapidly moved from one part to another, or else, as had been said by Earl Grey, the maintenance of a large military force.

The second paper read was:—

THE PROBABLE INFLUENCE OF RAILWAY CONSTRUCTION IN NATAL UPON TRADE AND UPON THE ADVANCEMENT OF CIVILISATION AMONGST THE NATIVES OF THAT COLONY AND THE ADJACENT TERRITORIES.

By A. Browning.

It may have occurred to many persons whose fortune it has been to live for some time in India,

that if only the climate were about 15° cooler, the country would be delightful.

Just such a country as India would then be exists in the South of Africa, where the mean temperature through the year is as nearly as possible 15° lower than the average temperature in Bengal. But there is another difference between the two countries not less important than even the climate itself, namely the population. In India there is a dense population of intelligent and industrious people with the accumulated good and evil of an ancient civilisation, whilst in South Africa the population is scanty, and the native population, so to speak, in its infancy. Here, then, is a noble field for colonisation. A country with a climate that is probably unrivalled, with a rich soil, abounding in minerals, but in want of population.

In Africa, however, there is a great difficulty, namely that of transport, as was found during the Ashantee War. It is a difficulty familiar to all African travellers, as well as to merchants interested in the trade of Africa, being in fact the chief barrier to trade. Livingstone, Baker, Cameron, and Stanley have all again and again declared it to be one of the chief, if not the greatest obstacle in the way of their progress in Africa.

Before entering further on the probable result of railways upon trade and civilisation in Natal, we may consider shortly the nature of the country itself.

Natal is almost lozenge-shaped, the east face being bounded by the sea, the north face by the Buffalo and Tugela Rivers, the west by the Drakenberg Mountains, and the south by Kaffraria.

The Drakenberg are a rugged and very picturesque range of mountains, rising in some places to a height of 12,000 feet above the sea, and frequently covered with snow, and it is difficult to imagine anything more lovely than the views in the early morning, about sunrise, up country in Natal, during the winter time when the grass is crisp and white with hoar frost, and the heights of the Drakenberg in the distance are covered with snow, and so clear that the outline and every detail of these mountains often appear quite sharply defined even at a distance of 60 miles.

Within its boundaries the country of Natal is seamed by rivers, generally running from west to east, often in rugged and deep ravines, and it is difficult to travel more than a mile or two in any part of the country without crossing some stream or river. These streams are of wonderfully pure and wholesome water, and from the lie of the country there is hardly a farm upon which a water mill could not easily be worked.

The climate of South Africa is somewhat affected by the fact that the current which flows along the shores of Natal from north to south consists of water which has become warm by exposure to the sun in the Indian Ocean, whilst at the Cape of Good Hope the current which flows in the sea from south to north, brings with it excessively cold water from the South Pole. Curiously enough, although so near each other geographically, the wet season at Natal is the dry season at the Cape, and *vice versa*.

As regards agriculture, it may be stated that Natal is a good country for arable farming, although as yet little cultivated. It is a first-rate horse-breeding country, good for cattle and sheep; and some idea of the climate and soil may be gathered from the fact that sugar-cane, tobacco, coffee, Indian corn, pineapples, mangoes, bananas, peaches, oranges, lemons, grapes, figs, apples, strawberries, and all kinds of vegetables, grow excellently; and, if tried, Natal would probably be found one of the best countries in the world for the production of tea and indigo.

In the Newcastle district wheat grows well, but the Transvaal, just beyond the Natal frontier, is the great wheat country, which might produce any quantity if only the grain could reach a market.

It should be borne in mind that Natal is not only a very rich country itself, but it is the natural exit for most of the trade of the Orange River Free State and the Transvaal Republic, and therefore its commerce is a matter of the greatest importance.

In England there are many erroneous ideas prevalent as to the appearance of Africa, some (though probably none in this room) having an impression that Africa is one great sandy desert. This is very far from being the case, and, as far as Natal is concerned, it is as green a country as England itself. Near the coast it is park-like, covered with a rich sward and patches of trees, often somewhat like the country to the west of Exeter. Further inland it is more like Switzerland or Spain, but the absence of lakes is a peculiar feature in Natal.

Although the resources of Natal are not yet developed, it is known that the coal-fields are large. The author visited three seams, varying in thickness from 4ft. to 7ft. in the Newcastle district, namely, at Dundee, Horn River, and Tiger Kloof, and brought away samples taken from the solid beds in the earth. An analysis of the Dundee coal gave the following result:—

Carbon	79·43
Hydrogen	4·98
Oxygen and Nitrogen	5·50
Sulphur	1·78
Ash	7·20
Water	1·11
Total	100·00

A sample of iron ore, also from the slopes of the Biggarsberg, quite near to the coal-fields, taken at random, when analysed was found to contain 37·57 per cent. of metallic iron. The magistrate of the Newcastle district appeared to consider that further north the quality of the coal improved, but the seams visited contained good serviceable coal, as appears by the analysis; and the experience of the author, at whose camp this coal was burned every night for weeks together, whilst passing through the Newcastle district was, that better coal could not have been desired. So great is the extent of this field that it is calculated to contain coal equal to the present annual production of Great Britain for a period of upwards of 1,000 years. But with all these natural advantages there is the great difficulty of transport to contend with, which has been admirably described in the Report of a Select Committee of the Legislative Council of Natal, dated 1871, as follows:—

"The carriage of goods in Natal is at present carried on by means of waggons drawn by teams of from 12 to 18 oxen.

The loads vary in weight from 3 to 5½ tons, with a tendency to increase in the average. The roads are generally mere tracks, more or less worn by traffic, and occasionally cuttings in hills where a sidelong ascent is rendered necessary, and a level upon which wheels could run cannot otherwise be obtained. In the winter or dry season the soil, baked by the sun, is sufficiently hard to resist impression, and the roads suffer little deterioration, but in the wet season, which with intermissions occupies nearly two-thirds of the year, the case is very different. The uncut surface, indeed, wherever the surface of the ground affords natural drainage, dries rapidly, and in such cases—except that in rainy weather it becomes dangerously slippery—offers no serious impediment to travelling; but wherever water cannot rapidly escape, swamps or mudholes are inevitable, of such depth that waggons sink in them up to their axles, while in the cuttings the effect of heavy rains upon the light soil is such as to render the maintenance of the way an almost insurmountable difficulty.

"In many instances roads have been obliterated or converted into mere watercourses, in others the work of repair is almost incessant, and entails an expense out of all proportion with its result."

Not only is the cost of transport great, but it is so uncertain that merchants are kept waiting for months, and almost years, for goods which could have been delivered in a day or two had there been a railway. This represents a loss of interest upon all money invested in trade, and renders trade so uncertain that it is wonderful the country should have prospered at all.

The way in which this adds to the difficulties of trade in South Africa may be imagined from the fact that transport from Cape Town to the Diamond Fields, a distance of 800 miles, was costing £85 per ton in January, 1874. Upon English railways carriage for the same distance would cost from £4 to £6 at present rates.

The value even now of South African trade may be imagined, however, from the fact that in the year ending 30th June, 1873, the amount of waggon hire ascertained to have been expended in the transport of goods to and from Port Elizabeth alone was £580,737; estimated sum paid of which there was no account, £25,000; total, £605,737.

No doubt the trade of Port Elizabeth is at present more valuable than that of Natal, but the country at the back of Natal has even greater natural advantages than that behind Port Elizabeth, and the harbour of Durban, though not all that could be desired at present, is capable of being made a most excellent one. It is natural, therefore, to hope that when Natal is developed, it will rapidly acquire an even greater trade than Port Elizabeth has now, valuable though that is.

The scantiness of the population in South Africa may be gathered from the following figures:—

In Mauritius	the population is		452	for each	mile area.
In England	"	"	269	"	"
In India	"	"	154	"	"
In Natal	"	about	15	"	"

whilst the average density of population in Cape Colony, Natal, the Orange Free State, and the Transvaal Republic is only 2·6 per mile over all.

It is hardly possible, in considering the future of South Africa, to look upon these four countries as divided from each other, for although, politically, they are separate governments at present, the good or bad fortune of any one of them is a matter of vital importance to all the others, and it is difficult to avoid looking forward to a close confederation amongst them, so that they may be able to act, in all emergencies, with unity of design and promptness.

Most of those present are familiar with the principle of the resultant of forces, and know how it is quite possible to have three powers each exerting a force of 100 tons producing as the result of their combined action a pull of one ton.

India is ruled with rigour by the English, although the proportion of Europeans there to natives is only one-twentieth of what it is in Natal, and there need be little fear as to the durability of British rule in South Africa.

Whatever political changes there may be in store for Natal, it will be admitted that in the years now past, the Zulus there have been ruled indulgently and fairly by the British Government, and all those interested in the matter must have been pleased to read in a recent despatch that her Majesty, our Queen, has expressed through the Secretary of State her "appreciation of the general kindness and justice with which the natives of Natal have for many years been treated by the white population."

There can be no doubt that the future of the African races is one of the most deeply interesting questions of the day, whether to the historian, the philosopher, the missionary, or the statesman.

In India, in dealing with the natives there is caste and prejudice to overcome. In South Africa there is nothing of that kind, and the natives are not bound together by tradition or religious fanaticism, but on the contrary there is something at times almost childish in their ideas. That the Zulus should prosper under British rule is what the author trusts may be the case, and although there is a common fashion of undervaluing the Christian Kafirs, he has seen some who are so evidently becoming civilised and worthy people that there is good ground for hoping to see the happiest results following the more complete development of the country. We do not, however, think it wise to give sharp tools to children, and it seems as unlikely that good results will follow from giving a merely intellectual training to the natives of Africa. It should not be supposed either that mere freedom from restraint is likely to produce good results, for as far as the author's own experience goes, they prefer being ruled by a just and wise master, who will tell them what they are to do instead of leaving them to hesitate between inclination and duty, with the trouble of thinking out everything for themselves.

By constructing railways in South Africa the spread of civilisation will, beyond a doubt, be greatly hastened; and one result will be to make Europeans more than ever the paramount power, not only within the limits of the existing English colony, but also amongst the natives of the adjacent territories. Those tribes who, having greater force of character, have formed themselves into nations under Governments of their own, may be expected to share in the gradual spread of civilisation, just as Mysore and the Nizam's Dominions do at present in India, where anyone may travel beyond the actually British territory and still find that the kindly influence of the paramount power ensures freedom, and safety to life and property.

In Africa also we may expect that savage customs will be abolished, and that sooner or later

the natives will move with the stream, "*Sua si bona norint.*"

Possibly some of the more irreclaimable sort of men may move out towards the warmer regions, below the equator, where an antipathetic civilisation will not follow them so fast, whilst the stronger races will remain, and become free and intelligent people in the course of time. Their future may have some analogy to that of the free Africans in the United States of America, and a study of what is now taking place there may throw light on this most interesting question.

About the end of 1872, the author, having just returned from India, left for Natal, with a staff of engineers, to execute a survey for a system of railways, it being proposed to construct them through a company arranged by Mr. Welborne, who had devoted considerable time and thought to the matter.

A number of lines, however, had previously been suggested, some of which were actually surveyed by engineers* who had shown much talent in their difficult work, for the country to be traversed is rugged, and its configuration confused and irregular in an extreme degree. These earlier surveys were, as may be imagined, of great use to the author in the selection of the route which he adopted, and indeed some parts of Mr. Paterson's plans have been adopted without any change.

The whole of the lines thus surveyed in 1873 will, in all probability, be made before many years have passed, and arrangements have already been nearly completed by Government for the construction, as a beginning, of the line from Port Natal to the capital, with branches along the coast running through the plantations north to Verulam and south to the village of Isipingo, the length of these lines being as follows:—

Durban to Maritzburg	78	miles
Umgeni to Verulam	$19\frac{1}{4}$	„
South Coast Branch	7	„
Total	$104\frac{1}{4}$	miles

The gauge of the proposed lines is that being now generally adopted in Africa, namely, the small, or 3 ft. 6 in. guage. The main line to Pietermaritzburg commences at Durban by a junction with the existing short line of railway, and proceeds first in a southerly direction past Congela on a flat country (about the only flat in Natal) to a point $4\frac{1}{2}$ miles from Durban between the Umbilo and Umhlatuzan Rivers, where the South Coast line branches off and the main line turns westwards to face the real difficulties of the country. From this point for about forty miles the difficulties are almost continuous, but they have been met by engineering expedients, without the need for extravagant works or embarrassing outlay, and without any gradients steeper than 1 in 30, or curves sharper than 300 feet radius. At first it was proposed to adopt a few curves of sharper radius, to avoid tunnels on the Inchanga and Fields-hill, but this has now been considered unadvisable, and therefore there will be a short tunnel at each of these places, and cuttings varying in depth up to 70 feet and embankments up to 60 feet in height.

About 36 miles from Durban the line attains a level 2,373 feet above the sea at the Half-way House, thence it falls 294 feet again to the foot of the Inchanga, and then gradually rises to the highest point between Port Natal and Pietermaritzburg, which is reached near New Leeds, and is 3,037 above sea level.

The line then falls gradually and through an easier country to the Umsindusi River, which is crossed close to Pietermaritzburg (at a level 2,059 feet above the sea), and thence rises to the town, where it is proposed to build the station, on a site very near the Government House, and in a favourable position with regard to the fort and barracks.

Beyond Pietermaritzburg the line of country is somewhat difficult until the town hill is surmounted, as may be judged by the fact that the main road rises 1,704 feet in about four miles, and that there is no lower summit to be found than that passed by the railway near Kettle Fontein. Thence to Newcastle, although by no means easy, the country is not so bad as about the Inchanga; but the nature of the line of country to be traversed will be best understood by a reference to the diagrams which have been prepared to show the chief variations of level and the plan of the route followed. Horizontal blue lines are drawn at each 1,000 feet, to indicate how very much of Natal lies at a level of more than 3,000 feet above the sea. A red line also shows the section which would be got along a line to the Free State proposed, by way of Oliver's Hoek, whilst a black dotted line shows the section by the route selected by the author, going by way of Ladysmith and crossing the Drakenberg a little south of Van Reenan's Pass. The comparative merits of the two lines may be judged by the fact that, owing to the variations of level, a locomotive going by way of Oliver's Hoek to the top of the Berg, would have to rise altogether 2,614 feet more than it would by the route selected, and that the length of branch to be made would be $71\frac{1}{2}$ miles in the former as compared with $39\frac{1}{2}$ miles in the latter case. The line selected also ends nearer to Harrismith than the Oliver's Hoek branch would.

Near Estcourt there is a difficult piece of country where the line has to descend 1,545 feet in $15\frac{1}{2}$ miles, from Highlands Farm to the Town of Estcourt.

The total length of line surveyed in 1873 was as follows:—

Main line	280·10	miles.
Coast lines	40·25	„
Drakenberg branch	26·75	„
Total.........	347·10	„

and the number of streams crossed may be judged by the fact that in the estimate for the above length of line, there were included 589 viaducts, bridges, and masonry culverts. The most important of these were as follows:—Viaduct over the Umgeni, near Durban, with 34 openings of 30 feet; viaduct over the Umlazi, near Isipingo, with 20 openings of 30 feet; bridge over the Tugela, at the Town of Colenso, with 5 spans of 100 feet; bridge with 2 spans of 100 feet, and 4 of 30 over the Umhloti; bridges with 2 spans of 100 feet each over the Umgeni, Umhlatuzan, Umhlanga, Sundays River, Klip River, and Blue Krans; bridges of 100 feet span over the Ingagane, Mooi River

* As, for instance, Messrs. Paterson, Abernethy, Milne, and West.

Bushman's River, Umbilo, Umsindusi, Umbilo (at PineTown), Lion's River, and Riet Spruit. And besides these there are a very large number of bridges with various numbers of openings of 30 feet span and less. For the more important rivers such as the Umlazi, which drains an area of 350 square miles, the flood discharge has been calculated by a formula adopted by the Indian Government.

$$D = 100,000 \sqrt[3]{N^2}$$

N being the area in miles drained, and D the discharge in cubic yards per hour.

Using this formula it would appear that we might expect a discharge from the Umlazi of 5,000,000 cubic yards of water per hour, during floods. This would require a water-way 500 feet broad altogether, but for safety 600 feet of span have been allowed.

In short, it may be remarked that, rugged as the diagrams show the route of the railway to be, there is no chance of a line of more uniform level being found. The whole country is sculptured with ridges and valleys, and either these inequalities of level must be overcome, or else each ridge must have its own line of railway to itself, a *reductio ad absurdum*.

Before leaving this part of the subject, it may be remarked that, bold and picturesque as are the features of the ground in Natal, the construction of such a railway as it is intended to make is a matter quite within the capabilities of the case and the resources of the colony, and the author having given much consideration to this very important question, has no hesitation in saying that a railway, such as has been laid out, will return a good revenue upon the outlay; and adding to this the incalculable advantages it will confer upon a land circumstanced as Natal is, such a system of railways will be remunerative in the best sense of the word.

It may seem, perhaps, unnecessary to give details of existing traffic unless to serve as an index to what is likely to follow the completion of railways through Natal, because, as has been already noticed, the colony is absolutely waiting to be developed; but the following particulars may be interesting, as bearing practically upon that point:—

1. Four years ago there were 34,663 acres of land under cultivation in the counties of Durban and Victoria, the produce of which was estimated at 13,500 tons weight, and valued at £317,150. To produce this, 10,000 labourers were employed, and food and other necessaries of life for themselves and dependants would weigh 7,500 tons at least.

2. In 1870-1 the crop of mealies or maize in Natal was estimated to be about 85,000 tons in weight, and it was proved to the satisfaction of a Select Committee of the Legislative Council, that, had a railway existed then, 25,000 tons of mealies might have been exported.

3. Allowing two tons of coal for the production of three tons of sugar, the coast district of Natal would at present use 9,000 tons of coal on the sugar estates alone. Add for household consumption at Durban 5,000 tons; Maritzburg and neighbourhood 5,000 tons; exportation and steam navigation on the coast 21,000 tons, and we have a total of 40,000 as the probable requirements per annum, immediately on the completion of the railways up to the coal fields.

4. The population of the diamond fields requires transport sufficient for 1,200,000 lbs. per week to supply them with the necessaries of life, say 28,000 tons a-year.

5. The tolls on Umgeni-bridge, four miles out of Durban, from 1st July, 1870, to 30th June, 1871, showed a traffic of 15,868 tons, and 42,017 passengers.

6. The tolls on the Inchanga Hill (that is on the up-country main road out of Durban) showed in the same period a traffic there of between 15,000 and 16,000 tons of goods.

7. Mr. Bond, giving evidence before the Select Committee of the Legislative Assembly in 1871, said that if a railway were made, enabling merchants to offer 5s. per 180 lbs. to farmers for mealies, he considered that in ordinary years 50,000 tons would be sent from Maritzburg district to Durban for shipment.

8. The net profits upon the existing short line of railway at Durban have for the last 5 years been at the average rate of upwards of £800 per mile per annum, and the company has recently been paying a dividend of 20 per cent. per annum.

9. From October, 1871, to May, 1872, 4,439 loaded waggons passed over one pass of the Drakenberg mountains through Natal into the Free State. The waggons contained, on an average, three tons of goods each, or in all 13,317 tons. In 1872-3, this traffic was increasing in the ratio of 29 to 22, so that from these figures we may expect a traffic of 30,000 tons between Natal and the Free State, by this one road two years hence.

10. At present the rates for transport of goods in Natal are very heavy, as will be seen by the following figures, showing the rates prevailing in November, 1873:—

Durban to	Maritzburg,	£5	for	54	miles, per ton.
Do.	Newcastle,	£20	,,	230	,, ,,
Do.	Ladysmith,	£15	,,	156	,, ,,
Do.	Diamond Fields,	£42	,,	473	,, ,,

The average of these rates is about one shilling and ninepence per ton per mile.

11. The trade of Natal is increasing as follows:— In 1863 the trade of Durban was 46,409 tons, worth £631,898. In 1872 it was 69,594 tons, valued at £1,448,049. So that we may infer that there will be a trade in 1881 of 100,000 tons from Durban, worth £3,000,000—that is, judging by the present rate of development, and without making any addition for the extraordinary development which may be expected to follow the construction of railways. Almost the whole of this, besides local traffic, must flow over the Natal railways when they are made.

12. The Gold Fields in the Transvaal are now an acknowledged fact. A regular stream of traffic has been setting in towards the Gold Fields, and it is only natural to expect that the whole traffic will flow through Natal. The only rival road is that by Delagoa Bay; but, as the country between the Transvaal and Delagoa Bay is unsettled and unhealthy, that route does not appear to be a dangerous rival.

The author feels that he has not done more than touch on the outline of this most interesting question, but time forbids the further enlargement

of this paper. If, however, it succeeds in drawing the attention to the admirable accounts of Natal already published by Dr. Mann and other great authorities on South African affairs, it will have done more than its merits entitle it to. And if opinions differ on many points from those now expressed, it is hardly needful to offer any apology, because it seems as little to be desired that we should all think precisely alike, as it would be that a picture should be painted all precisely of one colour.

So far as admiration for the natural beauties and advantages of Natal is concerned, the author is quite inclined to be enthusiastic, and he hopes to see the day when steamers of 3,000 tons burden may be able to sail into and out of the beautiful bay of Natal at all times and in all tides, and when, the railway being made through the colony, Durban will become a great coaling station, of use both to English commerce and to our ships of war.

DISCUSSION.

General Bisset, as an old resident of the Cape and Natal, had been much interested in the paper. He had resided at the Cape many years, having gone there in 1820, and consequently had witnessed all the vicissitudes spoken of by Mr. Bergtheil, and when the Dutch emigrated from the Cape to Natal in 1835 and 1837 he himself presented the leaders of these expeditions—Maritz and Peter Retief (from whom the town of Petermaritzburg was named)—with a copy of the Bible. He afterwards marched to Natal in 1843 with a detachment of troops, to take over the possession of the colony from the Dutch. Since then he had watched with great interest the progress of the country, and seen the difficulties arising from the presence of the native element. The black population had not increased so much from ordinary natural causes as from the constant influx from the Zulu country beyond the borders, where there were upwards of 400,000 natives congregated. It was very difficult to change the habits of so vast a population, and their civilisation would not be effected simply by planting schools or even by sending missionaries, unless, as was the case with the Moravians, they introduced trade and industry as well as religion. By that means they had been more successful than other Christian bodies. As to the measures to be adopted, he thought, in the first place, individual titles to property should be given to the natives, so that they might all have a personal interest in the safety and peace of the country, and not, as at present, lose all their rights if the chief of the tribe rebelled. They would thus also have opportunities of producing articles of export for their own benefit; and he was even prepared to advocate the purchase by the Government of flax, cotton, esparto grass, &c., as it would tend to promote habits of thrift amongst the people. The importance of railway communication being established was shown by the fact that one house at the Cape paid £200,000 in one year for the transport of produce to their various frontier stations. During the last ten years the revenue of the Cape had more than doubled, and equal progress had been made in Natal; but had railway communication existed, it would doubtless have been ten times as much.

Major Erskine said he had so recently escaped from the trammels of office that he did not feel quite able as yet to speak with perfect freedom on colonial affairs, but he considered the whole question lay in a nutshell, and would be solved simply by the construction of railways. When that was accomplished they would hear no more of the Kafir question, the sugar question, or any other difficulty. The colony was at last beginning to wake up to a sense of this necessity, and he believed the people would now adopt the plan which he had incurred some odium for recommending, viz., that they should make the lines themselves. Great engineering mistakes had been made there, as elsewhere, but they need not be repeated if only first rate professional advice was obtained in the first instance.

Professor Tennant said he was not prepared to speak of the colony of Natal, but he had much pleasure in exhibiting some photographs of the neighbouring diamond fields, and some specimens of the stones found there. The recent enormous development of those districts was very interesting, as showing what might occur in a country formerly considered to be destitute of any valuable minerals. He had been asked sometimes by persons who had travelled and hunted over these regions, how it was that they had not found these treasures earlier, but it always turned out on inquiry that they had never looked for them, and generally that they would not even have recognised them had they stumbled upon them by accident. Only recently two young men, returned from the diamond fields, were speaking to him of the precarious returns obtained there, when he put before them a box containing a number of pebbles from the same district, with six diamonds amongst them, but not one could they pick out. The fact was, many people went to the diamond fields expecting to find the stones already cut and polished. It had been feared by the trade that the great influx of diamonds would greatly depreciate their value, but the truth was, they were worth more now than twenty-five years ago, many new markets being open for their disposal, such as Australia and America. Mr. Jefferies, in his valuable book, published about twenty years ago, stated that a stone of one carat of first-rate quality was worth £8, but at the present time the wholesale price in London was £15 or £[illegible]. The discovery of diamonds in South Africa had been foretold many years ago by his old teacher, Mr. Mawe, who died in 1829. The art of diamond cutting, in which a century and a half ago England stood pre-eminent, but which had since been almost monopolised by the Dutch, was again being practised here, as it might very well be, there being no great difficulty in it. He also exhibited a piece of quartz from South Africa, with visible traces of gold in it, but said he considered after all that the coal-fields were of more importance to the future progress of the colony than any of the more precious minerals.

In reply to a request from the Chairman,

Dr. Mann said—The history of the Natal Chief, Langalibalele, alluded to in Mr. Bergtheil's paper, has excited so much notice of late that it may be worth while to state briefly what the exact circumstances of his offence and punishments are. The chief came into the colony of Natal with his tribe, as a refugee from Zululand, seeking protection from the English authorities in 1848. He was settled down by the Government near the mountainous inland frontier of the colony upon land set apart for his own use, and remained there, living the ordinary life of the rude natives, and tending his multiplying cattle, until the last year. But since the discovery of the diamond fields beyond this inland mountain frontier, the young men of his tribe have gradually acquired the habit of going up to the fields with white masters, and taking guns in payment for their labour. The Government in Natal having some ground, more or less well-founded, for suspecting that these guns were desired for the purpose of arming the tribe, an act absolutely forbidden by the laws of the colony, and that the chief had engaged in questionable negotiations with independent chiefs beyond the border, at last deemed it imperative to call Langalibalele to account, and to endeavour to stop this surreptitious acquisition of firearms. The chief was accordingly summoned to appear, first before the magistrate of his district, and afterwards at the Central Office of Native Administration in Maritzburg.

to answer for his conduct. He refused, however, to obey the summons, and when he heard that the authorities were coming up in force to insist upon his obedience to the law, he went away over the mountain with a small party of followers, and left his young men engaged in bringing out the cattle after him. The women and children, and old men of the tribe, in the meantime, were placed in concealment in caves at the base of the mountains, apparently with the intention that the main body of the young men were to return to look after them when they had placed the cattle in safety. It will be observed here that the cattle were the first objects of solicitude, and that the women and children came afterwards. The real reason for this procedure, however, is obviously that the cattle were portable and confiscatable property, while the women and children were known to be quite safe even if found by the white men. It so happened, however, that the cattle were met by a troop of the Government forces in one of the passes of the mountains, as they were on the point of effecting their escape, and the men who were driving them were required to return to their proper residence, and to drive the cattle back into the colony. They, however, refused unconditionally to obey this order, and as they were armed, in considerable force, and began to make threatening demonstrations, the white force, consisting of a small troop of mounted volunteers, was directed to retire deliberately. As they began, however, to execute this movement they were fired upon by some of Langalibalele's people, who had taken up strong positions behind the shelter of the rocks, and three white men and two of their native attendants were killed. The white volunteers withdrew entirely from the unequal contest, and the Kafirs continued their way with the cattle, and finally joined Langalibalele in Basuto Land, some 150 miles beyond the frontier. The colonial authorities, in the meantime, indignant at this unexpected act of resolute and successful resistance, proceeded to carry out the plan which had been arranged for breaking up the refractory tribe. They came up in force to the boundary of their location, and sent word into it that in three days the entire district would be occupied by the Government, and that all natives found in it with arms in their hands at the end of that time would be regarded as rebels and enemies. The Government force, consisting of an adequate body of loyal native tribes, and of troops of mounted colonial volunteers, at the end of the three days swept through the location to the base of the mountains, burned all the huts, and attacked small bands of armed men that they encountered in resistance here and there. When they reached the mountains they found that the women and children were guarded in natural fastnesses and caves, and it was currently reported among the natives that the men still absent with the cattle were coming back to assist in their defence. It was on this account considered indispensable that the caves should be cleared out at once. This was accordingly done, and the occupants were taken out, and sent down into the colony for safeguard. It is admitted on all hands that the conduct of the white colonists towards the natives in the colony had at all times been considerate and kind. The utmost effort was made upon this occasion by the authorities, and by the colonists, who were in responsible and influential command, to preserve this reputation, and to carry out the strong-handed proceedings deemed necessary in the emergency with as much forbearance and gentleness as the ultimate success of the operations allowed; and even greater measure of patience and forbearance would no doubt have been manifested had it not been for the wanton murder so recently of the men at the pass. Loss of life was incurred among the natives, on and during the clearance of the location. It is impossible that operations of this class can be carried through without some cost of this kind, more especially when imperfectly disciplined, and but half-civilised, agents have to be employed. But the impression of the authorities, who were most anxious to avoid unnecessary violence, and emphatically of the Secretary for Native Affairs, who has always been known as one of the most steady and consistent advocates of the best interests of the natives, was unconditionally to the effect that these lamentable consequences of the strife were entirely due to the culpable and fierce resistance offered to the authorities by men who well knew the evil consequences of their acts, and that the instances in which hot blood had betrayed the agents of the Government into unjustifiable violence, were, under all the circumstances, surprisingly few. In the worst case which has been spoken of, in which a rebel Kafir had made an obstinate resistance from one of the caves, and had killed more than one of his assailants, and was himself shot through the head, when he was ultimately taken out in a wounded state, there is no doubt whatever that the officer in command of the party had ordered that he should be carefully removed amongst other prisoners, and he was shot through some confusion in apprehending, if not in absolute contravention of the order. It is a noteworthy illustration of the ready way in which false impressions are circulated in affairs of this kind, that it has been actually falsely said that this Kafir was shot by the officer himself who was in command. A strong party of the Government forces had in the meantime followed Langalibalele and the cattle on beyond the mountains, and there, with the assistance of a Coolie force sent to co-operate with them from the Cape colony, and with the connivance of the Basutos—the native race of the place—the chief and a considerable number of his followers were ultimately seized. Langalibalele and his men were sent back to Natal, and the cattle were taken as a forfeit to the Government. The prisoners were subjected to a trial in the colony, which was conceived to have been in accordance with the native law; and the chief and one of his sons were sentenced to transportation to Robben Island in Table Bay, and to imprisonment there; while others of the offenders were visited with imprisonment within the colony. The entire tribe was broken up and scattered among other tribes, and a neighbouring tribe which had sympathised with Langalibalele on account of ties of kinship and relationship, was also ordered to be also broken up in a similar way. After the trial and sentence of the chief, two entirely opposite views regarding the transaction began to manifest themselves in the colony, and to take the form of a definite controversy. On the one side it was contended by a small party of apologists that the chief was not a conspirator; that there was no evidence of his having entered into treasonable engagements with other chiefs, or having intended himself to make any armed resistance to the Government; but that he was simply a victim to the turbulent spirit of his young men, who had a harmless and boyish ambition to get guns; and that when alarmed at the summons of the Government he had simply desired to get out of the way until the trouble had blown over, and that he might make terms from a distance for his submission and return, and that the struggle at the pass was an unpremeditated and unfortunate incident of the escape, due to the eagerness of the young men to save the chief's cattle, and to indiscreet and ill-considered attempts at arrests on the part of the Government. On the other side it was maintained that the Government had long been aware of the disaffected state of the tribe, and was possessed of reliable information as to hostile, or at least threatening negociations with other chiefs, that Langalibalele was especially dangerous on account of his well-known reputation among the natives, far and wide, as a sorcerer; that his refusal to obey the summons of the magistrate was part of a deliberately planned design of resistance and defiance; that he expected to rouse the Zulus and Basutos, besides some of the friendly tribes within the

colony, to take part with him; and that the hasty and defiant removal of the cattle was, in accordance with the custom of native tribes, an unmistakable indication of hostile purpose. A careful survey and unbiassed consideration of the statements on both sides at this distance from the event, both in space and time, certainly leaves a very clear impression upon the mind that the old chief was much more seriously compromised than is allowed by his advocates. The Secretary for Native Affairs at the Cape writes, in an official memorandum in January of the present year:—"There is no doubt that overtures were made to Molapo (the present chief of the Basutos) which were favourably received, and it is more than probable that had it not been for the prompt action taken by this Government, and the presence of an armed colonial force on the scene, as well as the pursuit by a large force from Natal, that Langalibalele would have found an asylum with Molapo, and the most embarrassing and wide-spread complications would have been the result." It is quite impossible to conceive that this official memorandum would have been deliberately penned, so long after the event, by an upright and honourable gentleman placed in the best possible position for knowing the facts of which he speaks, without reasonably good grounds for the assertion that is made, and without evidence that at least outweighs the bare denial of the compromised parties. There is an obvious reason for the backwardness of the Natal Government to make public the information upon this point that they had secured; namely, that the complicity of other tribes could not be officially acknowledged without the extension to them of penalties which it was inexpedient to have to enforce. In all probability, the most turbulent men of his tribe were more actively in fault than the old chief himself. He was, in some measure, a puppet in their hands. It is evident that upon more than one occasion, when he inclined to obey the call of the authorities, he was prevented from doing so by the remonstrances and opposition of four of his head men, of whom one, Mabudhle, was in command of the armed party which was escorting the cattle through the pass, and fired the first shot, and killed a white man. It is even said, with some considerable degree of probability, that Langalibalele had ordered that, in case of a collision with the authorities, the cattle were to be left to their fate; but it is no less clear that Mabudhle himself reported the collision at the pass to the chief, and boasted that he had killed his man, and nevertheless was maintained by the chief in his position of command in the further operations of the retreat. This hero of the fight, nevertheless, took good care not to be with the rest of his friends in Basuto Land when the chief was seized by the combined operations of the Cape and Natal. He is still at large. The punishment of Langalibalele, which was imprisonment for life in Robben Island, has been spoken of as being of excessive severity. But it really appears, upon a full consideration of all the circumstances of his position, the old chief can hardly be said to have been inconsiderately dealt with. The aim of the authorities in fixing his penalty was, not to punish him for his contumacy and misdeeds, but to remove him out of the way of further complications and mischief. If he had been tried for his life, for complicity in the murder of the white men, and hung, it might have been urged that his sentence was severe, because then there could have been afterwards no possible amelioration, or remission of the penalty when the need for severity was past. The sentence of confinement in Robben Island was at all times open, on the other hand, to remission when the circumstances that constituted the old man's dangerous power had passed away; and the spirit in which the South African Governments act in such matters is notably shown in the remission last year of the sentence of outlawry passed in similar form upon the chief Isidoi for resistance to the authorities in 1857, upon his voluntary submission, and payment of a fine of £50. There is much more to be said regarding the controverted question of the administration of native law, and of the very summary proceeding of breaking up tribes, by the armed hand, when they continue in resistance and contumacy, than can be entered upon on this occasion. But this much at least must not be overlooked, even in a cursory allusion to those matters. If it be true that the recognition of tribal rights and responsibilities maintains the authority and power of the petty hereditary chiefs, and therefore augments their influence for mischief when they are in contumacy and rebellion, it is also true that it is a still more efficient and powerful instrument when wielded by the Government on the other side in support of authority and order. This no doubt is the real reason why it has thus long been regarded with favour by the authorities in Natal. Tribal rights and responsibilities gave Langalibalele the opportunity of being troublesome to the Government; but the same rights and responsibilities also gave the Government power to sweep him in his contumacy and armed resistance from the face of the colony, although with only a small handful of half-trained colonists and imperial forces at command to carry through the work. The brunt of the operation was performed by the petty native chiefs, who brought their own men loyally into the field, the instant they received the order of the Government to do so. Mr. Bergtheil, in his interesting paper, has argued that if the native tribes had been broken up when they first came into the colony for protection, if their children had been educated, and if allotments of land had been made to individuals, the native race would have been far more advanced on the road to civilisation than it now is. I entirely agree in this; but I must also add that the difficulties of carrying out such a good work in the circumstances in which Natal has hitherto been placed, with fresh thousands of rude barbarians continually flowing in, and with almost infinitesimal resources at command, must, of necessity, at any time, have been inconceivably great. It is, proverbially, one thing to bring a horse to a river, and another thing to make him drink when you have got him there. In his uncivilised state the African nature has not the remotest shadow of an idea that a fixed claim of proprietorship in a piece of land can be worth anything to any human being. His acceptance of land, and over and above this, his use of it in any industrial or productive way, implies a very considerable measure of progress from the rude towards the civilised state. When a native has learned to value a title to the soil there is no doubt he has become, in a very considerable measure, an orderly and trustworthy member of the community; but before he can be brought to this very desirable state he has to be got into the condition of mind to care for the boon that is to become the active means of his regeneration. In regard to the fate of Langalibalele, Lord Carnarvon, after a careful consideration of the whole question, so far as it had been placed before him, thought that he most justly deserved punishment for refusing to obey the summons and the lawful commands of the Natal Government, and for attempting to escape from the jurisdiction of that Government with his tribe and his cattle; but he was, beyond this, of opinion that there was not sufficient evidence in the hands of the Natal Government to convict him of treason, sedition, and rebellion, for which he had been arraigned. To his lordship's mind the evidence did not suffice to make it absolutely clear, whether the offence was due to a deliberate scheme of concerted resistance, or whether it was simply the effect of unfounded fear or panic. His lordship also thought that it was unfortunate counsel had not been provided for the chief, and that his own plea was not taken to be one of extenuation or justification, rather than an unqualified admission of guilt. He further conceived that there was some confusion and awkwardness in the proceedings of the authorities, in trying the criminal by native law, because some part of the offence was not criminal in the view of civilised law; and in, nevertheless, introducing

to the indictment charges which were cognisable by e ordinary law courts; and that the evidence of the itness who testified to his defiant insolence when the mmons of the authorities was delivered to him, ought have been supported by the corroborative testimony other witnesses. It was upon these grounds that his dship announced that it was his intention to recom-nd the chief to the favourable consideration of Her ajesty, for the remission of that part of his sentence hich provided for his imprisonment for life on Robben land, but only upon the condition that he was not return to Natal. His lordship has also advised that e members of the broken up tribe shall be assisted in new start in life as far as circumstances will permit, d that the actual tribal disruption shall be restricted Langalibalele's people, and not extended to any other be which was conceived to have been in sympathy th him in his contumacy. The method by which these commendations of his lordship may be most satisfactorily d most conveniently carried out is still under the con-deration of the authorities. But the ultimate settlement the difficulty will no doubt be considerably facilitated the fact that Sir Garnet Wolseley has been commis-oned to administer the government of the colony, and examine exhaustively into the entire series of circum-ances which have caused the chief danger of Langali-ale's disaffection and resistance. The colonists, not naturally, feel some soreness at the discovery that at they conscientiously believe to have been a very ccessful piece of nipping sedition and rebellion in the d has been looked upon by a considerable party in ngland as an indiscreet, unnecessary, and too severe ercise of authority and power. There can be no ubt, however, that the impressions derived on the ot by an experienced and able administrator should mply suffice to vindicate the good faith and the fair me of the colonists in even these particulars, and that ports to head-quarters from such an administrator ould be all that can possibly be required to make the hole truth clear, and to explain the peculiar difficulties at the colonists of Natal have had to deal with in his grave emergency. Reference to some passages in the recent debate in the House of Lords, shows to me that there are three facts which should on no account e lost sight of. In regard to "the well founded uspicion of Langalibalele's complicity for treasonable ractices with other chiefs having been advanced," it should be remarked that the Secretary for Native Affairs t the Cape asserts officially that "there is no doubt that treasonable overtures were made by the rebel chief, to the chief of the Basutos, which were favourably re-ceived, and which with less prompt action on the part of the Government might have been very disastrous." In reference to the collision at the pass the fact is not simply that "a gun was fired, and that in the fray five valuable English lives were lost," but that the armed men of Langalibalele's tribe deliberately and skilfully took up covered positions behind the rocks, where cavalry could not act, and from those positions fired upon the retreating and unattacking white force, until three of the volunteers and two natives were killed, and according to Major Durnford, until their ammunition was expended. And again it was not because "one of his people, who was at the pass, was with Langalibalele when he was apprehended, that he was conceived to be in the one measure responsible for the death of the white men and their native companions; but rather because Mahudble, who commanded at the pass, and killed the first white man who fell, reported himself subsequently to Langalibalele as having beaten the Government forces, and as having killed his man, and was yet continued by the chief in his position of confidence and command about his person. In reference to Mr. Browning's arithmetical deductions of commercial prospects of Natal, Dr. Mann drew attention to the confirmation afforded by the very interesting and elaborate tabular statement of the commercial progress of the colony during ten years, drawn up by Mr. F. C. Drummond. The white population of the colony was 14,000 in 1863, and only 17,000 in 1873, owing to the influences named by Mr. Bergtheil, and to other circumstances, such as the facilities for passing on from the colony to the districts beyond made attractive by the profits of rude native barter, hunting, diamonds, and gold. Yet during this almost stagnant state of the producing parts of this very limited community, the value of the annual exports in the last seven years of the decennial period had been £203,000, £225,000, £271,000, £363,000, £382,000, £562,000, £622,000, thus amounting to more than three-fold within the seven years; and what is perhaps of still greater moment, reaching the amount with a steadily progressive impulse, that never even flagged from year to year. Mr. Drummond's interesting table also showed that the entire value of trade, including both imports and exports, was £3,000,000 for the ten years preceding 1863, and very nearly £7,700,000 for the ten years including 1863, and following it. The value for the first half of the last decade was £3,071,269, and the value for the last half £4,628,082. The average yearly value for a full period of 20 years was £537,144; but the value for the last year of the 20 was £1,448,049. There could be no possible doubt as to the question of what a rea-sonably and carefully-constructed railway through the heart of the productive district, and to the threshold of other producing lands beyond, might be expected to do for the quickening of this natural growth of material prosperity.

Mr. Bergtheil, having briefly expressed his pleasure at again meeting his old friends, General Bisset, Major Erskine, and the Chairman, of whose services to the colony he spoke very highly, said there was a very general impression that nothing could be done towards civilising the Kafirs, and, as far as the adults were con-cerned, it was probably correct. He thoroughly believed, however, in the education of the young, and was per-suaded that if you could induce a Kafir boy to go regularly to school you could make a good man of him.

The Chairman, in proposing a vote of thanks to Mr. Bergtheil and Mr. Browning, said he thought the colo-nists of Natal might feel considerably gratified at finding that their affairs had occupied the attention of the House of Lords nearly the whole of one evening, and had been discussed by some of the most able statesmen in it, and had again been the subject of attention on the succeed-ing evening in that room. Mr. Bergtheil had very forcibly adverted to the great success that attended his German colonists, who, at the time he (the Chairman) arrived, in 1853, had surmounted their first difficulties; but though he admired the perseverance which had enabled those industrious men to raise themselves from a state of poverty to independence and comparative affluence, he thought there were peculiar circumstances in their case which partly accounted for their success, and felt bound to say that in his opinion Natal was not the place for small men without capital to settle in. A good deal had been said about Kafir law, but it must not be supposed that the inhabitants of Natal were under the administration of a savage code such as that pre-vailing in Ashantee, or as had been administered by Chaka, Dingaan, and Panda, because anything in it which was repugnant to the principles recognised by Christian nations was set aside. General Bissett had referred to the great increase of the native population, and it was, no doubt, the case that though the resident population had increased, as people living peaceably always did, the great bulk of the addition came from the neighbouring territories. This fact was quite enough to show that English rule was not otherwise than beneficent. He should rejoice from the bottom of his heart to see railways commenced in Natal, and eight years ago he recommended the colony to do what he believed they were now about to do—make railways themselves. Without adverting to what had passed in

the meantime, he might say that the Government had now received an offer for the construction of the first section of the main line from Durban to Isipingi and Maritzburg, and from Durban to Verulam, the coast line through the sugar states, and from the seaport to the capital, at prices which he believed they would be justified in accepting, and was therefore in hopes of something being done before long.

The vote of thanks being passed unanimously, a similar compliment was accorded to the Chairman on the motion of Dr. Mann, and the proceedings terminated.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 14th, 1875; Clare Sewell Read, M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Chintamon, Hurrychund, 4, Addison-terrace, Kensington, W.
Francis, George Futvoye, Eaton-chambers, Buckingham-palace-road, S.W.
Hannaford, Charles, 25, Pembroke-square, Kensington, W.
Harper, H. Lewis, M.D., 19, Addison-road, W.
Hayllar, James, 15, Mecklenburgh-square, W.C.
Helton, James, 60, Montagu-square, W.
Hewetson, John, 8, St. James's-terrace, Regent's-park, N.W.
Holden, Caleb, 51, Lupus-street, Pimlico, S.W.
Horton, Captain William, R.N., Livermore-park, Bury St. Edmunds, and 52, Grosvenor-place, S.W.
Julyan, Sir Penrose G., K.C.M.G., C.B., 12, Spring-gardens, S.W.
Kelly, William F., 117, Ladbroke-grove-road, W.
Jackson, Richard Belgrave, F.R.G.S., 16, Addison-terrace, Kensington, W.
Oppenheim, Henry, 17, Park-lane, W.
Pointer, G. H., Cheesehill Brewery, Winchester.
Sherard-Kennedy, Edward, 6, Bedford-gardens, Kensington, W.
Waller, Rev. Horace, Twywell Rectory, Thrapston.

The following candidates were balloted for and duly elected members of the Society:—

Alcock, Sir Rutherford, 14, Great Queen-street, Westminster, S.W.
Bailey, C. Stuart, jun., 10, Harrington-square, S.W.
Bird, Edward, 2, Lawrence Pountney-hill, E.C.
Brown, Alexander Forrester, 53, Gloucester-terrace, Hyde-park, W.
Crowe, Francis, LL.D., F.R.G.S., 22, Westbourne-park-road, Bayswater, W.
Durlacher, Henry, 134, Harley-street, W.
Faija, Henry, 30, John-street, Bedford-row, W.C.
Fenn, Thomas, 14, Bedford-square, W.C.
Fry, Frederick Morris, 14, Montague-street, Russell-square, W.C.
Green, William John, 24, Spring-gardens, S.W.
Holborn, R. M., 11, Highbury-crescent, N.
Kent, Frederick, 8, Red Lion-court, Cannon-street, E.C.
Leeson, Herbert Seymour, 4, Old-square, W.C.
Liggins, Henry, 3, Ladbroke-square, W.
Middleton, Thomas, Springfield, Heath Charnock, near Chorley, Lancashire.
Palmer, T. G. A., 5, Paper-buildings, Temple, E.C.
Parbury, Frederick, 99, Lancaster-gate, W.
Peacock, Joseph, 15, Bloomsbury-square, W.C.
Poynder, William Henry, 21, Upper Brook-street, W., and Hartham-park, Wilts.
Pratt, J. J., Consul-General of South African Republic, 24, Coleman-street, E.C.
Price, Captain George Edward, M.P., 39, Onslow-gardens, South Kensington, S.W.
Riley, Moreton John, 7, Lancaster-place, Strand, W.C.
Stone, John, 5, Bernard-street, Regent's-park-road, N.W.
Woolley, Joseph, M.A., LL.D., Norbiton, Surrey.

The paper read was:—

THE BEST METHOD OF MAKING FIELD EXPERIMENTS PRACTICALLY USEFUL TO AGRICULTURISTS.

By Professor John Wrightson.

The varying conditions of climate, soil, and season, under which agriculture is followed, constitute grave difficulties in the path of those who would reduce its practices to definite rules. The manufacturer can rely on "processes" which, when once perfected, continue to yield uniform results. The agriculturist, on the other hand, is never certain of his results—he can only hope for the best. He has been sometimes spoken of as a manufacturer, but such an expression can only be accepted in a very limited sense. There is, indeed, this important difference between the agriculturist and the manufacturer. The agriculturist merely exercises a guiding influence over the great natural forces of the universe; under his controlling influence vegetative force, heat, light, and moisture, produce a "crop" where, without his interference, a tangled thicket of struggling vegetation would only have appeared. His function is, as it were, to open channels for natural forces to act through, and all is then left to nature. With the shaping, colouring, and finishing of his products he has but little to do. The manufacturer, on the other hand, begins with products, begins, in fact, where the farmer leaves off, and in his hand substances such as wood, skins, or corn, are converted into furniture, leather, and flour.

The agriculturist is indeed a stop nearer than the manufacturer to those vast elementary forces which may be said to produce life, and his pursuit is proportionally fuller of mystery. Is it then strange that the farmer cannot reckon on the processes he employs with the same certainty as the manufacturer? As an example, take the regulation of the heat of a furnace which is capable of sufficient control for the manufacture of some particular metal, and contrast this case with that of the farmer when he requires a certain degree of heat to ripen his wheat crop, and it will be at once seen that the farmer is placed at an immense disadvantage.

This, then, is the nature of the occupation which it is wished to subject to direct experiment, in order that it may be more thoroughly understood, and its practices reduced to rule. Oppressed with a sense of the vastness of such an enterprise, we seem almost inclined to exclaim, "Canst thou draw out Leviathan with a hook?" Or, leaving metaphor, to ask, can the operations of agriculture, conducted as they are on varying soils and in changing seasons, be successfully brought under any rule? Let it be allowed that a large class of farming practices can thus be brought under general rules, yet, if we confine ourselves to the domain of vegetable life, this will be found true only when vital connection with the soil is severed.

So long as the plant grows it is amenable to the varying conditions already mentioned, but

when once it is ripe it may be handled as a product. Hence harvest, haymaking, barn-work, &c., may be carried on uniformly, and the practice of any district may be introduced elsewhere. So also experiments upon processes of fattening oxen, upon improving live stock by systematic breeding, upon cheese and butter making, may be of general application, because in all these cases the material worked upon is cut off from interfering causes. I have, however, confined myself to the subject of "field experiments," and these having essentially to do with the cultivation of growing crops, must be so planned as to encounter the difficulties due to the play of interrupting elements. The fact that agriculturists recommend a certain course of treatment in growing particular crops points to the conclusion that even in crop cultivation rules may be followed. But such agricultural practices are found to vary in every district, and what is viewed favourably in Kent may be scouted in Cumberland. This is exactly what might have been expected when soil, temperature, and rain-fall are so different.

Variations in practice may be noticed in even closely contiguous districts, resulting from differences in altitude, soil, and climate; and to so serious an extent do they affect the success of farming operations, that a stranger may easily conduct his business at a loss, if he refuses to modify his methods according to the experience of the district in which he has settled.

It will be seen, then, that generalisations regarding agricultural practice are very apt to prove inapplicable, and this is why farmers look with distrust at the advice tendered in books and newspapers. Their rejoinder after perusing such advice is usually, "Ah well, that wouldn't suit our country." This very usual verdict should be instructive to us, indicating as it does clearly enough where the shoe pinches. The farmer is right, and instead of adopting novel practices which, probably, answer very well fifty or a hundred miles off, he confines his consultations to his neighbours and brother farmers, and his own market "ordinary." There deep and mysterious difficulties are discussed, and theories are advanced to account for failures of crops, blights, outbreaks of disease, and the host of difficulties which beset the tiller of the soil. There also he hears of advantageous changes of seed, of new and prolific varieties of cultivated plants, of useful artificial manures, and improved implements; and all this from men subjected to the same general external conditions as himself. Once more I beg to insist upon the local character of the interest of these discussions. Publish them in the agricultural newspapers and they lose much of their value, because farmers who read such accounts are aware that when the conditions are different, the result will probably be different also.

Without in the slightest degree defending agriculturists for disregarding the literature of their subject, which is, I think, a serious drawback to their progress, I recognise a principle of action in this partiality to local sources of information. When I take up a journal of the Royal Agricultural Society, and read that Mr. A. obtained a result from using potash salts on clover, or nitrate of soda on wheat, in some county remote from my own, I read with languid interest. But when I meet my neighbour, and ask his practical opinion on this subject, I am swayed strongly by his answer. Unfortunately his answer is too often of an uncertain character, and seems to be lacking in positiveness. I say, then, can we not obtain a rational consensus of opinion supported by direct experiment, and applicable to the particular district where the trial is made?

To prove that this can be done, and that it is of immense importance that it should be done, are the objects which have brought me before you this evening.

I shall confine myself to experiments upon growing "crops," because, as already explained, it is the growing plant which is subject to the greatest variety of external conditions. An investigation upon the relative feeding values of wheat and barley might be considered generally applicable to practice throughout the country; but the result of a certain dressing upon young wheat would possess a more purely local interest.

Before explaining a plan for realising the advantages of field experiments to the farmer, there are two points upon which I must say a few words. First, as to the nature of these experiments. A London audience associates with the idea of experiments, certain striking phenomena, such as the instant dissipation of silver wire by means of a strong electric current, or the production of blue sky in a tube under the masterly direction of Professor Tyndall. Naturally, therefore, an agricultural experiment might be expected to illustrate in some striking manner the process of germination, or the formation of vegetable cells. Such is, however, not the correct idea of an agricultural field experiment as understood this evening. It is a mere trial, and that perhaps with no very definite scientific truth in view, but rather a commercial one. How am I to grow the heaviest crop of corn? We say try the various methods recommended, and by the result judge which is fitted to your particular soil. A field experiment then means that the soil is requested to inform you which process suits it best. Three or more processes are submitted to trial, and the one which produces the largest weight per acre is considered to be the best. It is most important in catechising Nature that she should only be asked simple categorical questions, which may be answered, "Yes" or "No." In other words the conditions must be similar, except in some one point. Thus, on the same land, with the same seed, with similar preparation, and upon the same day, but with two different manures, I obtain two results. Here is a result—*cæteris paribus*—and the difference is due to the manures. To obtain this similarity of conditions is the great difficulty to be overcome in conducting this class of experiments, because it is almost impossible to be sure of the uniformity of the surroundings. It is this which makes repetition of importance, as no one agricultural field experiment is conclusive. If the result is slightly better on one plot than another, it may be objected that the land was probably a shade better than upon the rival inferior plot. Two plots, at least, are then necessary, and abundant repetition with a uniform result is the only way of obtaining trustworthy *data*.

Duplicate plots are, however, vexatious. No doubt when a paper is published upon the comparative merits of several manures, duplicate plots some

times introduce an element of confusion. One of them says "Yes," and the other says "No." This is annoying, and the troublesome duplicates are for the future omitted. The cause of truth is scarcely served in this way, for it must be remembered that, although duplicate plots sometimes neutralise each other's testimony, on the other hand, when they corroborate each other the testimony is greatly increased in value. Repetition is not only requisite during one season, but over several seasons, so that we may know the effects not only of soils, but seasons upon any particular point of practice.

In the next place, I wish to make a few remarks upon agricultural experiments as conducted in England up to the present time. It is above thirty years since Mr. Lawes, of Rothamstead-park, Herts, first commenced to make such experiments, assisted by Dr. Gilbert, with whom he has worked ever since. Liebig's work on agricultural chemistry had appeared four years previously, and Boussingault had been at work for years on his farm at Bechelbron. Mr. Lawes enthusiastically entered into the noble work of elementary agricultural chemistry by direct experiment. In a paper communicated to the Royal Agricultural Society's Journal for 1848, he deplores that so little is actually known upon the theory of agriculture. "Ask the most experienced farmer to explain the principles which govern the routine he is daily in the habit of practising? Ask him to determine the value of any rotation of crops, or their comparative exhausting powers? Ask him what ingredients must be restored to the soil to keep its fertility unimpaired? or the exact manner in which climate influences his produce? His answers will be vague and unsatisfactory." The above and numerous other important questions have been worked out with great success at Rothamstead. All that intellect, special knowledge, zeal, and money could accomplish has been realised, and the result has been a most noble triumph over difficulties. The power of manufactured fertilisers to keep up and increase the fertility of land; the effect of repeated applications of special manures in affecting the predominance of certain herbaceous plants and grasses; the effect of season upon the yield of wheat and other cereals; the residual effects of manures upon a series of crops, both in the case of ordinary rotations and of consecutive corn-growing; the cumulative effects of manure applied year after year to the same land; the effect of manure and cultivation upon the subsoil; the composition of drainage water from manured and unmanured soils; the relative feeding properties of different breeds of domestic animals; the composition of oxen, sheep, and pigs in both a lean and a fat state; these and other important questions have been exhaustively treated at Rothamstead. But a difficulty is ever present in the case of the field experiments, which may be briefly put as follows:—What guarantee have we that the Rothamstead results would be corroborated elsewhere? Mr. Lawes's wheat-field, now supporting its thirty-first consecutive crop, under a great variety of treatments, each followed out upon a particular section of the field, is a wonderful spectacle. Doubtless it teaches many other lessons besides those which will be seized upon by money-making farmers as of practical usefulness. But I doubt very much whether the general result of a successful wheat cultivation, year after year on the same land, would be obtained were the treatment of this field repeated in various parts of England. Rothamstead has yielded results of great practical value to agriculturists; but frequently the investigations conducted there bear more directly upon questions of vegetable and animal physiology than upon ordinary and immediate practice. The very idea of wheat after wheat repeated year after year is repugnant to farming instincts; the dressings applied are confessedly heavier and more expensive than a farmer would be warranted in applying; rotations are in many cases ignored, and the economic question is, very properly, sunk when the search is not after an economic result, but after the clue to some mystery connected with the nutrition of plants. I trust I am not understood to be adversely criticising the Rothamstead experiments. Far from that; I am a constant and devoted admirer of them, but they are wanting in practical adaptability to the cultivation of the country generally, and I think there is room for a second less abstruse, less captivating, perchance, to the purely scientific man, but more practical system of conducting field experiments. Could we have a Rothamstead in every county, and—what would be less easy to obtain—men of the public spirit and genius of Mr. Lawes and Dr. Gilbert at the head of each, much might be done, but such hopes are too bright to be ever realised.

As to other field experiments, the Royal Agricultural Society pays a yearly grant to its eminent chemist for purposes of investigation, and part of this is devoted to conducting field experiments, which are duly reported in the journal of the Society. Dr. Voelcker has, during the last few years, conducted such experiments simultaneously in different parts of the kingdom; but, although fully concurring in the principle of simultaneous trials, the localities appear to me often too widely separated to furnish fairly comparative results. Thus I find that experiments with manures upon permanent pasture were conducted in Gloucestershire, Durham, and Berwickshire, counties in which soil and climate must have varied widely. It is, therefore, scarcely a matter for wonder that the results should have scarcely been comparable. Take, for instance, the effect of bone-dust, usually considered an admirable dressing for grass. In the Durham series the result was unfavourable to its use, but I would ask is this likely to deter farmers from applying bones in remote districts? On the other hand, if under the auspices of such a wealthy and influential body as the Durham University, a series of experiments had been conducted in the County Palatine upon the effect of bone-dust as a manure for pastures, would not the result have been a most useful guide to the practical farmers of that particular district?

Various other experiments upon the relative value of manures and field processes have been made by energetic agriculturists, but, as already stated, their utility to farmers throughout the country is open to doubt. It is confined to the locality, and perhaps even to the farm on which the trial took place, and the publication chiefly serves as a means of keeping public attention directed to an important subject.

The scheme which I have the honour of propounding to-night cannot boast of any striking originality, but it claims to be thoroughly practical, and to have undergone the test of trial for several years in the neighbourhood of Cirencester. It may not be so suitable for rigid and scientific investigation as the system pursued at Rothamsted. But even if it be held to take a somewhat lower position with regard to the whole problem of agricultural chemistry, it must be allowed to be well calculated to stir farmers up to a sense of the value of definite and properly regulated trials.

This scheme is expressly designed to meet the objection so constantly made against field experiments—that they are not applicable to any other situations than those on which they have been tried. It is based upon the agricultural opinion of the neighbourhood, and practical suggestions are received and acted upon by a working committee. We commenced in 1868 by forming an experimental sub-committee of the Cirencester Chamber of Agriculture, and our first results were communicated by me to the Journal of the Royal Agricultural Society, in the volume for 1870. It was not, however, until the years 1873-4, that the scheme became in any sense mature, and there is still abundant room for both improvement and extension. The plan which we adopt is as follows:—The committee meet and decide upon the course of experiments to be tried. A circular is then sent to each member of the chamber, embodying the recommendations of the committee, and asking for the co-operation of the members in carrying them out. Upon the receipt of the answers, a second circular is addressed to those who are wishful to try the experiments, informing them that proper manure, &c., will be forwarded to them in a few days. Previously we had secured the co-operation of Messrs. Proctor and Ryland, of Birmingham, who undertook to weigh, bag, label inside and out, address, and forward to the experimenters the proper manures. At the same time samples for analysis were forwarded to my colleague, Professor Church. In some cases we prepare the manures for experiments ourselves at the college, and send them out in time to meet those coming from Birmingham. Each agriculturist wishful to co-operate at the same time receives an invoice of the manures sent to him.

It is of the utmost importance that uniformity of treatment should be secured throughout, and with that end in view we undertake the whole work of laying out the experimental plots, sowing the seed, and manuring the land. We also, in the autumn, weigh the crops on every plot, and all results are forwarded to me in order that they may be tabulated and compared. For these purposes an intelligent man, capable of measuring out plots and undertaking the work of manuring and weighing, is required, and this is one of the most serious expenses to be incurred. In our case this man is in constant ordinary employment upon the college farm, and we only pay him for the time during which we employ him. A second desideratum for experiments on roots is a drill for sowing. With the assistance of the Messrs. Reeve, of the Bratton Iron Works, a water-drill was designed suitable for our purpose. The two dredging-wheels work in narrow grooves, and at the lowest points of their grooves are removable screw-plugs, which at once allow any residue of manure to be swilled out with a little clean water. By means of this drill the last particles of manure may be washed from the drill and distributed over its proper plot. It is perhaps unnecessary here to go further into details as to the method pursued. The drill-man appears on a particular farm, according to due notice, with water-drill, seed, measuring-chain, wooden stakes, &c., and at once proceeds to mark out his land, drive in the stakes at the corners of the plots, and to sow his manures and seed, making at the same time a plan of the plots. I use post-cards, with a printed notice on the back, informing the experimenters that at a certain day and hour, if convenient, the drill-man will be with them, and that he will require a specified amount of assistance.

When all the farms have been visited and sown, our work is finished until November and December, when a post-card is once more sent round with a notice of the day fixed for weighing, and, this accomplished, tabulating and drawing up of the report concludes our labours.

In all our experiments we steadily keep in view the two principles of repetition and control. Repetition is secured first by insisting upon duplicate plots being always provided in each series—a most necessary precaution—and, secondly, by trying the same series on a number of farms, and through a succession of seasons an immense mass of confirmatory evidence is educed. In the same manner control is insured, as the experiments upon various farms bring out results which vary considerably, and save us from rushing to hasty conclusions. I attach great importance to the duplicate plots. It sometimes happens that they contradict each other; but how much better is it for the cause of science that this contradiction should take place, than that either of the results should have been taken and a false lesson been promulgated.

In other cases they agree not only with each other, but with the results obtained upon neighbouring farms, and when this is the case a strong chain of evidence is forged.

Presently I shall direct the attention of the meeting to some of the facts which we have demonstrated with regard to root cultivation; but I wish to state strongly that this system must not be considered to rest its claim for support on what has been already done; rather upon the fact that by simultaneous action we have the means of arriving at a definite result applicable to a neighbourhood, and, this being the case, the way is open for experiment in any possible direction.

Hitherto we have devoted ourselves for the most part to manuring root and corn crops, but, to my mind, there is a wide field for such like investigations. The principle is that of united action. If, then, it is desirable to test any point of agricultural practice—as, for example, the superior merits of some new forage crop, or of some newly-brought-out variety of barley, wheat, clover, or potato, in fact, of any plant—here is the requisite machinery. Supposing a new system of cultivation to be recommended, or a new fertiliser advocated, this surely is the rational method of testing its merits. Instead of a loose *on dit*, a committee such as I have described, in conjunction with its clients, would soon place on record results of immense value in their locality.

It is, however, quite clear to my mind, that such agricultural experimental stations should be established in every district, because the results obtained in one part of the country are no guide to farmers at a distance. It would, indeed, be a noble work, and one which this great Society might well espouse, to establish experimental centres all over the country. I have sometimes been told, "you are in an exceptional position in Cirencester. There is the college, with its scientific staff and laboratories, and this gives you an advantage over other districts." Over some, I grant, but not over all. Take, for example, the case of the Midland Farmers' Club meeting in the great town of Birmingham; the Farmers' Club in London; the Newcastle Farmers' Club in the north, or any other agricultural society whose head-quarters are situated in a manufacturing or commercial centre. Supposing such a society to think favourably of this scheme, what is to prevent them forming a committee to arrange a set of experiments suitable to the wants of their district? A good analytical chemist can always under these circumstances be found who would be willing to give his advice and assistance in forwarding so good a work. An active secretary to record the wishes of the committee, send out the requisite circulars, fix days, communicate with manure manufacturers, and tabulate and report results would in many cases be found among the younger agriculturists of the district. A little money would also be required to purchase manures, drill, seed, &c., and a man must be found to go from farm to farm, and both apply manure and afterwards weigh the crops. I believe every district possesses men competent, with a little training, for this work; and could a leading farmer let one of his good men go out on such a mission when required, and of course be paid for his time, then this difficulty would be met. The importance of money should never be lost sight of; but wherever there is a Chamber of Agriculture there are means for beating up subscriptions and donations among the landowners and friends of agricultural progress generally. From our own experience, I venture to say, that for £70 a-year, a very good series of experiments might be undertaken.

The second problem which I set myself to prove was that it is of immense importance that experiments should be tried. I believe this is necessary on account of an objection which may be at once raised as to their value. This objection is thus raised by Dr. Voelcker in introducing his report on field experiments on root crops, 1868:—

"But after all, it may be asked, what information is gained by such experiments that cannot be obtained far more economically and rapidly in nine cases out of ten by the careful analysis of the different artificial manures? The time fortunately, has now passed when the action of manures and the functions of the soil and the atmosphere in relation to plant life were shrouded in impenetrable mystery."

With all respect to the deservedly eminent authority who penned the above I must look a little closely into this sentence. Why, if the above expresses his view, does Dr. Voelcker not give up field experiments altogether, and give his opinion of a manure according to its chemical composition? But I hold that analysis can only illustrate the results obtained in the field. Field results really lie at the foundation of all our knowledge regarding fertilisers, and if a substance is found to improve a crop that is a fundamental fact. If analysis reveals the presence of some particular ingredient you have some reason for drawing an inference as to the cause of the beneficial action, but, so long as the benefit is an ascertained fact, chemistry is merely its exponent. But you cannot, even after analysis, say that this manure will, at all times and in all places, be of value; and that is why your field experiments must be repeated constantly, whereas your analysis once made is definite and constant. Take as an instance Peruvian guano. Three times out of four this manure will grow the best crop of roots when compared with any other manure in Northumberland. If the same guano were tried on the Cotteswold hills it would, very likely, compare unfavourably with any other manure. How then can chemical analysis help us here? Again, take bone-dust or half-inch bones. In Cheshire and Yorkshire, and other parts of England, bones have been found the best possible manure for grass, and yet Dr. Voelcker himself, in reporting upon experiments on permanent pasture in Durham county says, "Bone-dust did not appear the most suitable manure (it had, on the whole, given a worse crop than the unmanured plots) for the field upon which the experiments were tried. This is not the first time that I have found bone-dust inefficacious as a manure for permanent pasture." This being the case, I should like to know how you, as agriculturists, are to ascertain if you would be justified in distributing money over your fields in the shape of bone-dust? If you consult an agricultural chemist as to the best manure for worn-out grass land, ten to one but he will recommend phosphates in some shape. But it is evident that soil and climate come into play here, and that a serious mistake may be readily made. Again, I could produce satisfactory evidence that while some land will respond to heavy dressings, of say 10 to 15 cwts. of mixed artificial manures, other soils are amply satisfied with 3 cwts., and larger quantities are wasted upon them.

Another case in point is that of common salt as a dressing for mangel wurzel. Mr. Lawes, on the whole, pronounces against its use, whereas plenty of experiments might be produced to show that crops have been greatly increased from its use. From the foregoing cases it is evident that not only the manure, but the land and climate must be taken into account, and that experiments to be practically useful should be carried out in the district where they are intended to guide the practice of agriculturists.

Turning to the results obtained on the Cotteswolds during last season, I must first observe that, considering the exceedingly droughty nature of June and July, the wonder is that we obtained any results at all. Twenty agriculturists were sent out. The tabulated results are before the meeting, and in briefly pointing out their leading features, I will first ask your attention to the nature of the dressings employed. The mineral superphosphate contained, according to Professor Church's analysis, an amount of mono-calcic, or soluble phosphate, equivalent to 27¾ per cent. of bone earth made soluble. It was introduced into the series, not so much to prove its efficiency

as a manure, which was undoubted, as to furnish a basis for comparison with other manures. Unmanured plots were also reserved with much the same object, so that any manure, or mixture of manures, might be compared with ordinary superphosphate plots as well as with those which received nothing. Nitrate of soda, of great purity, containing 97 per cent. of the pure salt, was in the next place mixed with superphosphate at the suggestion of a member of the Chamber, who was in the habit of using such a mixture. Experiments in 1873 with ordinary guano had convinced us that, used alone, it was too strong for the seed, destroying its vitality, although subsequently it acted favourably upon the surviviug plants. We also had learnt that this injurions effect upon the seed was exerted less powerfully by Schröder and Company's dissolved guano, as also by ordinary guano when mixed with superphosphate. We accordingly relinquished ordinary guano, and even dissolved guano used alone, and employed mixture 3, on the left-hand column of the tables, namely, 2 cwts. of the dissolved guano and 3 cwts. of superphosphate. In order to make sure work, we applied this mixture in two different ways; first, by drilling it as a mixture; and secondly, by drilling the superphosphate with the water drill, and applying the guano broadcast over the land. This course was taken on account of the tendency to destroy the seed exhibited, even by dissolved guano on our land. It was thought that the superphosphate would start the plants, and the guano scattered over the surface would continue to nourish them in their later later stages of growth. Reference to Table IV, where the number and weight of the plants grown per acre are given, will show how completely the plan adopted saved the seed from destruction. In every case except two (and of these two I must speak again), the plots on which the guano was sown separately from the superphosphate bore a large excess of plants when compared with the plots on which both manures were drilled together with the seed. The result per acre was, however, very nearly the same in both cases, which I account for by the dry summer preventing the distributed guano from finding its way to the roots. I cannot help thinking that had the season been more propitious for the growth of roots we should have had a larger yield on the plots upon which the dissolved guano and superphosphate were applied separately.

Taken in connection with our other trials, another explanation is also possible. Our land does not respond to heavy dressings, and on this principle the 3cwt. of superphosphate might have satisfied its requirements. If this is the case, and since this plan of sowing prevented the destruction of the seed, it is possible that upon more responsive land a considerable increase in yield per acre would have followed the use of this particular mode of manuring.

Returning to mixture No. 2, where superphosphate and nitrate of soda were combined, it will be seen that the general average result over the eight sets showed a sad falling off in comparison with superphosphate alone. Further, notice how serious is the reduction of crop on Messrs. Maurice's, [illegible]'s, Brain's, and Hawkins's plots. A glance at Table IV. reveals the cause of this diminution in the effect produced in every case upon the number of plants per acre. The same result, only in a less degree, had been observed in the hot season of 1873, but no doubt the dry time of 1874 greatly increased the evil.

Next, I must ask your attention to the fifth combination, in which superphosphate, nitrate of soda, potash salts, and organic matter, supplied in the form of pollards and bran, were used. The object of this mixture was to add organic matter and nitrogen to a mineral superphosphate, so as to imitate the chemical composition of a bone superphosphate. It did not suit the swedes, but it became exceedingly interesting as supporting the conclusion come to regarding the nitrate of soda and superphosphate mixture. A still further reduction in weight per acre (see Tables II. and III.) of plants per acre (see Table IV.) fully bear out the result just noted. Here is, however, another very striking fact, for, on a more minute inspection of the table, it will be seen that there are two farms, those of Mr. Arkell and Mr. W. J. Edmonds, of Southrop, which yielded exceptionally good crops on the plots manured with mixture 5. Still further, you will notice that these two farms are the identical two upon which the nitrate of soda and superphosphate (mixture 2) gave exceptionally good results; so that it appears that the disastrous effect produced in the other cases by the addition of nitrate of soda was not felt on these soils, and on looking to Table IV., this is fully accounted for by the number of plants being exceptionally high on these farms in plots manured with mixtures 2 and 5. Further on once more, looking on the results from dissolved guano, in conjunction with superphosphate, these same two farms seem not to have been injuriously effected by the presence of a highly nitrogenous and organic manure. The evidence is, I think, irresistible, because it is borne out and supported in the case of the two farms by no fewer than six plots in each case. The conclusions I arrive at are of high importance. First, I think we proved by the general average of series as well as by a majority of them, that the addition of nitrogen and organic matter was, on the whole, injurious to the swede crop in our district during the hot and dry season of 1874; secondly, the experiments proved that on two soils this evil effect was not felt, but that a beneficial action was induced. This proves to my mind the use of repeating a set of experiments upon many farms in order to obtain a general result of practical value, and also the actual need of every farmer becoming an experimenter upon the wants of his own particular soil.

Patent bone phosphate is prepared from sewage, and all I have to say regarding it is that it yielded a somewhat small, but, considering its price (£4 per ton), a satisfactory increase over unmanured plots. The return from the use of this fertiliser is also characterised by considerable uniformity.

Next as to the general effects of the manure. These experiments of 1873-4 have clearly shown that in our district the character of the land and its agricultural condition exert a very positive effect upon the increase from the use of any manure whatever. This is a strong point in favour of our particular systems of experimenting. I must say it has

taken me by surprise, and that it is a blow to the utility of isolated series of experiments. In both seasons we have met with farms upon which manured plots actually gave a lower yield than unmanured ones. Such a case is that of Mr. Hawkins, of Oaksey, who obtained nearly 13 tons of roots without artificial manure, and in nearly all cases where manures were used a less weight. Contrast this with the Rev. T. Maurice's experiments, or with those obtained at Dean Farm, or Southrop, where it will be seen that the entire crop appears to be due to fertilisers; the average unmanured plots in these cases ranged from 1 ton 7 cwt. to 2 tons, and 2 tons 5½ cwt., whereas superphosphate and other manures brought up the yield to 12 and even 15 tons per acre. Between these extremes there are many degrees, and it is worthy of remark that in 1873, the same varied effect from the use of fertilisers in general was observed. The conclusion we have come to is, that land in high agricultural condition will not in our district answer to extra importations of artificial manures, but that land in low condition is greatly benefited by their use. It has long been known that for conducting agricultural experiments poor land is best, because it pronounced a more distinct answer regarding fertilisers; but to the money-making farmer it is of importance that this lesson should be brought home, when he has to decide as to the purchasing of artificial manure.

From the foregoing remarks it will be noticed that experiments conducted upon the principle explained furnish results from which two principles may be educed. The first is that a general lesson may be learnt by means of evidence which extends harmoniously throughout the series; the second, that there is at the same time a valuable but consistent disagreement owing to differences in the soil, which is equally valuable, as it must invite individual farmers to become experimentalists.

If we have established the principle that experiments may be made to carry with them a uniform lesson extending through the series, that is all I contend for. The results already obtained may be of secondary importance, but that is no reason why a series should not be planned which would bring out facts of numerous first rate consequence.

We are now engaged in testing Mr. Cobbett's acclimatised Indian corn as a crop for our hills, and several members have sown barley at double the usual interval, and with half the usual quantity of seed, in order to test the efficiency of wide drilling, and their seeding on their crops. Our root experiments will embrace a trial of several sewage products, and with these additions to our programme we hope in the course of the season to obtain results useful, at least, to our own locality.

TABLE I.—GENERAL RESULT OF EXPERIMENTS ON TOP-DRESSING WHEAT, UNDERTAKEN BY MEMBERS OF THE CIRENCESTER CHAMBER OF AGRICULTURE, 1874.

Bushels per Acre calculated at 62 lbs. per Bushel.

Dressings per Acre.	Rev. T. Maurice, Harnhill.	R. A. College.	Mr. Playne, Chalford.	Mr. W. J. Edmonds, Southrop.		
	Bushels.	Bushels.	Bushels.	Heads. Bushels.	Tail. Bushels.	Total Bushels.
1.—Nitrate of Soda 1½ cwt.	40·6		30·7	35·2	1·1	36·3
				37·6	2·0	39·6
	Average. 40·6		Average. 30·7	Average. 36·4	Average. 1·5	Average. 37·9
2.—Nitrate of Soda 1 cwt.	46·8	33·8	26·0	38·3	1·7	40·0
		32·0		38·7	1·3	40·0
	Average. 46·8	Average. 32·9	Average. 26·0	Average. 38·5	Average. 1·5	Average. 40·0
3.—Sulphate of Magnesia 1 cwt.......	35·5	34·5	26·3	33·5	1·1	34·6
	43·0	31·3		39·3	1·7	41·0
	Average. 39·25	Average. 32·9	Average. 26·3	Average. 36·4	Average. 1·4	Average. 37·8
4.—Sulphate of Magnesia 1 cwt., Nitrate of Soda 1 cwt.	43·5	32·0	29·0	35·8	1·5	37·3
	38·7	33·2		37·0	2·0	39·0
	Average. 41·1	Average. 32·7	Average. 29·0	Average. 36·4	Average. 1·7	Average. 38·1
5.—Unmanured......................	32·2	33·8	26·8	38·3	1·7	40·0
	39·6	34·2	28·8	40·0	1·7	41·7
	Average. 36·0	Average. 33·5	Average. 27·8	Average. 39·1	Average. 1·7	Average. 40·8

General Result of Experiments upon Swedes, 1874, undertaken by Members of the Cirencester Chamber of Agriculture.

TABLE II.—SHOWING WEIGHT PER ACRE FROM VARIOUS DRESSINGS.

Dressing per Acre.	Earl Bathurst, Oakley-park.	Rev. T. Maurice, Harnhill.	Mr. B. Parson, Coates.	Mr. Arkell, Dean Farm.	Mr. W. J. Edmonds, Southrop.	Mr. Stevens, Ranbury.	Mr. Brain, Quennington.	Mr. Hawkins, Oaksey.	Average of the Eight Sets.
	T. cwt. lbs.	T. cwt. lbs	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.
1.—Mineral Superphosphate 3 cwts. per acre	10 9 72	10 0 0	12 14 32	11 10 100	10 16 28	9 13 44	10 18 84	13 9 52	
	10 13 4	9 3 44	12 14 12	14 1 108	11 5 60	9 17 76	10 10 0	11 6 28	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	10 11 38	9 11 78	12 14 22	12 16 48	11 0 100	9 15 60	10 14 42	12 7 96	11 4 4½
2.—Mineral Superphosphate 3 cwts., and Nitrate of Soda 1 cwt.	10 17 56	6 14 32	10 5 40	14 8 64	12 3 44	6 0 10	8 19 72	10 10 40	
	11 18 104	8 15 60	10 10 0	11 16 108	13 3 4	5 9 12	7 0 0	11 0 100	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	11 7 109	7 14 102	10 7 76	13 2 86	12 13 24	5 14 67	7 18 99	10 15 70	9 19 50½
3.—Mineral Superphosphate 3 cwts., Dissolved Guano 2 cwts., drilled together.	12 10 0	11 18 104	12 13 24	15 4 32	11 18 84	8 11 48	11 6 108	11 5 80	
	12 18 84	10 7 56	15 0 0	15 12 36	12 2 76	12 16 28	9 16 8	10 9 72	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	12 14 42	11 3 24	13 16 68	15 8 34	12 0 80	10 13 94	10 11 58	10 17 76	12 13 14
4.—Mineral Superphosphate 3 cwts., Dissolved Guano 2 cwts., sown broadcast separately	13 3 4	8 18 84	12 11 108	14 8 84	13 1 8	10 1 28	10 9 32	12 14 72	
	12 0 80	10 18 24	14 5 0	15 6 108	12 17 16	10 8 24	11 0 0	12 19 72	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	12 11 98	9 18 54	13 8 54	14 17 96	12 19 12	10 4 82	10 14 72	12 17 16	12 16 18
5.—Mineral Superphosphate 3 cwts., Nitrate of Soda 1 cwt., Organic Matter ½ cwt., Potash Salts ½ cwt.	10 13 84	10 5 0	10 0 0	13 14 72	10 18 84	3 15 0	8 5 20	9 10 0	
	7 6 88	7 9 12	9 10 80	15 18 4	11 16 16	8 18 84	6 13 64	5 2 96*	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	9 0 30	8 17 6	9 15 40	14 16 38	11 7 50	6 6 98	7 9 42	7 6 48	9 7 44
6.—"Patent Bone Phosphate" 3 cwts.	9 7 56	5 4 92	12 0 0	9 12 16	7 2 76	7 9 32	7 0 80	13 10 40	
	8 13 4	7 17 96	10 3 44	8 10 60	7 18 4	7 1 88	8 14 72	12 6 8	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	9 0 30	9 11 38	11 1 78	9 1 38	7 10 40	7 5 60	7 17 76	12 13 24	8 18 34
7.—Unmanured Plots	6 8 84	2 1 8	10 8 44	2 9 92	2 1 88	3 5 0	3 14 52	11 8 4	
	5 11 28	0 14 36	4 10 20	2 1 8	2 0 0	3 7 56	8 10 0	14 9 12	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	6 0 0	1 7 78	7 9 32	2 5 50	2 0 100	3 6 28	6 2 26	12 18 64	5 3 89½

* This Plot was re-sown—hence a large number of roots and little weight per acre.

TABLE III.—SHOWING INCREASE OVER UNMANURED PORTIONS PER ACRE.

Dressings per Acre.	Earl Bathurst, Oakley-park.	Rev. T. Maurice, Harnhill.	Mr. E. Parson, Coates.	Mr. Arkell, Dean Farm.	Mr. W. J. Edmonds, Southrop.	Mr. Stevens, Ranbury.	Mr. Brain, Quenington.	Mr. Hawkins, Oaksey.	Average increase in the Eight Sets over unmanured Plots.
	T. cwts. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.	T. cwt. lbs.
1.—Mineral Superphosphate 3 cwts. per acre	4 9 72 4 13 4 Average. 4 11 38	8 12 34 7 15 78 Average. 8 4 0	5 5 0 5 4 92 Average. 5 4 102	9 5 50 11 16 58 Average. 10 10 110	8 15 40 9 4 72 Average. 9 0 0	6 7 16 6 11 48 Average. 6 9 32	4 16 58 4 7 86 Average. 4 12 16	+0 10 100 —1 12 36 Average. —0 10 80	6 0 27
2.—Mineral Superphosphate 3 cwts., Nitrate of Soda 1 cwt.	4 17 56 5 18 104 Average. 5 7 109	5 6 66 7 7 94 Average. 6 7 24	2 16 8 3 0 80 Average. 2 18 44	12 3 14 9 11 58 Average. 10 17 36	10 2 56 11 2 16 Average. 10 12 36	2 13 94 2 2 94 Average. 2 8 39	2 17 46 0 17 86 Average. 1 16 66	—2 8 24 —1 17 76 Average. —2 2 106	4 15 78
3.—Mineral Superphosphate 3 cwts., Dissolved Guano 2 cwts., drilled together	6 10 0 6 18 84 Average. 6 14 42	10 11 26 8 19 90 Average. 9 15 58	5 3 104 7 10 80 Average. 6 7 36	12 18 94 13 6 98 Average. 13 2 90	9 17 96 10 1 88 Average. 10 19 92	5 5 20 9 10 0 Average. 7 7 66	5 4 82 3 13 94 Average. 4 9 32	—1 12 96 —2 8 4 Average. —2 0 100	7 9 36½
4.—Mineral Superphosphate 3 cwts., Dissolved Guano 2 cwts., sown broadcast separately	7 3 4 6 0 80 Average. 6 11 98	7 11 6 9 10 59 Average. 8 10 88	5 2 76 6 15 80 Average. 5 19 22	13 3 34 13 1 58 Average. 12 12 46	11 0 20 10 16 28 Average. 10 18 24	6 15 0 7 1 108 Average. 6 18 54	4 7 6 4 17 86 Average. 4 12 46	—0 3 104 +0 1 8 Average. —0 1 48	7 12 40½
5.—Mineral Superphosphate 3 cwts., Nitrate of Soda 1 cwt., Organic Matter ½ cwt., Potash Salts ½ cwt.	4 13 84 1 6 88 Average. 3 0 30	8 17 34 6 1 46 Average. 7 9 40	2 10 80 2 1 48 Average. 2 6 8	11 9 22 13 12 66 Average. 12 10 100	8 17 96 9 15 28 Average. 9 6 62	0 8 84 5 12 56 Average. 3 0 70	2 2 106 0 11 38 Average. 1 7 16	—3 8 64 —7 15 80 Average. —5 12 16	4 3 66½
6.—"Patent Bone Phosphate" 3 cwts.	3 7 56 2 13 4 Average. 3 0 30	3 17 14 6 10 18 Average. 4 13 92	4 10 80 2 14 12 Average. 3 12 46	7 6 78 6 5 10 Average. 6 15 100	5 1 88 5 17 16 Average. 5 9 52	4 3 4 3 15 60 Average. 3 19 32	0 18 54 2 12 26 Average. 1 15 50	+0 12 88 —0 12 56 Average. —0 0 40	3 14 66½
7.—Unmanured	(6 0 0	1 7 78	7 9 32	2 5 50	2 0 100	3 6 28	6 2 26	12 18 64)	

TABLE IV.—NUMBERS AND WEIGHTS OF SWEDES PER ACRE.

Dressings per Acre.	Earl Bathurst, Oakley-park.	Rev. T. Maurice, Harnhill.	Mr. E. Parson, Coates.	Mr. Arkell, Dean Farm.	Mr. W. J. Edmonds, Southrop.	Mr. Stevens, Ranbury.	Mr. Brain, Quennington.	Mr. Hawkins, Oaksey.	Average of the Eight Sets.
	No. lbs.	No. lbs.	No. lbs.	No. lbs.	No. lbs.	No. lbs.	No. lbs.	No. lbs.	No. lbs.
1.—Mineral Superphosphate 3 cwts.	724 1·62	881 1·27	853 1·66	869 1·4	911 1·33	640 1·7	784 1·5	673 2·2	
	649 1·82	858 1·25	827 1·76	787 2·0	942 1·33	716 1·5	758 1·5	651 1·9	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	686 1·7	870 1·26	840 1·6	828 1·7	926 1·33	926 1·6	771 1·5	661 2·0	813 1·6
2.—Mineral Superphosphate 3 cwts., and Nitrate of Soda 1 cwt.	650 1·87	758 0·92	635 1·81	786 2·1	748 1·15	409 1·6	695 1·4	534 2·2	
	694 1·91	544 1·8	587 2·0	739 1·8	859 1·7	482 1·2	538 1·4	574 2·1	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	672 1·89	651 1·3	611 1·9	762 1·9	803 1·76	446 1·4	616 1·4	554 2·15	639 1·7
3.—Mineral Superphosphate 3 cwts., Dissolved Guano 2 cwts., drilled together	637 2·2	668 2·0	653 2·17	776 2·2	836 1·6	429 2·2	636 2·0	534 2·3	
	651 2·2	642 1·8	777 2·16	786 2·2	911 1·48	754 1·9	494 2·2	670 2·0	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	644 2·2	655 1·9	715 2·16	781 2·2	873 1·5	591 2·0	565 2·1	552 2·15	672 2·0
4.—Mineral Superphosphate 3 cwts., Dissolved Guano 2 cwts., sown broadcast separately	772 1·9	850 1·17	812 1·7	903 1·8	805 1·8	745 1·5	668 1·7	570 2·5	
	743 1·8	956 1·27	798 2·0	799 2·15	888 1·6	632 1·8	673 1·8	667 2·2	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	757 1·85	903 1·23	805 1·8	851 1·9	846 1·7	688 1·65	670 1·75	618 2·35	767 1·8
5.—Mineral Superphosphate 3 cwts., Nitrate of Soda 1 cwt., Organic Matter ½ cwt., Potash Salts ½ cwt.	596 2·0	745 1·5	471 2·36	820 1·9	780 1·5	275 1·5	592 1·5	534 2·0	
	475 1·7	513 1·6	494 2·14	702 2·5	865 1·5	566 1·7	460 1·6	592 1·0	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	535 1·88	629 1·55	482 2·26	761 2·17	823 1·5	420 1·6	526 1·55	563 1·5	592 1·8
6.—"Patent Bone Phosphate" 3 cwts. ..	756 1·38	813 ·7	746 1·8	831 1·3	787 1·0	731 1·15	702 1·1	681 2·2	
	615 1·58	690 1·3	745 1·5	814 1·17	862 1·0	638 1·2	573 1·7	560 2·4	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	685 1·48	752 1·0	746 1·6	823 1·23	825 1·0	684 1·17	638 1·4	620 2·3	722 1·4
7.—Unmanured......................	684 1·0	284 ·81	541 2·15	706 ·39	560 ·4	540 ·1	575 ·7	598 2·1	
	573 1·0	497 ·32	706 ·7	457 ·5	599 ·3	598 ·6	703 1·3	682 2·3	
	Average.	Average.	Average.	Average.	Average.	Average.	Average.	Average.	
	628 1·0	390 ·4	624 1·3	582 ·4	580 3·5	570 ·35	640 1·0	640 2·2	582 ·9

DISCUSSION.

Mr. James Howard had long entertained the opinion that there were far too many separate opinions in practical agriculture, and far too few ascertained facts. The paper they had just heard had struck a fresh key note, and very opportunely, for agricultural societies continued playing the same old tune over and over again; in fact, they had got into a certain groove, and went on year after year in the same round, without any change whatever. If the idea now thrown out were generally acted upon by the great societies it would open a new career for agriculture, and there was no doubt that if what had been done locally were carried out nationally it would be productive of far greater benefit; he hoped that the Royal Agricultural Society of England and the Highland Society of Scotland would devote their energies to the carrying out of such experiments as had been described. Mr. Lawes had set a noble example in this direction, and had laid not only the farmers, but the whole community under a great obligation to him, for no other individual and no society had carried out such elaborate and complete experiments. Mr. Wrightson had referred principally to experiments on manures, but there was a much wider field for investigation even than that, for he was ashamed to say they knew nothing as yet of the A B C of the practical cultivation of plants. No one could even say what was the best distance at which to plant wheat, whether eight, ten, or twelve inches. A few years ago he grew a splendid crop of mangold wurzel, planted twenty-seven inches apart, but a farmer from Somersetshire remarked that if he had set them only sixteen inches apart he would have had ten tons per acre more. It might be said that experiments of this kind were very inconclusive because of the great variation of soil, climate, &c., but if the great societies he had named were to carry out a series of experiments simultaneously all over the kingdom, and the results in 19 cases out of 20 pointed to the success of a particular system, it would go far towards demonstrating what was the correct principle. If they would do so, they would enter on a new and much more useful career than continuing simply their old round. If any one said that such and such a thing was right and useful, they were at once met with the remark that it might suit Bedfordshire, but it would not suit Leicestershire or Lincolnshire, and during the last few years, since he had paid more attention to the practical part of agriculture, he had been much struck at finding how little was really known as compared with engineering, another line of industry with which he was connected. In that, one could turn to the record of experiments, and say such and such things had been demonstrated, and there was no need of further discussion, but in agriculture it was totally different.

Mr. Warington said that in order to be of any real value two things were necessary in any experiment; the first was that it should be performed with care and accuracy, or else the results were useless; and secondly, the conditions of the experiment must be known, so that it could be interpreted and repeated. Looking at field experiments from this point of view it would be seen why, as usually conducted, they yielded results so various and contradictory. At Cirencester they had conducted their experiments very carefully, but they yielded very various results, manures which produced a very excellent crop on one farm appearing to have little or no effect on another piece of ground in the immediate neighbourhood, and thus confidence in the results was shaken. After hearing the careful manner in which the experiments had been conducted, it could not be expected that they would be performed under better conditions elsewhere; the result was owing simply to differences in the condition of the soil. These differences were so great that in one farm a manure would be eminently successful, whilst in another it had no effect; and this led to the conclusion that if the experiments were to be of any value in establishing a principle, the conditions under which they were made must be thoroughly ascertained, and this was just the information which experiments made by farmers' clubs did not supply. If a new drug were introduced, and a physician wished to ascertain its effect, he would not prescribe the same dose to the whole of the patients in a large hospital, irrespective of their ages, maladies, constitutions, and the treatment to which they had severally been previously subjected; but that was what was done by farmers in endeavouring to ascertain the action of a given manure, and the consequence was that all kinds of results were obtained, and the manure was said to be uncertain in its action. The truth was, however, that both the drug and the manure had a perfectly definite action. Nitrate of soda had a certain definite action; and wheat, barley, and clover, each had their particular characters which required a certain quantity and description of plant food. The crop was constant in character, and so was the manure, but the conditions of the soil were unknown, and therefore it was that they failed to learn much from these experiments. At the same time there was a certain practical empirical value attached to these experiments, though they did not teach the laws of vegetable physiology or the action of manures. A man who was laying out a deal of capital on his land wanted to know whether he was doing so economically, and he was very wise, therefore, to ascertain experimentally in the first place whether he could obtain a paying result; but he should always bear in mind that the conditions of the field were an unknown quantity; so that if £100 worth of a certain manure gave a certain paying result in connection with that unknown quantity, x, he must not suppose that it would do the same in the next field, or with his neighbour, where the unknown quantity, instead of being x, might be y or z. Professor Wrightson seemed to think that by having experiments sufficiently numerous, rules of procedure for any given locality might be arrived at, but he did not believe it. There was an immense difference in the character of the soil produced by high or low farming; in the former case an immense accumulation of plant food being stored up in the soil which was wholly wanting in the other; there were, besides, great natural variations in the case of heavy and light lands, which would not yield the same results with the same manure. The Rothamstead experiments had been, he thought, a little misunderstood; they were never intended to give rules for farmers to follow, but to ascertain principles showing the character of crops and the behaviour of manures, and this had been accomplished by carefully determining the conditions of the experiments. There would be a plot manured with nothing but superphosphate, not that a crop of barley was expected from it, but to aid in comparing the results from other plots; then a plot with superphosphate and alkaline salts; another with simply ammonia; another with ammonia and superphosphate, and so on. Thus, step by step, every one of these prepared plots served as a key to answer the questions raised by the others, and the general result became intelligible. In this way the extraordinary fact came out that the barley plant had an immense capacity for obtaining alkalies from the soil, whereas wheat could not obtain alkalies with nearly so much readiness. It was found, indeed, that a field of barley dressed with superphosphate, alkalies, and ammonia gave no better crop than one manured with superphosphate and ammonia only, whilst in the case of wheat the crop was considerably improved by the addition of alkali. The objects of such experiments was to obtain scientific knowledge, whereas the value of such as had been referred to at Cirencester was practical and empirical only.

Mr. Edward Packard, jun., had listened to the paper with much satisfaction. It showed the want in this great agricultural country of some nucleus for the right

carrying out of experiments on scientific principles, and he thought the remarks of Mr. Howard showed how the want might be supplied. Some years since he had called public attention, at the Framlingham Farmers' Club, to the advantages to be derived from the adoption of some such system as that in force in Prussia, of having agricultural stations; and it was very extraordinary, with all the energy and scientific knowledge of English agriculturists, that no steps had been taken to induce the Royal Agricultural Society or even local societies to establish similar stations to those which had been formed for so many years in Germany and France with such marked benefit. If this matter were properly laid before the Royal Agricultural Society, he thought they would see the necessity of getting local associations to co-operate with them and form in every county an agricultural station. It was evident that very varying results were obtained from the same quality of manure, according to the locality, and it was therefore necessary that different parties should have an opportunity of judging for themselves which was best.

Mr. Hughes wished to ask whether analyses had been made of the different soils upon which these experiments had been tried. If so, it was a pity they were not furnished, because it was evident that the difference of yield was attributable more to the soil than to the manure applied. Thus Mr. Stevens, with a mineral superphosphate and nitrate of soda, got 6 tons, while Mr. Wilkins got exactly double. As an old student of the Agricultural College he was pretty well acquainted with the character of the soil in the neighbourhood, which varied very greatly, some very light and some very heavy. He had been associated many years with Dr. Voelcker as his assistant, and he thought Mr. Wrightson had rather gone out of his way to criticise his statements with regard to bone dust. If he had been present he would doubtless have given the reason why he found such different results from its use in Durham and elsewhere, for, as every farmer knew, there were great differences in the character of bones, and the smaller they were ground the greater and quicker was the effect on the crop. He thought the experiments which had been mentioned must have been conducted under rather unfavourable conditions, if a certain time was fixed for putting in the seed irrespective of the weather, and the result might be materially affected by it, but at the same time after the appointment was made it might be difficult to postpone it. The experiments would in his opinion be much more valuable if carried out on the same principle as those of Mr. Lawes.

Mr. Pell, M.P., desired to endorse most thoroughly what had been said by Mr. Howard with reference to this new field of action opened up for the agricultural societies. He remembered the great impetus given by these societies to the mechanical department of agriculture, but there had not been a corresponding improvement in the chemical department; and what had been learned was through the action of philanthropic individuals. At the same time he could not help feeling that experiments had been going on, though not perhaps conducted by scientific men, or tabulated in a formal way, viz., those which had been performed by farmers themselves, and discussed at market tables and similar gatherings. But if any one desired to initiate a series of experiments there was a great difficulty in finding men to carry them out properly, weighing, drilling, and recording the results in the careful and persistent way which could alone make them of any value. He himself had failed in obtaining information, which he should have been glad to communicate afterwards to others, from the difficulty of finding a man who would carry out his orders, and spend his money in a way that would be useful to himself and his neighbours, but to meet this difficulty they might have recourse to the Chamber of Agriculture, farmers' clubs, and local societies. In connection with these institutions there was very often the county members' subscription for the best pen of ewes, or the sheriff's prize for the best pig, which produced perhaps one competitor only, but the same thing went on year by year, because it was the habit to do so, without any attempt being made to expend the money in a more useful manner. He had not been much of an experimentalist himself, but he had been lately trying to grow barley repeatedly, as recommended by Mr. Lawes. His success remained to be seen, but he was quite satisfied that elevation had a good deal to do with the result, and that not only must analysis of the soil be given, in order to obtain scientific information, but also many other points, such as the warmth of the farm at night, whether the growth of trees intercepted the free passage of air, and so on. These were difficulties, but he believed they could be got over if the experiments were sufficiently numerous and extended. He would only add that he would gladly do what he could in his own neighbourhood to forward the idea.

Mr. William Botly agreed with the observations of Mr. Howard, but, as a member of the Royal Agricultural Society, he might be allowed to say, that in the volume of transactions just published there was an account of two instances in which the Rothamstead plan of growing wheat year after year had been successfully carried out, one in Wiltshire, and the other about 38 miles from London. As Mr. Wrightson had stated, the dressings necessary for such a system were very expensive, and this was proved by the cases he had referred to, where the receipts for seven years had been £4,809 11s. 5d., whilst the payments had been £3,984. At the same time one of the farms, which cost £15,000 thirteen years ago, had recently been valued at £31,000. This proved what he had often insisted on, that the great thing needed for improved agriculture was security of tenure and compensation for unexhausted improvements.

The Chairman said he cordially agreed with what had been said as to the value of Mr. Lawes's experiments from a scientific point of view; but, unfortunately, they were made on one description of soil, with one climate, and under the same conditions year after year, so that they did not produce as much practical benefit as might be desired. He very much wished there was a Rothamstead in Norfolk, and an agricultural college in every county in England; for if there were such experimental plots all over the country very valuable results must be attained. The differences of cultivation, of climate, and of soil must always be regarded in agricultural experiments; and though Mr. Howard had referred to the demonstration of certain facts in connection with engineering and mechanics, he did not see how it was possible to do the same in agriculture. Looking over the experiments recorded in the tables, one or two things had struck him rather forcibly as a practical farmer. It appeared that on one plot of ground there were produced 684 roots, whilst in the next there were only 284; probably it was a very dry season, and one plot had the advantage of a thunderstorm at the time of sowing which the other lacked. He was astonished to find that guano had been applied in close proximity to the seed, and that nitrate of soda should be dissolved in water. Guano was of all things the most potent manure, and should never be applied near the seed on any account, and it was much better sown broadcast and harrowed in than drilled. Nitrate of soda, again, was extremely soluble, the difficulty being to make it hold out long enough, particularly if a shower of rain came; and therefore he should not have thought of applying it in conjunction with water. With regard to salt not being found beneficial in some cases, it would not probably be so on heavy clay lands, but on the sandy soil of Norfolk it would be found a fair fertiliser. The whole of the experiments demonstrated the extreme lightness of the root crop of 1874, and if it should be found in a month or two that meat was exceedingly dear, he hoped it would be remembered that last year there was no grass,

and there had been very few turnips in the winter, so that farmers in the grazing districts had not had the opportunity of manufacturing much beef. Speaking to an audience, the majority of whom, probably, were more gardeners than farmers, he would suggest that there were experiments which could be conducted on even a very small piece of ground; one in particular, of a very interesting nature, was the following:—If oats were sown and kept constantly cut as they grew, it would be found next year that they produced not oats but something else; he knew an instance where this had been tried in a garden, the oats being kept cropped with a pair of shears, and covered from the frost with a little straw in the winter, and the next spring they produced a crop of wheat. In other cases barley and rye had been the result. It was only oats, however, which thus varied, other grain always reproducing itself. He begged to propose a vote of thanks to Mr. Wrightson for his valuable paper, which would set farmers thinking, at any rate, and he was very glad to hear that the experiments were to be continued. He hoped they would be for a long time to come, for it was only by long and careful observation, under various circumstances, that any definite results could be attained.

The vote of thanks having been passed—

Mr. Wrightson, in reply, said he was very glad to find that the general scope of his remarks had been so favourably received. They had been criticised very fairly from the scientific point of view; but still the chamber had accomplished what they set themselves to do, viz., to make a simple series of experiments on the manures supplied to roots, in order to find out which gave the best result. No doubt it would be an advantage if an examination of the soil and climate were added; and the remarks which had been made as to the want of completeness of the experiments were not so much in opposition to the general idea as suggestions for its further development. Certainly, if they could command the ability and money necessary for such complete investigations, it would be much better than mere chemical analyses. The Chairman, with his usual quick eye, had detected a wonderful difference in the number of plants on two adjoining plots, being 684 and 284, but the latter instance was quite exceptional. It was an unmanured plot, and enforced the lesson that the effect of manure was not only to increase the crop, but to give greater certainty and uniformity. Both the plots in question were unmanured, but in one case the land was in a much better state of cultivation.

GRANTHAM'S STEAM TRAM-CAR.

On Wednesday afternoon a trial was made of this car in the presence of some of the members of Council and others interested in the question. The members of Council present were Sir Henry Cole, K.C.B.; Captain Douglas Galton, C.B., F.R.S.; Edwin Lawrence; Admiral Lord Clarence Paget, K.C.B.; and Seymour Teulon, with P. Le Neve Foster, secretary.

The car was seen at work on a short tram laid down, for purposes of experiment, near the West Brompton Station of the West London Extension Railway. It consists of an ordinary tram-car, fitted with a small engine and boiler, these being placed in a central compartment, and boxed in so as to be entirely out of sight. A passage is left through this central compartment so as to afford access from one end of the car to the other. The driving cylinders, &c., are placed low down at the sides, the boilers and fire-boxes (of these there are two, one at each side) occupying the central space over them, and a small space above the roof. The only visible part of the apparatus is a short chimney rising from the centre of the roof. The object of the inventor, in the construction throughout of the car, has been to avoid any noise, or discharge of steam into the air, which might frighten horses, and for this purpose a separate chamber is provided, in which the steam is permitted to expand, and whence it escapes gently and imperceptibly into the air.

MISCELLANEOUS.

THE PATENT BILL.

This Bill was read a third time on Tuesday last, and will in a short time come before the House of Commons. Several additional amendments were introduced by the Lord Chancellor, and some of them are of importance. The instructions to the examiners have been varied, and they are now directed to inquire "whether the invention appears open to objection on the ground of want of novelty, as far as can be ascertained *by such examination as prescribed*, of former specifications, and other documents and publications in the Patent-office." The added matter is indicated by italics, and it would appear that the examination will be less strict than was at first proposed. Clause 20 of the amended Bill, which relates to foreign inventions, has been modified by the omission of that part which required the endorsement on the patent of every foreign patent existing at the time of the signing of the warrant. A new sub-paragraph is added to the same clause, which modifies to some extent the former proposals with respect to foreign inventions. It is as follows:—

"If at the time of the application there is not a foreign patent for the invention in force, a patent shall not be granted unless the applicant declares himself to be the first and true inventor, or declares and shows himself, as prescribed, to be entitled in law, by assignment or otherwise, to all the rights in respect of the invention of the first and true inventor, and no patent shall be granted in respect of a communication from abroad."

The words "foreign patent" are held to include a patent granted in the colonies. Clause 34, which deals with the respective rights of the patentee and the Crown, is slightly altered. The Crown is empowered to use the invention immediately after the application, and no agreement as to royalty between the department using the invention and the patentee is to be valid without the approval of the Treasury. The Crown may use the invention without waiting for the terms to be settled, but such use or publication of the invention is not to prejudice the grant of a patent for the invention. The paragraph in Clause 48 which authorised the Commissioners to allow an applicant to have not exceeding twenty-five copies of his specification without payment has been omitted. Two new clauses are inserted; one relates to the award of costs by the law officer in opposition cases, and the other to the recovery of costs in Scotland. The powers of the Crown in Clause 60 with regard to the cancelling of a patent are limited; such cancelling can now only take place "before the sealing of the patent." The remainder of the amendments are merely verbal, or relate to matters of detail.

In the southern parts of Italy and in Tuscany, a variety of ginesta, *Spartium junceum*, or Spanish broom, is used for cordage, coarse baggings, &c. In some parts of France it is used for the same purpose. The *Spartium scoparium*, or common broom, grows plentifully in Italy, and furnishes an abundance of fibre, but there appears to be a prejudice in favour of the Spanish broom.

Paraffin is coming into use in Germany in the manufacture of glazed papers of all kinds. For white and delicate coloured papers, 24 parts by weight of paraffin are mixed with 100 parts of china-clay; the compound is dried and ground with cold water, and mixed with the pulp in the proportion of 4 to 5 per cent. Paper thus prepared is said to take a fine gloss, and to resist the damp well.

VIENNA EXHIBITION REPORTS.

(*Continued from page 441.*)

Following the report last noticed in the *Journal* come several by Lieut. T. H. Anstey—(*a*) international horse and cattle shows, held in connexion with the exhibition; (*b*) cattle exhibited at the live stock show at Vienna (from the German of Secretar Schutz); (*c*) sheep at the same show (from the German of Prof. Dr. G. Wilhelm); and (*d*) pigs at the same show (from the German of M. Kemper). These, as dealing with matters rather out of the usual range of this *Journal*, it may, perhaps, be permissible to pass over without any special notice.

Next come some reports on the various congresses held in connexion with the exhibition. First of these is the report on the International Patent Congress, by Mr. T. Webster, Q.C. In this, after detailing the circumstances which led to the formation of a congress, the writer proceeds to give the different resolutions passed at the congress, which, with the reasons for each, may be summarised as follows:—

1. The protection of inventions should be guaranteed by the laws of all civilised nations because:—
(*a*) The sense of right among civilised nations demands the legal protection of intellectual work. (*b*) This protection affords, under the condition of a complete specification and publication of the invention, the only practical and effective means of introducing new technical methods without loss of time, and in a reliable manner, to the general knowledge of the public. (*c*) The protection of invention renders the labour of the inventor remunerative, and induces thereby competent men to devote time and means to the introduction and practical application of new and useful technical methods and improvements, and attracts capital from abroad, which, in the absence of patent protection, will find means of secure investment elsewhere. (*d*) By the obligatory complete publication of the patented invention, the great sacrifice of time and of money, which the technical application would otherwise impose upon the industry of all countries, will be considerably lessened. (*e*) By the protection of inventions, secrecy of manufacture, which is one of the greatest enemies of industrial progress, will lose its chief support. (*f*) Great injury will be inflicted upon countries which have no rational patent laws, by the native inventive talent emigrating to more congenial countries, where their labour is legally protected. (*g*) Experience shows that a holder of a patent will make the most effectual exertions for a speedy introduction of his invention.

2. An effective and useful Patent-law should be based on the following principles:—
(*a*) Only the inventor himself, or his legal representative, should be entitled to a patent. (*b*) A patent should not be refused to a foreigner. (*c*) It is advisable, in carrying out these principles, to introduce a system of preliminary examination. (*d*) A patent should be granted either for a term of fifteen years or be permitted to be extended to such a term. (*e*) Simultaneously with the issue of a patent, a complete publication of the same should take place, rendering the technical application of the invention possible. (*f*) The expense of obtaining a patent should be moderate; but, in the interest of the inventor, a progressive scale of fees should be established, enabling him to abandon, when convenient, a useless patent. (*g*) Facilities should be given, by a well-organised patent office, to obtain in an easy manner the specification of a patent, as well as to ascertain what patents are still in force. (*h*) It is advisable to establish legal rules, according to which the patentee should be induced, in cases in which the public interest may require it, to allow the use of his invention to all responsible applicants for an adequate compensation. (*i*) The non-application of an invention in one country shall not involve the forfeiture of the patent, if the patented invention has been carried into practice at all, and if it has been rendered possible for the inhabitants of such country to purchase and make use of the invention. (*k*) In all other respects, and particularly as regards the proceedings in the granting of patents, the Congress refers to the English, American, and Belgian Patent-laws, and to the draft of a Patent-law prepared for Germany by the Society of German Engineers.

3. Considering the great differences in present patent administration, and the altered international commercial relations, the necessity for reform is evident, and it is of pressing moment that Governments should endeavour to bring about an international understanding upon patent protection as soon as possible.

4. The Congress empowers the preparatory committee to continue the work commenced by the first International Congress, and to use all their influence that the principles adopted be made known as widely as possible and carried into practice.

5. The committee is likewise authorised to endeavour to bring about an exchange of opinions on the subject, and to call, from time to time, meetings and conferences of the friends of patent protection.

6. To this end the preparatory committee is hereby appointed to act as a permanent executive committee, with power to add other members to their number, and to appoint the time and place for the next meeting of the Congress, in case such a meeting should be considered necessary for the promotion of the foregoing resolutions.

The last three resolutions are merely relative to the action of the congress after the conclusion of it first sitting at Vienna.

In the concluding portion of his report Mr. Webster gives some remarks on the above resolutions, as well as suggestions as to the form which a general Patent-law for all countries might take.

In addition to the report proper, there are the following Appendixes:—A. Programme of the congress. B. List of members. C. Report of House of Commons Committee. D. Proceedings on the report. E. Meetings of inventors and others. F. Letter of Mr. Macfie. G. Letter of Mr. B. Woodcroft. H. Address of Hon. J. M. Thacker. I. Tables of English and foreign patents. K. Receipts and expenditure of the Patent-office. L. M. N. O. Proposals for German Patent-law. P. Report on Patent-law. Q. Prize essay on Patent-law. R. German project for Patent-law. S. Opinion of M. Renouard. T. Proceedings in Austrian Courts for piracy of English trade marks and names. Report to British Commission. U. Austrian Patent-law, &c. V. Commercial treaty (1865), Austria and Great Britian. X. Provisional protection of industrial designs and inventions. Y. Resolutions of congress. Z. Proceedings of executive committee.

Dr. Fr. L. Weinmann's report on the yarn congress, which follows the last-mentioned, is a very short one. The object of the congress was to discuss the question of a uniform numbering of yarns. After five days' discussion, they agreed to certain resolutions affirming that the introduction of such a uniform principle was quite practicable, and that it should be based on the metrical system, the number of metres in one gram giving the base required.

A memorandum on the proceedings of the congress of cultivators and spinners of flax and manufacturers of linen, is also contributed by the same writer. This begins with a sketch of the present condition of flax culture throughout Europe. Dr. Weinmann then passes to an account of the actual proceedings of the congress. The first question submitted to the congress for discussion referred to the amount of knowledge and experience already obtained in regard to the selection of linseed and its production for growing seed, also to the means for improving the same. This was followed by a discussion on the best existing and the best possible system of cultivation. The best method for preparing flax was then discussed, and lastly the existing defects in the flax trade, and proposals for their remedy were taken into consideration.

This ends the official portion of the work. The numerous papers on scientific, engineering, and other questions, as well as the extracts from the Austrian reports, important as they are, cannot be reviewed in these columns without occupying more space than can well be devoted to this subject.

Before concluding, however, it may be interesting to English exhibitors and others, as showing how thoroughly the exertions of the Secretary to the British Commission were appreciated by Foreign Governments, as well as by his own, to state that Mr. Cunliffe Owen has received the following honours in connection with this or other exhibitions. He is Commander of the Legion of Honour, of France; of the St. Michael Order of Merit, Bavaria; of the Order of Christ, Portugal; of the Royal Order of Charles III., Spain; of the Franz Josef and the Iron Crown, of Austria; and of the First Class of Gustavus Vasa, of Sweden; Knight of the Order of Leopold, Belgium; of St. Olaf, Norway; and of Frederick, Wurtemburg. To this long list of honours has just been added that of a Companion of the Bath. The following are the offices Mr. Owen has held in connection with the different international exhibitions:— Deputy-Superintendent for the British Commission at Paris in 1855; Superintendent of the Foreign Depart-

ment in London in 1862; Assistant Executive Commissioner at Paris in 1867; and, finally, Secretary for Vienna in 1873.

GENERAL NOTES.

Philadelphia Exhibition.—A meeting of the Association of Agricultural Engineers recently took place to discuss the question of exhibiting at Philadelphia. Ultimately the following resolution, moved by Mr. James Howard, Bedford, and seconded by Mr. Shuttleworth (Clayton and Shuttleworth), Lincoln, was unanimously passed:—"That, looking to the prohibitory duties—from 30 to 40 per cent.—imposed by the United States upon English agricultural machinery, the Association of Agricultural Engineers recommends its members to hold aloof from the Philadelphia Exhibition, considering the imposition of prohibitory duties to be out of harmony with the objects of international exhibitions." Members of nearly the whole of the great firms, and many of the smaller ones, were present, and the feeling was that no good could accrue to the English makers for exhibiting, although it would unquestionably be of advantage to American makers to have our best specimens displayed before their eyes. American machinery can be imported into this country duty free; but as the English agricultural machinery is unrivalled, little beyond a few reapers and mowers is imported from America. It appears that the Canadian tariff also excludes English agricultural machinery by the excessive duties levied thereon.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

April 21.—"The India Museum Question." By Dr. Forbes Watson. On this evening A. S. Mundella, Esq., M.P., will preside.

April 28.—"The Protection of Buildings from Lightning." By R. J. Mann, Esq., M.D., President, of the Meteorological Society. On this evening Robt. H. Scott, Esq., F.R.S., Director of the Meteorological Office, will preside.

May 5.—"Horse-shoes and Horse-shoeing." By George Fleming, Esq., Veterinary Surgeon, Royal Engineers.

May 12.—"River Pollution, and the Impurities of the Water Supplied to our Towns." By Jabez Hogg, Esq., Surgeon to the Royal Westminster Ophthalmic Hospital, President of the Medical Microscopical Society, Fellow of the Royal Microscopical Society, &c.

May 26.—*No Meeting.*

June 2.—"Toughened Glass." By Perry F. Nursey, Esq., C.E.

Indian Section.

Friday evenings at eight o'clock. The following arrangements have been made:—

April 23.—"The Preparation and Uses of Rhea Fibre," by Dr. J. Forbes Watson.

April 30.—"The Growth of the Factory System in India, with especial reference to the Production of Textile Fabrics, and the Relative Advantages of the British and Indian Manufacturer," by Elija Helm, Esq., of Manchester. On this evening Andrew Cassels, Esq., Member of the India Council, will preside.

May 14.—"The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East," by the Rev. James Long.

May 19.—"The Agricultural Statistics of India." By Clements R. Markham, Esq., C.B.

Chemical Section.

Friday Evenings, at 8 o'clock.—The followin arrangements have been made:—

April 16.—"Recent Advances in Photographi Science," by J. Spiller, Esq., Vice-President of th Photographic Society. On this evening Warren D La Rue, Esq., D.C.L., F.R.S., will preside.

May 7.—"Alum Shale and its Application," b Sydney Rich, Esq.

May 21.—"Explosive Compounds." By Alfr Nobel, Esq., the founder of the Nitro-glycerine In dustry.

Cantor Lectures.

The Third Course of Cantor Lectures will be " Some Forms of the Modern Steam Engine," b F. J. Bramwell, Esq., President of the Institutio of Mechanical Engineers. The Course will consi of four lectures, the dates for the rest of which wi be as follows:—Mondays, April 19, and 26.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p. (Cantor Lectures.) Mr. F. J. Bramwell, F.R.S., "So Forms of the Modern Steam Engine." (Lecture III)
Royal United Service Institution, Whitehall-yard, 3 p. Captain E. Rogers, "The Gatling Gun; its Plac Tactics."
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. W. R. Cooper, "The Horus Myth."
London Institution, Finsbury-circus, E.C., 5 p.m. Bentley, "Classification of Plants." (Lecture III.)

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. P. M. Duncan, "Grander Phenomena of Phys Geography."
Civil Engineers, 25, Great George-street, Westmin S.W., 8 p.m. 1. Mr. William Hackney, renewed d cussion on "The Manufacture of Steel." 2. Mr. J. Smith, "Bessemer Steel Rails."
Statistical, Somerset House-terrace, W.C, 7¾ p.m. E. W. Brabrook, "Friendly Societies and Similar In stitutions."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.
Zoological, 11, Hanover-square, W., 8½ p.m.

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p. Dr. Forbes Watson, "The India Museum Question."
London Institution, Finsbury-circus, E.C., 7 p.m. Freeman, "History and Use of the English Languag (IV.)
Meteorological, 52, Great George-street, S.W., 7 p. 1. Mr. Robert H. Scott, "Notes on Sea Temperat Observations on the Coasts of the British Islands 2. Hon. Ralph Abercromby, "Certain Small Osc tions of the Barometer." 3. Mr. Francis Past Errors of Low Range Thermometers." 4. Mr. R. Scott, "Exhibition of Wild's Pressure Anemometer."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thurs...Royal, Burlington House, W., 8½ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. H. G. Seeley, "The Fossil Forms of Flying Animals."
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Fri.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p. (Indian Section.) Dr. J. Forbes Watson, "The Pre paration and Uses of Rhea Fibre."
Royal United Service Institution, Whitehall-yard, 3 p. Captain E. Podmore Clark, Instructor of Musketry Hereford Militia, late 62nd Regiment, will exhibit an explain his Military-Model-Apparatus for Illustrating Drill.
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m. Prof. Ramsay, "The Pre-Mi Alps, and their Subsequent Waste and Degradation."
Antiquaries, Burlington House, W., 2 p.m. Annual Meeting.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Civil and Mechanical Engineers' Society, 7, Westminster-chambers, S.W., 7½ p.m. Mr. R. W. P. Birch, "Sewage of Towns."

Sat.......Royal Institution, Albemarle-street, W., 3 p.m. Mr. G. Smith, "The History of Assyria."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.

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FRIDAY, APRIL 23, 1875.

ommunications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ROCEEDINGS OF THE SOCIETY.

REVOLUTION INDICATOR.

A meeting of this Committee was held on the th inst. Present—Vice-Admiral Erasmus Ommney, C.B., F.R.S. (in the chair), Captain H. F. holson, R.N., Captain E. P. Nisbet, John R. renhill, Lieutenant-Colonel A. Strange, F.R.S., Seymour Teulon. The Committee took into sideration the practical trials of the selected truments, made on the 8th inst., on her Majesty's n-boat *Arrow* (which had been lent for the pur- e by the Admiralty), and determined on further ion.

he trials referred to lasted the whole day, and e carried on during a short trip starting from rness. They took place in the presence of the mittee, consisting of the members above-named, h the addition of Rear-Admiral Nolloth. The mittee was also assisted by A. Le Neve Foster.

CHEMICAL SECTION.

A meeting of this Section was held on Friday ing, the 16th inst., Warren De La Rue, S., in the chair.

he paper read was:—

CENT ADVANCES IN PHOTOGRAPHIC SCIENCE.

By John Spiller, F.C.S.,

Late President of the Photographic Society.

n this room, on the 20th January, 1853, the otographic Society of London was founded, er a very successful exhibition of photographs been held under the auspices of the Society of s. The then new collodion process, invented Frederick Scott Archer, had given a great etus to the study of photography, and was dy being widely practised by amateurs, who ght in the newly-formed Society the means of changing experiences and discussing their lts. Helped by Royal patronage liberally owed, and by the zealous working of its early the art soon made commendable progress, rnal of the Photographic Society for the years may be consulted as the sole of a history, which has in later has rarely been equalled or excelled in other departments of applied science. For some of these improvements, and especially those of recent date, it will be my endeavour to bespeak your attention; taking, as far as time allows, more immediate cognisance of those principles and processes which have served to popularise photography in the present day.

In this effort, let me begin by acknowledging my indebtedness to many friends who have kindly aided me by lending specimens illustrating several of the newest phases of the art. Some of these photographs are shown as notable examples of high artistic merit, including portraits, landscapes, "combination prints," enlargements, and transparencies; other specimens are either of historical interest or shown as illustrative examples of particular processes. The programme being somewhat wide for the limits of one lecture, I must hasten to approach my subject under appropriate headings.

Collodion Processes.—Beyond the general recognition of liberal proportions of bromides and more alcohol than formerly used, the composition of photographic collodion cannot be said to have been altered from the practice of former years. Cadmium salts are now in general use as "sensitisers," and more attention is paid to the quality of the pyroxyline (or nitrocellulose) employed, some operators preferring that made from paper, according to the recommendation of Dr. Liesegang and others. The so-called "emulsion processes" are gaining ground from the fact of their enabling us to dispense with the "nitrate bath," the collodio-bromide process of Messrs. Sayce and Bolton leading the way to this improvement. This admirable suggestion is founded upon an earlier observation made by Mr. G. Wharton Simpson, who used a collodio-chloride emulsion for coating paper to be used in the printing process. The leading fact is that chloride (or bromide) of silver may be produced in collodion by double decomposition, so as to furnish a product containing at once all the ingredients ready for immediate use—whether in the camera or printing frame—and which may be kept for lengthened periods without sensible deterioration; since the haloid salt is formed in so finely-divided a state that it remains suspended in the collodion as an emulsion. Lieut.-Colonel H. Stuart Wortley advocates the introduction of nitrate of uranium together with the silver, and has published formulæ which are even now on their trial; the advantages claimed being greater sensitiveness combined with special superiority in rendering colour—an effect which Dr. Hermann Vogel believes he has equally secured by tinting the collodion film.

For "dry plates" possessing permanent sensitiveness, the writer claims to have led the way by publishing, in 1854, in conjunction with Mr. Crookes,* the first dry-plate process; and although the nitrate of magnesium is no longer employed for this purpose, the possibility of the case was established, and a host of other "preservatives," including the collodio-albumen and gum-gallic processes, are now in daily use, the latest development of this system being the albumen and beer process of Capt. Abney, R.E., which has done

* Phil. Mag., May and August, 1854.

such good service in securing photographs of the recent transit of Venus.

Collodion Transparencies and Enlargements.—Collodio-chloride of silver has been used very successfully by Dr. Van Monckhoven for copying and enlargements, and her Majesty's War Department makes good use of the same process for reproductions. As a method of copying faded photographic prints this plan of working has been shown by Mr. H. Baden Pritchard to offer great advantages. Mr. Jabez Hughes, of Ryde, produces "transfer collodion enlargements" by development upon glass, and subsequent transference of the toned collodion film to a sheet of white paper or cardboard, by which excellent results are secured, and great permanence is at the same time guaranteed by the unalterable nature of the materials employed. A similar principle is made use of in the production of photo-enamels, the film being transferred in these cases to surfaces of porcelain or enamelled copper, and subsequently fired. Several operators have brought this process to a state of perfection, and the permanence of these photo-enamels is beyond question.

Mr. Valentine Blanchard has within the last few days described a process of enlargement in which albumenised paper is employed with promise of great results. Mr. Edwards has recently shown some good enlargements, and Messrs. Spencer, Sawyer, Bird, and Co. use the autotype process for the same purpose, where the generally-admitted delicacy of the carbon print is taken advantage of both in securing the intermediate negative, or "transparency," and finished print. The details of this process will be again alluded to under the head of carbon printing. The Woodburytype impression delivered upon glass also furnishes excellent transparencies; but none of these processes give better results than the simple collodion when properly toned, as may be seen in the capital lantern slides of Mr. Frederick York, and the excellent enlarged transparency of the full moon which our worthy Chairman gave me in 1860 as an average sample of his work.

Silver Prints.—The charge of want of permanence brought against the ordinary photographs printed upon paper prepared with the chloride and nitrate of silver is sustained by a mass of evidence, and the fading action is observed to be closely connected with the use of hyposulphites as fixing agents. Much can be done by careful manipulation and by paying great attention to chemical conditions, in the way of overcoming, or reducing to a minimum, the destructive action of sulphur-compounds upon the silver which forms the basis of the photograph; foremost amongst needful precautions may be mentioned the use of ammonia or carbonate of ammonia to maintain alkaline conditions in the fixing bath, and this followed by a most careful washing completed with at least one immersion in hot water. Silver prints subjected to this treatment are to a great extent protected against the chance of fading, especially if preserved in a moderately dry atmosphere or in closed portfolios; but there is yet another cause for suspicion whenever albumen has been used for the purpose of imparting a glossy surface to the paper. White of egg is known to contain a certain proportion of sulphur naturally combined with the organic elements, and whenever the albumen undergoes deco position this sulphur is either in part liberated free to act upon the silver. We do not know present of any sure method of counteracti this evil, but it might be worth while asc taining how far tannin or carbolic acid, appli in the final stage, renders such organic chang impossible.

Mounting materials and the cardboard it have often to be tested for impurities, the prese of which may defeat all our previous efforts tow securing the permanence of the silver print, ho ever well it may have been toned, fixed, washed.

Printing in Carbon or Pigments.—For the rea just now stated it has become imperative to for other means of solar printing, which, pensing altogether with silver and sulphur, escape the possible contingencies to which th process is liable. Uranium printing offers a be chance of permanence, but although experim have from time to time been made in this direct the evidence is not yet sufficiently conclusiv warrant an absolute reliance being placed in mode of working. The necessity for appealin a chemical process involving the use of a metal appears, however, to be mainly dispo by the fact that so much progress has lately made in carbon-printing that improvements for the present to arise out of the mastering details. So far as I am aware there is no inst on record of a faded carbon print, and ther a reasonable ground for believing in the manence of combinations of gelatine and chr oxide, which form, as it were, the cemen materials around the particles of carbon (or ment) composing the graduated shades of picture. The chemistry of carbon printin perhaps not yet fully made out, but it has rec much attention from Mr. J. W. Swan and oth who have helped forward its practical realis We all know how unalterable is a sheet of pa ment, and yet this is but an untanned fil animal gelatine. It dissolves slowly in bo water, but resists attack from the ordinary o ing influences of the atmosphere. Properly ta or indurated with certain metallic salts, it bec insoluble and even more indestructible. In ink, Frankfort black, and other forms of ca (including black lead, used in some experim by M. Marion) may certainly be depended for permanence, and so also may chromic o which for years past has been employed as a ment. The only question that arises in my is that we might perhaps "make assurance d sure" by resorting to an after tanning pro I pointed out five years ago.* Let alum and metallic ingredients do their work as now, finish in a bath of tannin or other astringent.

Having thus reviewed the chemical ques we must descend to practical details, and how a carbon print or "autotype" is no produced. This I am enabled to place before hearers with all the advantages of latest impr ments, inasmuch as an admirable summary of that is known upon the subject has just b communicated to the Photographic Society by J. R. Sawyer, in a paper entitled "Photogra

* Journal of the Photographic Society, October, 1868, p. 1

Permanent Pigments, with recent improvements Autotype Transfer."

Mungo Ponton having shown that paper coated potassium bichromate is affected by light, and [illegible] that the presence of gum or gelatine [illegible] the change, Poitevin conceived the [illegible] idea of introducing a pigment which, by [illegible] locked up in the altered gelatine tissue, [illegible] it possible to obtain a carbon print. This was secured merely by washing with water to [illegible] the unaffected portions of the chromated [illegible], leaving insoluble those parts, in grada-[illegible], according to the greater or less marked [illegible] of the light. William Blair, of Perth, im-[illegible] this process by directing his operations to back of the sensitive coating, producing supe-[illegible] results as regards the rendering of half-tones, necessarily obtaining reversed pictures. Mr. [illegible]. Swan, of Newcastle, greatly improved the [illegible] by introducing a system of transfer in [illegible] India-rubber paste was employed to turn the image, so that it could be developed with [illegible] certainty by washing in warm water, and finally transferring the picture to an appro-[illegible] mount. Mr. J. R. Johnson proposed the [illegible] a rigid temporary support, such as a plate [illegible] or glass, to receive the pigmented gelatine and hold it during the process of washing. [illegible] reversed negatives Mr. Johnson was [illegible], by "single transfer," to mount the carbon on a sheet of alumed gelatine paper.

[illegible] was the state of the process when Mr. J. [illegible] observed that he could obtain much [illegible] results by discarding the rigid support and [illegible] to paper specially prepared, which, per-[illegible] of extension and contraction during the [illegible] and subsequent drying of the carbon [illegible] or autotype, was not so apt to break the [illegible]. Mr. Sawyer's patent "flexible support" [illegible] treated first with chrome alum and [illegible] and allowed to dry; such a coating is in-[illegible] in water, as Mr. Swan had previously [illegible]. Upon this a layer of ordinary gelatine [illegible] 10 per cent.) is applied, and then this is [illegible] with a solution made in a digester, as [illegible]:—

1 lb. button, or bleached lac.
5 quarts of water.
4 oz. borax.
1 oz. soda crystals.

[illegible] to get a perfectly smooth surface, the [illegible] is subjected to rolling pressure between [illegible] plates, and each sheet at the time of use is [illegible] over with resin and turpentine, mixed with [illegible] wax. It is not difficult to imagine that a [illegible] support," built up in this manner, would [illegible] a soft couch or bed for the reception of a [illegible] or pigment print about to be developed, [illegible] readily believe that superior results can, [illegible], be obtained in this way. The final [illegible] is transferred to sheets of paper coated with [illegible] of gelatine and precipitated sulphate [illegible], mixed with a little chrome alum.

[illegible] temporary support can be used repeatedly [illegible] rubbed over with the repellant coating of [illegible] resin, the cost is no bar to its employ-[illegible], and the process is said to be admirably [illegible] for amateurs' use. If these bright antici-[illegible] are realised, we may shortly hope that carbon will replace silver for all ordinary purposes, and that no more complaints will be heard of fading photographs. Thomson's "China" (four vols.) and Mundy's "New Zealand" may be referred to as successful examples of pictorial illustration by the improved autotype process.

Photography in the Printing Press.—Of late years great advances have been made in this interesting development of photo-chemistry, and there are now several distinct principles of working, which under varying circumstances are capable of meeting the object in view. The reproduction of maps, plans, line engravings, and subjects destitute of half-tone, presents no difficulty whatever, any one of the photo-lithographic processes lending itself to this purpose and invariably producing satisfactory results. Mr. Butter, of Woolwich Arsenal, has executed a large series of plates illustrating military equipment. Mr. Griggs has done some admirable work for the India-office, including patterns of Cashmere shawls, &c., involving the use of colours. Major-General Sir Henry James and the Topographical Department at Southampton, working by a modification called photo-zincography, are reproducing the Ordnance maps; and the Chatham establishment is doing very similar work by a process devised by Capt. Abney, R.E., which has been patented under the name of Papyrotype.* The Dallastype, the Kerography of W. J. Linton, the Electro-Photography of Chas. Hancock, probably come into this division, but no details of these processes have ever been published, although the results in some instances have been highly satisfactory.

The simplest form of photo-lithography is that in which a sheet of paper prepared with gelatine and chromate is exposed to light under a negative, next uniformly coated with a thin layer of lithographic ink supplied from the ordinary inking-roller, then submitted to the action of warm gum-water to loosen the attachment of the unaltered gelatine and with it the superimposed greasy ink, which, washed away, leaves a transfer ready to be laid down upon the lithographic stone. Great care is requisite to prevent abrasion and injury to the design in the process of developing the transfer; but, this point attended to, it is manifest that the ink adheres permanently only to those portions which have been hardened and rendered insoluble by the action of light, and these are in turn transferred to give the design upon the stone.

Another class of processes includes those employing a layer of chromated gelatine, which, by the action of light, exhibits a different rate of water-absorption according to the depth or extent of the indurating action induced by the solar exposure, and in these we have true gradations of tone.

The first in this category was Paul Pretsch's photo-galvanography, which, aided by the encouragement and assistance given by the Chairman and Dr. Hugo Muller, certainly paved the way for greater results. Pretsch's first English patent is dated Nov. 9th, 1854; he described his process here in April, 1856, and specimen prints were afterwards issued with Nos. 89 and 103 of the *Photographic Journal*. Mr. R. H. Courtney's process of later date is very similar.† The general

* "Instructions in Photography," by Capt. Abney, R.E., p. 122.
† Journal of the Photographic Society, Vol. XV., p. 5.

principle was to expose to light a film of chromated gelatine (under the negative) for just such a period of time as would suffice to bring out clearly the effect of relief when afterwards sponged with water. A cast was taken in gutta-percha or plaster of Paris of the whole surface, which exhibited depressions corresponding to the intensity of light-action, and then from this cast an electrotype was made which could be printed from like any ordinary surface block.

Omitting the successive steps in the history of photo-mechanical printing, we come now to the latest examples of work in this class as exhibited in the Albertype, and the collographic process of Messrs. Spencer, Sawyer, Bird, and Co. A grand step in the way of progress was presented in 1869, by Herr Joseph Albert, of Munich, whose invention was rewarded a year later by the Photographic Society's Medal. In these specimens the gradation in tone is perfect, and we know that an immense number of impressions may be printed from the same plate without appreciable loss of delicacy. The mode of proceeding is somewhat as follows:—A thick glass plate is levelled and flooded with a liberal supply of chromated gelatine, which when set is exposed to light under a negative, the upper surface is then acted upon by water and an astringent to give at once a printing block. By the judicious use of gum-resins a certain quality or texture known as "stipple" is imparted to the surface, and the ink applied with a roller for each impression. The "Utrecht Psalter" reproduced for the Paleographical Society, and coins in the national collections (Numismatical Society) may be quoted as examples of recent work executed by the English firm already mentioned; whilst a kindred process, the Heliotype, has served to illustrate Mr. Plimsoll's work, "Our Seamen; an Appeal."

Woodburytype.—Having had the privilege of bringing the first specimens of this process to the notice of the scientific world, at the Dundee meeting of the British Association, 1867, I felt great interest in inspecting last week some of the most recent examples of the Woodbury process, and for a certain class of work where rapid production is imperative the results leave little to be desired. Mr. Downey's portraits of H.I.M. the Shah were published by thousands within a week of the negatives being taken, and the regular appearance of the illustrations in the "Figaro Programme" (weekly), and the "London Sketch Book" (monthly), attest to the practical success of the process. The details are now so well-known that a brief description suffices. Mr. Woodbury works the chromated gelatine for the purpose of obtaining a hard insoluble film on development, which he terms the "gelatine relief." With this a plain block of type metal is impressed by contact under enormous hydraulic pressure, which, singular to relate, does not crush the matrix. The mould or printing block thus produced is then served with a warm gelatinous ink, the paper laid on the top, and the excess of pigment squeezed out, which leaves the desired impression, requiring only to be fixed in an alum bath.

The gelatine relief gives admirable casts in plaster of Paris, which form a pleasing mode of reproducing microscopic objects, and these also were shown at Dundee, but as yet little practical use seems to have been made of the idea.

In conclusion, I must ask your indulgence for many shortcomings in this attempt to bring a very large subject within the scope of a single lecture, and I beg to refer you to Mr. Henry Blackburn's account* for a correct estimate of the artistic importance of these processes of reproduction—the joint efforts of chemistry and photography to satisfy one of the wants of the age.

DISCUSSION.

Mr. Blanchard said the method which Mr. Spiller had just mentioned, as being practised by himself, was one which had already given surprising results. All photographers knew that in using the ordinary collodion and similar methods, the great advantage had been the power of multiplication, but in this very process the negative, that vital something out of which all the results arose, was gradually worn out, and therefore the ten thousandth copy could not be as good as the first; and it had been felt that while the daguerreotype and other processes produced at one operation a perfect result, they were defective inasmuch as the power of multiplication was absent. The method which he described at the Photographic Society on Tuesday evening last, had certain unmistakeable advantages; indeed, it was analogous to the electrotype process with regard to wood blocks. A wood engraving was made, but it was not used or printed from, an electrotype or cast of some kind being employed, and if the number to be printed was large, by going again to the original wood block as many electrotypes as necessary could be supplied. Now the plan employed by him was to use the negative only for a transparency, an enlargement of whatever size that might be required being taken, and from this transparency a print was made upon paper in the ordinary way, but reversed; it became in fact a negative on paper, but by waxing the negative it could be made perfectly transparent, and useful for printing purposes. If a large demand arose it was only necessary to make say 100 prints from the transparency, each of which became a negative, and from each one a hundred copies in turn might be made, and so a thousand copies be produced in a very short space of time; whilst at the same time the original negative from which the transparency was made remained intact. He was convinced that if, in the early days of photography, some method of working similar to this had been adopted, there would have been a degree of progress quite beyond any one's anticipation. If Mr. Spiller had asked him he should have been very pleased to have brought some examples of this method for exhibition. Many years ago, when the calotype process was brought to perfection, he had been much charmed by a certain quality which photographs obtained in that way possessed; for though the collodion process gave a delicacy which was never obtained on paper for small work, still in looking at some of the grand specimens produced by Gustave Legray and others of some of the fine French cathedrals, every lover of art must admit that there was a quality there which nothing in collodion could equal or excel. On showing some of the results he had obtained by this new process to artist friends, they had told him that there was something in these pictures which they could not exactly describe, but which gave a pictorial quality they did not find in the ordinary collodion process, and he thought from what had been already obtained, that it would lead to results far surpassing anything he had yet accomplished.

Mr. Sawyer then proceeded to show the process to which Mr. Spiller had referred. Holding up two pieces of material in his hand, he said one was the printed tissue as described by Mr. Spiller, being the

* The Art of Popular Illustration,—*Journal of the Society of Arts*, March 12th.

gelatinous film prepared with a pigment, such as Indian ink, and the other was the temporary support. One side of the tissue had been in contact with the negative, and had been acted upon by light. Now, it was found that although the light had acted unequally upon the surface by reason of the gradations of the negative, yet the whole of this surface was insoluble. If that were not the case it would appear a simple matter, having exposed it to light under a negative, to slip it into hot water, and develop the picture at once. That could not be done, however, because there was a film of insolubility over the whole surface, and if this were put into hot water it would simply detach itself from the paper, the whole thing would float about as a black mass, and there would be an end of it. In order to get at the picture at all it was necessary to remove it from its support and get at the soluble portion from the back. To do this it was mounted on a temporary support, which had an adhesive character when moist, and contracted when dry. The two surfaces therefore were put together under water, all the air being thoroughly excluded, when they would adhere so long as they remained moist. These two pieces being then put together under water and pressed into contact, they became attached to each other, they were then put into hot water, the hot water attacked the soluble film, and allowed the paper to be stripped off. The pictures were developed at a temperature varying from 100° to 120°. F. The process consisted of the following steps:—1. The picture was exposed to light under the negative. 2. It was put into contact with the temporary support. 3. It was now slipped into hot water, which softened the soluble gelatine at the back, as was indicated by its oozing out round the edges of the paper. And 4. The paper on which the pigment was originally placed was stripped off. The picture was now buried in a mass of material, the greater part of which had to be washed away; but, after washing it for a few seconds in warm water, it began to appear, and very shortly it was to be seen complete.

Mr. Spiller, whilst this process was proceeding, said he might anticipate the stage at which Mr. Sawyer would arrive by showing a carbon print thus produced. The temporary support having been stripped off, it could be employed again after being rubbed over with wax and turpentine.

Mr. Taylor said he might make one remark of a historical kind with regard to the production of the *Pall Mall Gazette*, which had been shown by Mr. Spiller, and stated to be a photo-lithograph. The fact was it was a typographic process, the details of which had not been divulged, but he knew sufficient of it to know it was of that character.

Mr. Hartley suggested that the process of nature-printing, which had been shown some years ago, had suggested to Mr. Woodbury the taking an impression of the gelatine film on type metal. It would be recollected some years ago Mr. Bradbury described at the Royal Institution a method of taking impressions in metal of natural objects by means of hydraulic pressure, and in the journal of the institution some very beautiful specimens were shown. Fern leaves, seaweed, and small objects of that kind were placed on a sheet of type metal, and then, by hydraulic pressure, were so pressed into the metal that an intaglio was produced, from which impressions might be taken in printing ink so beautifully fine that it was almost impossible to detect the difference between a piece of mounted seaweed and the impression on paper, if properly coloured.

Dr. Russell, looking at the matter as a chemist, said there was one point very satisfactory to observe, namely, the permanence of the print. There was no doubt, as had been said, that photographic pictures did fade, and it was interesting to observe that the phase through which the art was now going was the use of such a permanent material as carbon, than which hardly anything of a more permanent nature could be desired. The changes which the gelatine underwent in this process were also very interesting to notice, and he wished Mr. Spiller could have given more information with regard to the changes brought about in the gelatine by combining chromic acid with it, and the reduction of the chromates. One could not help feeling the truth of what had been said about albumen, which was a most objectionable material chemically, being constantly changing, so much so that chemists had not been able to decide what its actual composition was. Whether it contained phosphorus or not was still a disputed point, and certainly the sulphur, which was always present, whether combined or not, was held there in a very feeble condition, and as albumen was just the sort of substance which would undergo decomposition, the sulphur would be liberated and act very deleteriously.

Mr. Sawyer now exhibited the finished process, and explained that the picture thus developed was still on the temporary support, and, consequently, was reversed, the right-hand side of the object appearing as the left. In order to again reverse it, it was necessary to use a paper prepared with gelatine, chrome alum, and sulphate of baryta. All that it was necessary to do was to put the picture once more in water, to float upon it the paper which was to form its final support, lift them out of the water, and hang them up to dry, when the process was complete. The temporary support was then removed, leaving the finished picture in a proper position.

The Chairman said the interesting *resumé* which Mr. Spiller had given of the progress of photography was extremely useful, for in all sciences and scientific arts which made so rapid a progress as had been the case with photography, it was necessary from time to time to look back and see what had been accomplished, and then to think over what it might be possible to attain hereafter. It was only about thirty-six years since the public were astonished by the daguerreotype process. Soon after Mr. Fox Talbot, to whom photography owed so much, brought out the calotype process, and since then the results which had been brought forward, one after the other, with such quick succession, and with such a vast development of the perfection of photographic representation, were simply overwhelming. They were, therefore, very fortunate in having a gentleman possessing the high scientific and chemical attainments of Mr. Spiller to come forward and give a recapitulation of the history of the art. On looking back, it appeared evident that one great step effected was to render the pictures more and more permanent. At an early stage a certain degree of permanence was attained, and then attention was paid to increasing the sensitiveness of the medium, the great impetus in that direction undoubtedly being the discovery of Mr. Archer, who appropriated gun-cotton to a use for which it was not originally intended by its discoverer. There are no processes now extant so sensitive as those in which collodion is used, nor any which give such minutely fine results, except the daguerreotype. But the collodion process has many advantages over the latter, in the first place being much more easily practised, whilst it also admits of the copies being much more readily multiplied. One important matter for future investigators to attend to will be to render photographic media sensitive to a greater number of rays of the spectrum. Attempts had been made in this direction, with some considerable success, by Colonel Stewart Wortley and by Mr. Vogel, of Berlin, but no sensitive film had yet been produced which is so readily affected by all the rays as the retina of the eye. Some very beautiful experiments have recently been made by Mr. Dewar, now Jacksonian Professor at Cambridge, to show that the retina is more sensitive to the most luminous rays than to the actinic rays. He proved this by a most beautiful experiment at the Royal Institution, where the eye

of a frog produced a great deflection of the galvanometer when exposed simply to the light of a common taper. Only a few days ago he was informed by Professor Stokes that before long lenses could be made completely achromatised. It was well known that crown and flint glass achromatised for any two distant points of the spectrum, but by making use of titanium glass, lenses could be perfectly achromatised, so that photographers would have all the rays of light brought to a common focus on the medium, and it should be their study to make the medium sensitive to all these rays. He had already said progress was first evinced in rendering photographs more permanent, but notwithstanding that, silver prints were still very liable indeed to fade, and he did not know of any instance where he had not been able to perceive a gradual decline of that kind of photograph. Hence these very beautiful processes which had been described that evening must be of the highest value. Photographic prints were produced by printing ink, and were as permanent as ordinary printed matter, and this very beautiful process, called heliotype, which Mr. Sawyer had described, also possessed to his mind all the attributes of a permanent process, as permanent in fact as paper, parchment, or any medium on which the photographic picture could be conveniently placed. The remarkably rapid progress of photography had been brought about by the experiments of a great number of individuals, some possessing great chemical knowledge, and others without that advantage. The emulsion process, which Mr. Spiller had called attention to, showed the advantage of these experiments eing tried both with chemical knowledge and without it, because, undoubtedly, chemists and scientific people could not know by anticipation the effect of small changes in the processes, and would recoil from making the apparently most unchemical mixtures, which, however, had produced good results. Photographic processes also had different objects. For example, sometimes it was necessary to have the most sensitive process, whilst at other times the convenience of the operator, and the powers of carrying about the plates on which to receive the image, was of importance. For this purpose the dry-plate process presented peculiar advantages under some circumstances, and it had been recently employed successfully in astronomical observations—for example, in the transit of Venus. For his own part, he should prefer the wet process for astronomical photography; but the photographers who went out to the various stations had done wisely in employing both the wet and dry methods. Lastly, he might call attention to the fact that besides pictorial delineation, photography was now being employed most successfully in the higher branches of physical investigation, in astronomical records, meteorological and magnetic registers, investigations of the properties of light, and in a number of other ways; and those who lived for another 25 years would, he believed, hardly recognise in the science and in the results of the application of the science of photography the same processes, which, even in the present day, advanced so much. In conclusion, he begged to propose a cordial vote of thanks to Mr. Spiller for his valuable paper.

Mr. Spiller, in acknowledging the vote of thanks, desired to say a word with regard to the suggestion of Dr. Russell, whose great chemical knowledge rendered any observations he made of importance. He suggested that they should pay attention to the chemical problem, and to determine what was the compound produced by the action of chromic acid upon gelatine under the influence of light. This was a question which certainly had engaged some attention, but it would require a long investigation to settle it. They would require to know what was the body formed by the nascent oxygen given off by the chromic acid, whether it combined with the gelatine to produce an organic body, or whether it escaped as oxygen gas. Certainly the chromates employed were reduced from chromic acid to chromic oxide. One word more with regard to the specimens shown that evening. Mr. Sawyer had at his invitation exhibited a process of great interest; but he had reminded them that there were two modes of producing carbon prints, one being a photo-mechanical process, such as he saw being employed at the works at Ealing on the previous day, the ink being applied by means of a lithographic roller, and the other in which the picture was produced from the tissue in the mode Mr. Sawyer had just exhibited.

Mr. Wills then proposed a vote of thanks to the Chairman, and directed attention to the number of very fine photographic specimens upon the walls.

[The paper was illustrated by a varied collection of photographic specimens, and Mr. J. R. Sawyer gave a practical demonstration of his improved mode of working the autotype process.]

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 21st, 1875; A. J. MUNDELLA, M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Carr, Mark William, C.E., 4, Woburn-place, W.C.
Creswick, H. C., 23, Gibson-square, N.
Cronk, Edwin Evans, 23, Cockspur-street, Charing-cross, S.W.
Ernst, Dr. Adolphi, University, Caracas, Venezuela.
Hamonet, Alfred, 6, Langham-street, W.
Humbert, Charles Francis, Little Nascot, Watford, Herts.
Hunter, James, 73, Belsize-park-gardens, Hampstead, N.W.
Kynaston, William, 5, Russell-square, W.C.
Ouchterlony, James, 84, Belsize-park-gardens, N.W.
Overall, John, Shacklewell-lane, Dalston, E.
Perceval, Spencer Arthur, 11, St. George's-road, Eccleston-square, S.W.
Raymond, William T., 121, Pall-mall, S.W.
Richards, Edward Harrinson, 8, Adam-street, Adelphi, W.C.
Row, Skinner, 74, Bedford-gardens, Kensington, W.
Rowe, Robert, 40, Alfred-place West, South Kensington, S.W.
Sanderson, Arthur, 84, Earl's-court-road, S.W., and 52, Berners-street, W.
Santley, Charles, 5, Upper Hamilton-terrace, N.W.
Townshend, Charles Thornton, India Museum, South Kensington, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Bergel, Samuel, 68, Kensington-gardens-square, W.
Boor, George C., Leonard-house, Green-lanes, Stoke Newington, N., and 1, Artillery-lane, E.C.
Hainsworth, James, 10, Upper Phillimore-gardens, W.
Wood, Ebenezer, 11, Rood-lane, E.C.

The paper read was:—

THE INDIA MUSEUM QUESTION.

By J. Forbes Watson, M.A., M.D., LL.D., &c.,

Reporter on the Products of India, and Director of the India Museum.

Seven years ago I had the honour of explaining in this room the details of a scheme for extending the usefulness of the India Museum by means of the preparation of sets of trade collections for distribution in this country and in India; and at the same time I took occasion to suggest that England,

which participates in all the advantages resulting from the existence of the India Museum, should likewise share in the cost of providing a suitable building for it; and I am here this evening to indicate the progress which the question has since made in public estimation, and to lay before you the actual state of the matter.

In discussing the present position and the possible future of the India Museum, it is impossible to consider it apart from the other great museums of this country, or apart from the prevailing opinions with regard to the proper functions of museums generally. This Society, which has ever been the champion of the application of science and art to practical industry, and of the introduction of scientific and artistic teaching into education, is the last body which requires to be convinced of the great services which museums can render to this cause. But it is impossible to deny that the public at large has no adequate conception of the practical importance of the objects which the existing museums promote, and feels no very warm interest in the work, looking upon it very much as it would look on the expedition for the observation of the transit of Venus, with wonder how such large sums of public money come to be spent for objects of such apparently remote usefulness. Thus the public, although it accepts whatever is done for it with a kind of hesitating gratitude, is reluctant to co-operate heartily in any efforts for the further extension of museums. At any rate the small advantage taken of the facilities afforded under the Free Libraries and Museums Act, is a proof that there is as yet no popular appreciation of the services which either of these institutions is capable of rendering. There is this to be said, however, that the whole art of using museums for the accomplishment of practical purposes has hardly as yet advanced beyond the tentative or experimental stage. The practical tendency noticeable in all the museums established or advocated during the past 25 years is due mainly to the influence of exhibitions, especially of that of 1851. Up to that time museums were institutions almost exclusively devoted to scientific purposes, and it is only since then that the idea has gained ground of using them as instruments for directly influencing practical life, by disseminating through their means information on current economic or domestic questions. I need only mention a few of the directions struck out by the pioneers of the new movement. There are museums of applied science, or technical museums, such as the one in Edinburgh, planned by the late Professor George Wilson. There are museums of applied art, like the South Kensington Museum, with which the name of Sir Henry Cole will ever remain associated. There is another direction which in the end promises to be as fruitful as any. It is that traced out by the efforts of Mr. Twining, for the establishment of museums illustrating social and domestic economy. The designation of a pioneer may likewise be justly given to Dr. Lyon Playfair, to whose consistent and eloquent advocacy the cause of museums is largely indebted. Of all these museums, however, only those referring to applied art have as yet acquired any wide sphere of influence, or have already become facts of national importance, though even their influence is still capable of great extension. I may also be allowed to mention that the special circumstances of the India Museum are particularly favourable to the development in another direction of the practical usefulness of museums, viz., towards their application to the furtherance of commerce, though as yet not much more than a few preliminary attempts could be made to give practical effect to the idea. In general, it may be concluded that, with the partial exception of the art-museums, the principal result of the past twenty-five years has been rather one of promise than of performance, consisting rather in the acquisition of a good deal of experience with regard to the proper organisation and efficient management of museums, than in the accomplishment of any practical results on a large scale.

There has, however, been no time more likely than the present to bring museums largely into request. There is a wide-spread feeling that our manufactures and our commerce will have in future to depend more on scientific knowledge than they have hitherto done. The action taken by this Society in the matter of technical education, and the labours of the Royal Commission on Scientific Education are a sufficient proof of the growing desire for technical knowledge. With regard to the defects of the present commercial training, the note of alarm was sounded a short time ago by Sir Bartle Frere, who was surprised to find that the trade of Eastern Africa was chiefly in the hands of German houses, and he attributed their success, there and elsewhere, to a superior commercial training. Eastern Africa is by no means an isolated instance. If Sir Bartle Frere had visited Polynesia or Southern America, he would have found German houses equally prominent there. To show that their education in reality prepares them for commercial enterprises of a character so unusual in the case of countries without colonies, I may mention as an instance of the thoroughness of German commercial teaching, that a distinguished writer on commercial and technical subjects lately sent me an account of the trade routes between India and Central Asia, taken from the usual course of instruction at one of the German commercial schools, and showing that even with regard to such a remote subject the knowledge possessed by an average German clerk is likely to be more correct and ample than that to be found in the offices of most of our East India houses. And the result of this attention given to geographical and natural science is not only that Germany now shares with us the honours of African explorations and Arctic expeditions—which some people might perhaps not grudge—but also begins to take year by year a larger share of the profits and influence to be derived from our position as carriers and agents for the commerce of the world.

Now, as regards the problem both of technical and commercial information, I feel convinced that mere scientific teaching will produce but slight results, and that the true solution lies mainly in the establishment of efficient technical and trade museums. Such a course is alike in accordance with the whole current of modern thought and practice throughout the entire field of their relations with external nature, as also in accordance with the most marked mental characteristics of the English race. The characteristic of modern methods, alike per-

ceptible in the case of research and discovery as in the mode of imparting information, is to increase the direct contact with nature, and to develope the power of personal observation and the art of drawing correct inferences from the observed facts, —to acquire, in short, the power of using facts instead of cultivating a mere aptitude for receiving the impressions and ideas of others. It is to the influence of these tendencies that must be attributed the more and more extended use of "object lessons" in primary education, and of laboratories and museums in the higher education. And one of the great advantages of this method is that it is applicable not only in education—*i.e.*, in the training and instruction of those preparing for practical life—but that it is likewise the most efficient method for communicating information to those who have already entered upon practical life, that is, to the active classes of the community. This is more especially true of this country. The practical classes of England depend for their knowledge almost exclusively upon experience and observation. Book learning is little used, and even less valued, and they certainly have no aptitude for assimilating abstract and theoretical ideas. Thus the influence of what may be called technical literature is exceedingly limited even in this age of print. I was surprised on the occasion of my recent experiments in Manchester, to find that I could not procure a single scientific account of cotton spinning, and curiously enough one of the fullest books on the subject seemed to be merely an English version of some lessons on cotton spinning in use at a German technical school. A collection of actual specimens or models seems to afford the best handle, so to speak, for the minds of the classes in question, for of all modes of imparting instruction a visit to a museum is most akin to direct personal experience and observation.

I have given this prominence to the problem of commercial information, because a short description of the action which the India Museum can take in this respect gives a good opportunity of pointing out some of the special features of that museum, whilst also affording an example of the practical application of principles which, in my opinion, should guide its action in other fields and be applied to all the chief or central museums throughout the country.

On the occasion of my former paper on Trade Museums, and on several occasions since, I have so fully explained the principles of arrangement with regard to them, and the mechanical details connected with their execution, that a very brief description will now suffice.

A trade museum containing ample reference to all Indian products of any commercial importance will consist of several thousand specimens, arranged in such a manner that the whole collection may be exhibited in a moderate-sized room. The specimens will be grouped in strict accordance with the established trade classification, and at the side of the Indian specimens will be placed similar articles produced in other countries, and competing with India in the markets of the world. In connection with each article there will be drawings and illustrations referring to its natural history, or to processes of manufacture; there will be cartographic illustrations of the localities and of the extent of its production, and in many cases diagrams showing the rise and fall in prices and other statistical details. By the use of such graphic methods of representing information the utmost concentration will be obtained, and it will be possible to exhibit the plates containing the information by the side of the actual product to which they refer. A trade collection of this description will represent the essence as it were of the extensive commercial collections at the India Museum, and it will at a glance supply an amount of information on each product which it would at present be utterly impossible for the public to procure from any sources accessible to it. At the same time the information afforded by these collections can be brought within reach of the mercantile community of the whole country as well as of India by the simple expedient of producing at once as many identical sets of the collections as there are places interested in Indian trade. The whole country would thus share in the advantages arising from the existence of the India Museum. It may even be considered that compact collections, like those described, will on all usual occasions be more convenient for reference than the bulkier original collections in the parent museum. It is impossible, however, to expect that the small collections can replace the original museum whenever a difficult or obscure point is in question, nor in any case which requires scientific or technical investigation. Thus, on all such occasions, reference will have still to be made to the India Museum itself. Another important function of the museum will be to keep the information supplied with the trade collections always up to the level of the times, and to take advantage of every opportunity of supplementing the gaps, which of necessity will at first be numerous.

Trade collections arranged on the above principles would be interesting, whatever the country to which they referred, even if it were one already well-known. But all the circumstances of India combine to make such collections in its case specially valuable. In the number of characteristic and valuable products, India surpasses every other country, so that the information must be interesting, whilst at the same time, the distance of India from this country, its magnitude, the character of its climate, and the small number of Europeans, render the information more difficult of attainment. Considering therefore the special interest attaching to commercial information bearing on India, and considering also that, as already mentioned, there is at the present moment a widespread feeling in favour of extending the facilities afforded in this country for commercial information in general, it is not surprising that the subject of the India Museum has of late attracted considerable attention on the part of the Chambers of Commerce of the United Kingdom, a number of whom have already given practical evidence of their belief in the value of the kind of trade collections here advocated, by subscribing for the textile work now in course of production in my department.

Let me now point out the manner in which the principles embodied in the plans for the trade museums bear upon the successful solution of the important problem indicated at the beginning of the paper, *i.e.*, upon the use of museums for

directly influencing the practical life of the country.

In the first place, the trade museums have a definite practical object in view, and will be designed solely with reference to the wants and interests of the special class vitally interested in the accomplishment of that object. A strict adherence to this principle is at the root of the practical efficiency of all museums whatsoever. At first sight it might appear that the national purpose of a museum will be better attained by keeping in view the public generally, and not a special class only. Such an opinion has a plausible sound, but it is, in reality, a dangerous fallacy, and one to which all failures of past years as regards museums and exhibitions can be directly traced. You want to influence the practical life of the country. But practical life means action, and to influence practical life you must influence the actors. Unless they are reached, no amount of general interest or sympathy on the part of non-actors will be of the least avail. It needs no explanation that the whole work of the country is done by special classes, of which each makes it its business or its vocation to do a portion of the general work of the country. The national purpose of a museum is fulfilled if the work of the country is advanced, and this is done by rendering to each worker, in his own special work, whatever assistance the museum is capable of affording. Moreover, the public at large is the sum of all special classes. If the merchant, the manufacturer, the agriculturist, the engineer, the artist, and the scientific man, have each been specially provided for, can it then be said that the public in general has been left out in the cold? I am far from denying that there are not matters in which the general public is interested as such, that is, in which the subject on which the information bears, is, or ought to be, of equal practical importance to every individual member of the public. Such subjects are, for instance, the knowledge of the laws of health, the formation of a correct public taste in art, the diffusion of those general scientific ideas which make the whole difference between a cultivated and a barren mind. I shall subsequently have occasion to show how wide is the application, even in these fields, of the principles exemplified in the plans for the trade museums. In this case, likewise, success can only be anticipated by keeping each kind of museum strictly to its special function, and keeping it clear of those details which may be all-important in the case of scientific or of business museums.

The consequences of this strict specialisation of the collections are important. By being addressed to an informed public, instead of to an ignorant one, a high standard of excellence is introduced. Whatever commercial information is of no use to the merchant, is of no use to anybody else; whatever technical information is of no use to the manufacturer, has likewise no useful purpose whatever, and so on. Every collection will thus be judged by the highest professional standard. If a collection is a scientific collection, it fails in its purpose if it does not satisfy all the conditions of scientific classification and arrangement, even though ignorant people might be taught a few notions by it. If a collection has a practical purpose, it also fails in accomplishing it, if it be not so accurate and complete that practical people will refer to it for information, although such a collection may have a certain interest for school boys, or for people not acquainted with the subject. All vague, inexact, or indefinite so-called popular knowledge is thus eliminated, and the much misused tendency of modern times towards what is called popularisation of knowledge restricted to the subjects in which alone it is of public advantage, that is to the fundamental and rudimentary principles of general science and art, but not to either pure science, or applied science, or applied art.

Another advantage of the specialisation of museums is that it introduces a test of success different from that now too commonly adopted. The real test should always be that of success in getting some work done, or in assisting towards it, and should not consist in what is called popularity, measured by the number of people who have visited a particular institution. An appeal to numbers always means an appeal to the ignorant many, and not to the informed few. It leads infallibly to popularity hunting and to a preponderance of attraction and show over solid instruction. It is quite conceivable that increased popularity may be achieved to the detriment of real work. Thus suppose that a great scientific museum like the British Museum were to adopt any regulations, which, whilst facilitating the access of the public to the scientific collections, should at the same time interfere with scientific research. I am speaking here quite irrespective of any actual arrangements at the museum, and without any intention of expressing any opinion whether that venerable institution is at the present time too much or too little accessible to the public, or, indeed, even to the men of science outside its pale. But in the above hypothetical case there would be an increase of useless popularity, and at the same time a diminution of of real useful work. Besides, it is often found that even popularity is more easily achieved by satisfying the few specially acquainted with the subject, whose authoritative approval will, as a rule, sway the opinions of the less informed masses.

The second leading principle kept in view in the plan for the establishment of trade museums is that such museums, in order to be useful to the practical classes, ought not merely to contain the materials for study or inquiry, but also a direct representation of results, *i.e.*, conclusions rendered apparent by the very mode of exhibition, description, and arrangement, so that the mere attentive inspection of the series of specimens and illustrations will enable the visitor to gather at once all the main bearings of the subject. A vitally important consequence of this method is that by systematically discarding all specimens the bearing of which on the purpose of the collection is not clear or is unimportant, and by excluding all undigested information, the size of collections is most materially reduced, and that, moreover, information compressed into such a small compass gains in clearness and in practical usefulness. Two cardinal objections to the extended use of museums are thus removed. One of the main obstacles has always been their anticipated costliness, but with small compact collections, accompanied by condensed information like those here in view, this difficulty will in a great measure vanish. Another and even more formidable objection to the use of

museums has always been their presumed scientific character, which would render them of little use except to people who already possess a considerable amount of scientific training.

This is undoubtedly true of all museums in which the specimens are arranged without reference to specific practical purposes, and are not accompanied by the necessary information. A tedious process of investigation, for which practical men are little suited, is, in that case, required in order to arrive at a practical conclusion. It is some experience of this kind which has in the popular mind rendered the word scientific too often synonymous with difficult, abstruse, or unintelligible—and which has led it to oppose practical or useful to scientific or useless information. But surely it is possible to combine science in the methods of investigation, with practical clearness in exhibiting the results of investigation. Of all the kinds of information which have ever been supplied by State effort, there is none which has a more distinctly practical character than that supplied by astronomical or meteorological observations for the guidance of the mariner, or that supplied by the maps of the Ordnance Survey to the railway engineer, to the agriculturist and merchant—or than the information obtained by the Geological Survey. And yet the methods by means of which all this practical information has been worked out, are of the most scientific and obstruse kind. In fact, the only reason why the supply of information is ever undertaken at the public cost is found in the fact that, in many cases, information which may be urgently required for the conduct of practical affairs is yet of such a nature that its elaboration necessitates an amount of skill and science which practical men cannot be expected to possess, or that it requires an amount of trouble and such a long period of patient application, that practical men cannot spare the time which they would have to devote to it in order to accomplish the work by themselves. Hence the greater the complication of a problem, the greater is the amount of science or of time required to produce conclusions available for practical use, and the more difficult becomes the position of the individual, and the greater the necessity for public action. Thus, as regards commercial information, the India Museum ought to occupy a position similar to that occupied by the before-mentioned surveys and observatories in their departments. It ought to be a skilled organisation which will gather from the natural sciences—from geography, technology, and statistics—all facts and conclusions directly applicable to Indian trade, and render them universally available for the mercantile community.

To argue that such a proceeding is useless because private trade itself would in course of time arrive at a sufficient knowledge of all the practically important facts, is to argue in complete misapprehension of the issue. In course of time, yes, but in what time, and at the cost of how many blunders and failures? If narrowly investigated, it will be found that public action in the collection and elaboration of information does not, as a rule, ensure that facts will be discovered which otherwise would not have been ultimately discovered, but solely that time is gained, that important fact is discovered sooner, and that information becomes public property in a shorter time than it would have been without public action. To illustrate the matter by a few examples; ships had sailed before the establishment of observatories, and would have gone on sailing to this day had such institutions never been called into existence, the only difference being a greater loss of life and property. Railways would have been built without the help of the ordnance maps, and mines sunk without the help of a geological survey, only there would have been more trouble and more blunders. To take another example, the existence of the South Kensington Museum has in no way originated the movement of artistic reform now pervading all England, although it has accelerated its pace. After Pugin had first traced the principle of functional truth and organic development in architecture, and after Ruskin had shown the application of the same ideas to the whole range of art, whilst Owen Jones established their application to colour and ornamentation, it was quite certain that those ideas would in time prevail, because in a progressive country like ours, all ideas founded on truth and nature will always force themselves, though gradually, into general acceptation. South Kensington has not developed a single man with artistic initiative who can be compared to those just named; nor has it added a single new idea to those which men propounded before it was ever thought of; but there are many ideas which but for it would have continued to this day as mere suggestions, instead of being already widely introduced into the practical arts of this country.

It is impossible to speak too strongly of the importance of time in practical affairs. Economy of time—saving of trouble—which means in addition to time the saving of purpose and energy are all various aspects of that systematic economy of force which is characteristic of the whole of our powerful industrial organisation. Besides, practical progress under the influence of competition becomes a race, and in a race time wins. To be indifferent whether certain points of practical information will be known sooner or later, is like being indifferent whether one goes to a certain destination by rail or by road. Thus, the trade museums here described will completely fulfil this purpose if they save a certain amount of time to practical men; if they make public property, knowledge which is now practical monopoly; if they enable each new man to start with the accumulated experience of his predecessors. Every hour saved in the acquisition of information, every letter, every journey spared leaves so much more time and energy for the conduct of business, and must result in increased profit to the individual and in increased productiveness to the country.

I have devoted so large a proportion of this paper to the consideration of the practical usefulness of the India Museum, not because I think that commercial usefulness is the sole, or indeed the most important, of the purposes to which the museum can be devoted, but because in dealing with the political importance of a full representation of the history, art, science, literature, and social condition of India, I should *otherwise* have had to rely mainly on the proof of moral

facts. Now, I am the last man to despise moral effects, but after all, to a great extent moral effects are a matter of opinion, whilst practical effects are a matter of fact; and belief in moral effects may often be founded only on the strength of conviction, or on the existence of certain predisposing sympathies, whilst the existence of practical effects is a matter of direct evidence; besides, if only moral effects are insisted on, and Englishmen, as a rule, begin shrewdly to suspect that there are no practical results to fall back upon, although, if they are once satisfied that the latter has a practical backbone in it, they are willing enough to accept, in addition, all the moral advantages.

In dealing now with the subject of the India Museum as a whole, the shortness of time at my disposal this evening prevents me from entering into any detailed description of the leading groups, or into any detailed explanation of their probable influence. For all those details I must refer to a paper which I prepared on the subject for the Oriental Congress of last year, and which has been lately published.* I will restrict myself now to a rapid sketch of the main outline of the proposals contained in that paper, and to a few remarks on the special features of the programme of action therein recommended, commenting on it especially in so far as it is likewise applicable to the management of the other great museums of the country. I need hardly say that the views which I am about to explain are entirely personal views, and in no sense divulge or foreshadow the action which the Secretary of State for India in Council may ultimately adopt.

The essence of the proposals is the erection, in a suitable position, of a building capable of affording accommodation to the India Museum and the India Library, and which would likewise provide lecture-rooms, and such other space as might be required for the purpose of an Indian Institute for inquiry, lecture, and teaching, the cost of the building being shared between India and England, whilst the institute would have to rely solely on public support.

All the leading features of the plans for the efficient management and the full and practical utilisation of the museum collections, consist mainly in an extended application of the principles explained in that part of the paper which refers to the establishment of trade museums. The main difficulty in the management of a museum is to combine scientific thoroughness with that condensation of information, and that simplicity of the results which are indispensable if the influence of museums is ever to be felt beyond a small circle of connoisseurs. The solution of the difficulty lies in a division of functions between the central museums and local museums. The first would serve mainly for the preservation and elaboration of information, and for the general advancement of science and art, whilst local museums would fulfil the function of making that information practically useful by rendering it accessible to the practical classes throughout the country. The central museum would not only be a store or reservoir of the accumulated knowledge of generations, but would likewise be a laboratory or workshop, in which the typical collections would be prepared; it would epitomise the leading features of every one of the different groups of the museum, in the same manner in which the trade collections, already described, epitomise all the practically important conclusions which can be derived from a study of the whole of the collections of raw produce and manufactures contained in the India Museum. The local museums would consist mainly of copies and reproductions of these typical collections.

It must not, however, be inferred that the usefulness of the original collections of the central museum will be exhausted the preparation of typical collections, and that all the information which the central museum is capable of affording would be embraced within their compass. The central museum, from its systematic completeness and rich stores of information, will always remain the place for final reference, and will afford an inexhaustible field for new investigations, for the working up and the digestion of crude material, and for its elaboration into the clear and methodic shape in which it is capable of being made accessible to the public. It will contain the original documents, as it were, of the inquiry, and remain the workshop in which new results will be constantly produced,—the typical collections will exhibit only its final conclusions, and bring them into circulation, thus increasing its usefulness in about the same manner that printing multiplies the usefulness of a manuscript, and thus the central museum will be more especially an institution for increasing our knowledge, whilst the typical collections will be the means of increasing the number of people who will possess that knowledge. Thus the function of the central museum, as a store of information, as a source of official reference, and as a scientific institution promoting original inquiry, is independent of the typical collections; but the latter will extend the area of its influence from the scientific and literary class to the whole commercial and manufacturing community, and to the public at large.

The advantages of typical collections are the same as those already pointed out with regard to trade collections, viz., cheapness, compactness, simplicity, and clearness. It is not difficult to prove, moreover, that for the purpose of influencing and instructing the public at large, the small typical collection will be in every way superior to the complete original collection. Take any of the collections belonging to the British Museum, or to any scientific museum. It stands to reason that in representing the natural history of plants, or of fishes, or of birds, or minerals, the untutored public will more easily assimilate the principles of scientific classification, and gather the structural progress apparent in the hierarchy of organic beings, if the collection contains only the number of specimens strictly required to bring out those main ideas in strong relief, the specimens being selected on account of their marked characteristics and typical significance. By increasing the number of specimens, the mean-

* On the Establishment in Connection with the India Museum and Library of an Indian Institute for Lecture, Inquiry, and Teaching, on its influence on the promotion of Oriental studies in England, on the Progress of Higher Education among the Natives of India, and on the Training of Candidates for the Civil Service of India. London: W. H. Allen and Co., 1875.

ing is diluted, and finally obscured altogether, in the crowd of confused and unconnected details. Take the example of palæontology. A full palæontological series of the globe, which, if it could be compiled, would be invaluable to scientific geologists, would have to consist, at a guess, of, say, 50,000 specimens. But who will deny that a small collection of, say, 200 typical forms, will be far more suitable for rendering apparent to an unskilled visitor the few rudimentary notions which explain the bearing of the palæontological remains on geological science, and which are all he can be expected to be interested in.

Or take the rooms upon rooms filled at the British Museum with Greek vases, looking to the profane so very like each other. A dozen or a score of such productions would be ample for typifying to the general public the position which the Greek vases occupy in relation to ceramic art generally. Indeed we may state as an undoubted fact, what at first sight looks like a paradox, *i.e.*, that the larger a collection the smaller the number of people who can visit it with any advantage, that is, of people who can derive from the inspection any useful ideas or conclusions.

The subject of typical collections also naturally offers itself as an illustration of another leading principle, without the systematic adoption of which it is idle to expect great and national results from the existence of museums. This principle consists in securing an organised public co-operation in carrying out the objects of the museum. It is evident that the preparation of typical collections is a very difficult undertaking. Nothing is so easy as a show of erudition, but nothing so repulsive to the general public. But to bring order and clearness to the exposition of a complex subject is a task for which only a few master-minds are qualified. The principal but most rare characteristic of our modern scientific men is the endeavour to fix certain leading types, and then to follow the variations of these types in accordance with the changes of the determining conditions. If these ideas are to be embodied in the typical collections like those here described, it is evident that this must be beyond the grasp of even the best staff which a museum can possess, and that it can only be done with the co-operation of the most eminent men of the day, each taking the groups which most nearly corresponds with the subject of his particular study. Thus as regards the India Museum, though it may be said that it is fortunate in having, in Dr. Birdwood, a man whose successful experience in dealing with similar matters in India is a tangible guarantee for entertaining hopes of a similar success in the case of the present museum, and, though on its staff there are several who have already made their mark in Indian subjects, yet it would be impossible, by their unaided efforts, to attempt the full execution of more than a few of those typical collections. Luckily, however, amongst those prominent on the field of Indian research men are not wanting who will devote time and trouble to a task of such manifest public advantage. I may mention the names of Mr. James Fergusson, of Mr. Edward Thomas, of Sir George Campbell, of the Hon. W. Egerton, and of Mr. Arthur Grote, and there are other members of the Asiatic Society who are willing to help in this work.

There is also another direction in which public co-operation is no less urgently required, *i.e.*, co-operation for the purpose of securing a full dissemination of the information obtained through the instrumentality of museums. The support of the Indian Institute, and the foundation of local museums, belong to this part of the subject. I have no time to enter into this matter, beyond mentioning the fact that the formation of an influential committee is now under consideration, for the purpose of deciding what steps should be taken in order to secure the establishment of the Indian Institute.

Allow me to wind up by a brief reference to the present location of the India Museum, and to the question of its future and permanent location. The galleries at South Kensington containing the collections of this museum, will be first opened on the 25th of May, for a conversazione given by the President of the Society of Civil Engineers, and no long delay will elapse before they are opened to the public likewise. It is out of question to expect that by that time anything like the full programme here indicated can be carried out. Only rough divisions between the main groups can be attempted at first. The special and typical collections must be the growth of years of labour, though probably the most interesting of them will be completed before the expiry of the three years' lease at South Kensington.

As regards the question of the future building, the first point is the expenditure required for it. On the subject of sharing the expenditure between England and India, I cannot add a single word to the convincing memorials presented to the Prime Minister, by the Chambers of Commerce of Manchester and Glasgow, as also by the Association of the Chambers of Commerce of the United Kingdom, which association has, in addition to a memorial already presented, adopted, at their late meeting, a resolution of following up their representations by a deputation. It is gratifying to find that the reasons which show that England should participate in the expenditure, have been sufficiently convincing to make some people inclined to think that not only a share but the whole of the expenditure should be borne by this country. Remembering the observations of John Stuart Mill in his autobiography about the advantages which accrue to an intermediate plan, from the existence of any distinct proposition of an extreme character, I am led to believe that the memorial presented by the Council of this Society in favour of paying for the whole establishment of the India Museum with English money will prove of no small assistance in securing the adoption of the intermediate course, of that recommending the sharing of the expenditure between the two countries.

As regards the amount of expenditure, it has been roughly estimated at about £100,000, which, however, would have to be spread over several years. As a certain time would have likewise to elapse before the plans could be prepared, the sum required in the current year would be but small.

Lastly, as regards the size, character, and location of the building. On all grounds of public expediency it would be of undoubted advantage to make use of the site in Charles-street already in

possession of the India-office. An India Museum then would be not only in close proximity to the office, and easily available for official reference, but it would be in the very centre of public life, and not far removed from the centre of business. The only objection ever brought forward is the want of space. Apart from the fact that the condition of the surrounding property in nowise excludes the idea of future extension, there is abundant evidence that the space already in the hands of her Majesty's Government would be ample, not only for the purposes of an India Museum and Library, but also for the location of a Colonial Museum. I may mention several facts bearing on this point. There is no difficulty in erecting a building with a net floor space of double, or even treble, that now about to be occupied by the India Museum at South Kensington, and it must be remembered that the space will be far more convenient for arrangement than the wasteful and inconveniently narrow galleries at South Kensington. There is likewise to be kept in mind that the preparation of typical collections is sure to relieve the museum of a great deal of surplus articles. Moreover, I am satisfied that, by discarding in a great measure the use of the small moveable cases, and by introducing the system of permanently fixed glass cases of large extent there will result not only a great saving in money, but likewise a surprising economy of space, accompanied by increased effect. If we are satisfied on the score of space, the other advantages of South Kensington—air and light—resolve themselves into a question of a few extra dusters and a trifling increase of the gas bill. Moreover, it cannot be left out of sight that the proposed concentration of educational museums at South Kensington cannot be effected without occupying a good deal of space, as also (as I had occasion to point out in a series of letters made public some time ago), it is to be taken into consideration that the idea of exhibitions is not nearly so dead that it could not be resucitated with a more practical programme; because, whenever the people of this country will set earnestly about the establishment of technical museums, they will discover that no such museums will be efficient unless they are constantly recruited and kept to the level of the most recent progress by an international competition at exhibitions. On all these grounds I consider that it would be bad policy to alienate permanently any buildings or ground which would render it afterwards difficult, if not impossible, to resume the exhibitions. Thus, both in the best interests of the India Museum and in those of the grand series of institutions established at South Kensington, I hold that it is best to adopt the Charles-street site as the place for the permanent location of the India Museum.

DISCUSSION.

Mr. F. Drew felt himself unable to criticise the paper generally, but with regard to the suggestion that half of the expense should be borne by England, it was quite new to him that the expense of an India Museum should be even partially borne by this country. He saw nothing inequitable in its being paid for by India, and he thought the friends of that country would be glad to see an expenditure which would be the result of bringing her more prominently before the English public, while the natives would not grudge the money spent in educating their masters. From the tone of the memorial recently sent by the Society of Arts to the Prime Minister, he supposed there was a probability of this plan being adopted, and on that supposition the next point to be considered was what would be the effect on the management. He believed that the granting of public money by Parliament meant nothing more nor less than that the Department of Science and Art should take within their grasp one more museum than they had already, and if this were the case he feared the fate of Dr. Watson and his museum must be summed up in three words—annexation, absorption, superannuation. It must be said the result would not be so bad after all, if it were placed in the hands of a department, which had produced the best and pleasantest museum in London; but it by no means followed that because they had managed a general museum well that they would be equally successful in managing an India Museum. What was wanted was a continued flow of knowledge for India, and that could best be obtained if the museum were in the hands of those immediately responsible for the government of that country.

Mr. Banerjee said the last speaker had entirely misconceived the feelings of the people of India in supposing that they would not begrudge the whole expense of this museum. As a native of India, and speaking for his countrymen, he thought they would very much object to bearing the entire expense on their own shoulders. The cost ought to be borne in the ratio of the advantage derived by each country, and with some consideration also for the relative wealth of the two nations. Now the natives of India were each taxed to the extent of about 3s. 4d. in the pound, whilst Englishmen only paid 1s. 8d., though England was at least fifteen times as wealthy. As far as he could see, the museum to be established would be more for the benefit of England, and though, as had been said, Indians did not grudge paying something to educate their masters, he thought they had paid almost enough during the last century. Year after year ten millions, or one-fifth of the whole revenue of India, was spent in England, and anybody who knew anything of political economy must be aware that such a thing was most disastrous to the trade of that country. Therefore while India would not at all hesitate to pay her fair share in the formation of this museum, the people of India hoped that in this matter, as in all others, they would have justice done to them.

Dr. Leitner agreed in many respects with both the previous speakers. There was no doubt that a large part of the Indian revenue was spent in England, but at the same time the result must be looked to in the good administration of India, and it was absolutely necessary in the interests of that country that more should be spent in the manner proposed by Dr. Watson. There was, no doubt, a danger if the views of Mr. Banerjee were solely attended to, that a continent as large as Europe, with a vast variety of interests, would be treated as an annex to an existing institution. Much as he should rejoice to see the burden lessened which was weighing down the poor people of India, he could not, in spite of his admiration for the earnestness and ability with which Dr. Watson had been following up this idea for the last fifteen years or more, but support in his own interest, and in that of the museums, the view put forward by Mr. Drew. It was a different question altogether whether England should contribute to the museum; but, looking at it practically, he thought the safest course would be to leave the matter either to the Indian Government, or to that marvellous generosity of the Indian people, which, once stimulated, had shown itself in such surprising and gratifying results. At Lahore they had a museum six times as large as the one in London, and certainly much more striking. And he hoped Dr. Watson's views as to making it

simply a museum for practical purposes would not be too closely followed; of all nations, when rightly stimulated, none was more susceptible to the idea of the grand than the great English nation, and to leave that element out of consideration would be a mistake. Whilst the scientific element should be followed, therefore, the *tout ensemble* should not be lost sight of as a means of invigorating and giving healthy and noble ideas to those who visited it; for a certain number would certainly go away with an ardent desire to consider more than they had done the interests of the great Indian empire. If he differed on any point from Dr. Watson, it would be with regard to the elimination of duplicates, for the great success which had been achieved in Germany and elsewhere had been due in very great measure to the agglomeration of similar specimens, in which eventually new specimens were found. Indeed, a great deal of Dr. Watson's own success had been attained through supplying the different centres of commerce with duplicates from his own treasures. The duplicates would help to supply the various groups under which one and the same article would be placed. For example, an emblem of Shiva, put in as a stone, would come in again under domestic economy, under ethnology, and to illustrate history, religion, mythology, and so forth. He felt bound to utter a word of caution when he saw a man like Dr. Watson entering on a course which he feared might be disastrous to himself, because to him it was due that the India Museum had been brought before the public, having been removed from its previous almost inaccessible eminence. He was quite right in urging that a proper locality should be provided for it within the immediate reach of those most interested, viz., the officials of the India-office. However great their knowledge of India might be, it never had that comprehensiveness and grasp without which all knowledge of India was worthless; and this museum would give, not only to the present and past, but to the future rulers and administrators of India, such a general view, and it ought, therefore, to be placed within their reach as well as of the natives of India who came to London to study at the medical schools and elsewhere. It would be impossible to suggest a better site than Charles-street, or a more efficient management than that which controlled the museum at the present moment. He hoped, therefore, that the Chairman, who had heretofore shown much interest in Oriental matters, would take advantage of his parliamentary position to see that if the English nation did contribute to this object, it should be done in such a way as to materially assist the object in view, by entrusting the money to the management of the India-office.

Mr. Wm. Taylor said it was a peculiar and not very creditable fact in taking a comprehensive view of the administration of India in all its departments, that so little had been done for the material prosperity and industrial productiveness of the country. We had obtained by conquest, treaty, or good management this vast country, had endeavoured to rule it well, and had given them the benefit of our laws, more so, perhaps, than some of them desired, and within the last twenty-five years we had done something for education. But that education had been wholly literary, and generally speaking very superficial, though it had raised a certain number of young men amongst the natives to the position of very excellent clerks, and there had been instances where gentlemen of superior intelligence had qualified themselves for higher appointments in which they had discharged their duties with great efficiency. Moreover, the Indian gentlemen with whom they had become acquainted at the India Association and in that society, were men of great intelligence and high character, who in every way did credit to their education, which had certainly been an English one. But what had been done to increase the industrial capabilities of the millions of people who were dependent for their existence on the produce of the little bits of ground they possessed, and the security of whose life lay at the foundation of the stability of the empire? There was an excellent museum at Lahore, and indeed he wished to except the Punjab from his remarks, because there the natives had been brought into co-operation and sympathy with the English, and there alone had the idea of practical industrial education been encouraged. He looked upon the scheme of Dr. Watson as lying at the root of the system of practical education without which he feared that great country would ere long go to the bad. The population was rapidly increasing, and there were millions of agriculturists just raising sufficient to support themselves, and how was that increase of population to be fed? Unless something were done to sustain and develop the capabilities of the country he feared for the future, and he looked upon such a museum as had been described as more calculated than anything else to develop an industrial organisation and lead to future prosperity. The system of education, like everything else, required a centre, and that could best be supplied by a museum of this kind, from which rays of light, civilisation, and industry, would be disseminated to every corner of the land. Whether the money came from India or England, he hoped it would not be wanting, and he did not think any sensible person could doubt that Charles-street was the proper site for the building.

Dr. Dresser felt a strong sympathy with Dr. Watson in the endeavours he was making to enable Englishmen to study India and its arts and manufactures more ... He had had many opportunities of observing the progress of English manufactures, and they had reaped a great advantage from the study of Indian fabrics and objects. Prior to 1851 there was a very poor class of art applied to industries, but at that time he remembered ... Herbert, whose pupil he was, calling his attention to Indian objects in the exhibition, and remarking that he could not find amongst them all a single instance of an inharmonious combination of colours. This observation was afterwards repeated publicly by Mr. Redgrave and Mr. Owen Jones, and he believed it was to a great extent the cause of the advance which had lately been made in art industries. English manufacturers had made a great deal of money by copying the ... fabrics of Algeria, China, and Japan; again, some of Minton's best productions, in a decorative point of view, were little more than re-casts of fine works from China or some other Eastern country. He was of opinion, therefore, that whatever might be the benefit to India, England, at any rate, would profit greatly from the opportunities of studying Indian productions. A short time ago he took two English manufacturers to the India Museum, where they learned some valuable lessons, but he certainly did not see why India should pay the whole expense of such an establishment. He was persuaded that with a better knowledge of each other the two nations would like each other better, and do more to aid one another. If England could show the natives of India how to make what they wanted with less labour, or could sell it to them at a less cost, and take their produce in return, it would be a great benefit to them, and therefore he considered Dr. Watson was perfectly right in endeavouring to bring the two countries into closer connection with one another.

Mr. Hyde Clarke, said it was quite true ... even the advantages gained by England, India would participate in, but the chief feature which must commend this scheme to the minds of all, was that it was calculated especially to promote the best interests of India. Mr. Banerjee had come forward to express the opinions of the people of India, and though he was not aware that steps had yet been taken to provide for popular representation, in that country, it was an example of the progress of English rule that he should have come here to the seat of Government and freely expressed his own opinions and those of his friends, which he could not probably have done so freely and fully in the time of ...

great emperors who ruled in Delhi. Notwithstanding what he had said about the grievances of India—as to which those who had examined the subject would hardly agree with him—there still remained the question, how was India to be governed for the benefit of her people? Was she to be governed by the knowledge of those people themselves, or was she to have applied to her the knowledge and experience of western civilisation? India was making progress in many respects, even in industrial education, though she did not differ so materially from other countries as to be exempt from those vicissitudes and revolutions of industry which had overtaken other nations. He believed this museum, as proposed by Dr. Watson, would subserve the great purpose of industrial advancement, but he wished to protest against the statement that we were oppressors of India instead of having assisted in every way towards its progress. Looking to past experience, it was desirable that the idea now brought forward should be realised at the earliest possible moment. Forty years ago a committee of the House of Commons sat on the subject of trade education, and it recommended the very system of instruction to which Dr. Watson had referred, and there were hopes at that time that it would be provided. They had waited forty years, but he hoped they would not have to wait forty more for what, after all, would be of much more benefit to India than to England. Whatever might be the nature of the contribution made by this country, he hoped it would not be long delayed, and he was sure, with the good feeling towards India now existing, there would be very little difficulty about the apportionment. One matter Dr. Watson had referred to, viz., that the natural consequences of the establishment of a trade museum must be the addition of a trade library, which would be the means of making the wants of India known, and would help her interests as well as those of British manufacturers.

Mr. Banerjee desired to say that he had been misunderstood, not having intended for one moment to insinuate that the English had oppressed his native country. He should be false to the lessons of history and to the facts had he made any such statement, and he would not have been there to represent the grievances of India had it not been for the English education he had received, and which he never would have obtained but for the English Government. All he meant to say was that as India was so poor it would only be fair to bear that in mind in apportioning the expense of the India museum, and to charge her with only so much as the circumstances of the case justified.

The Chairman said he was an advocate for the extension of museums of all kinds throughout the kingdom, and also for the appointment of a Minister of Education, who should have the entire control of such establishments, because the misfortune was now that museums and galleries were under different boards and trustees, very often irresponsible bodies, the result being anything but economical, useful, or harmonious. On this general subject he thought the paper exceedingly valuable, but Dr. Watson had, perhaps, a little overstated the public indifference to the question and the alleged neglect of the Free Libraries and Museums Act, which was passed some 40 years ago. It was a long time before any good work bore fruit in this country, but at present it was bearing fruit to an extent hardly recognised, particularly in London, where less was known about the working of the Act than in almost any town in England. In Birmingham, there was a grand central free library, embracing a splendid reference library, the Cervantes library collected by Mr. Brand, a glorious Shakespeare library, and a fine museum, which was being added to every day, not only by payments out of the rates, but by the stimulus which the ratepaying had given to the whole community. In Sheffield they had a central free library and three branches, and the Prince of Wales was coming down before long to open a new park and a museum. The towns which had taken advantage of the Act had found themselves so restricted in their expenditure by it, that a week ago he had introduced a Bill to amend the Act giving to local authorities the power of expending twice as much as they had been able to heretofore. He hoped, therefore, that all the large towns throughout the country would soon have, not the bleak, barren emptiness which had hitherto marked them, but instructive museums which should show them something of Oriental as well as other art, and be a source of rational amusement and instruction to the people. Perhaps Dr. Watson had dwelt rather too much on the advantage to England of the India Museum, for he believed such an establishment would be twice blessed, and that India would fully share the advantage of her connection with this country. Such a museum would not only instruct manufacturers in Oriental art, but it would also enable both them and the English people generally to appreciate better the products of India, and teach them how to develope her raw materials. They had seen something of her productive power at the time of the cotton famine; new industries had since been introduced, and from India it was expected that nearly the whole of the supply of quinine—the most valuable drug in the pharmacopœia—would be derived. There would also be a largely-increased cultivation of tea. It was quite true that India was comparatively a poor country; but what the people required was more remunerative employment, which could only be obtained, not by cultivating a bit of rice for a bare subsistence, but by introducing something which would find a market all over the world. With regard to the cost, he said unhesitatingly that England ought to be not only just, but generous. The revenue of India was hardly sufficient to meet her expenses, which had been perhaps rather too lavish where the most rigid economy was required. He was one of a small band in the House of Commons who intended to see that nothing was spent either in India or in England on Indian account which was not fairly due from India, and he should rather err on the other side than be too exacting. He regretted the unfortunate expression which had been made use of about the people of India educating their masters, because in these days all claimed to be subjects of the same sovereign, and to stand on a perfect equality; but if Englishmen were going to be educated the education was worth paying for, and they might at least pay for it themselves, and were much better able to do so. Some gentlemen were anxious that India should bear the whole expense, in order that the museum might be kept under the control of the India-office, and undoubtedly there was room for suspicion lest they should drift into the hands of the Science and Art Department; but he thought the days of the preponderance of that department were numbered, and that the whole would have to be placed under the control of a responsible minister. At the same time he thought Mr. Banerjee laid too much stress on the statement that ten millions of the Indian revenue were spent in England. If it were so it was spent exclusively for the benefit of India.

Mr. Banerjee—In pensions.

The Chairman—Not the ten millions.

Mr. Banerjee—Six or seven millions.

The Chairman said he thought the pensions of Indian officers were fairly earned in India, and if England was to govern the country at all she could not do it much more cheaply, as far as officials were concerned. If the most able engineers, scientific men, lawyers, and administrators were sent out to India, England could not be expected to pay them, and in this respect India only had to do the same as any of the colonies. He agreed with Dr. Leitner that Dr. Watson had done great service in bringing the India Museum a little nearer the earth, for formerly it was what artists' called "skied" to

such an extent that it required a man of great energy and robust constitution to make up his mind to visit it a second time. Dr. Watson might be congratulated on the fact that it would now be well seen for the first time, and that was the most important step towards getting it properly provided for hereafter. The permanent locality should certainly be convenient of access, not merely for sightseers, and it should be arranged in a scientific manner, as had been suggested by Dr. Watson, whom he hoped would long remain at the head of it. Those who knew anything of the splendid art productions of India would agree with him that it was an art education to go through an India museum. He hoped India would derive great advantage from its establishment; but that she would not do what he feared he had seen some signs of lately, Anglicise her own art productions. He begged to conclude by moving a vote of thanks to Dr. Forbes Watson.

The motion having been passed unanimously,

Dr. Forbes Watson, in reply, said an appeal had been made to him to think twice before doing anything which would involve a grant of public money from the Imperial Exchequer, for fear it should result in the museum getting under the sway of South Kensington. All he had to say on that point was this, the first thing to be considered was—what was right? If it was just that the expense should be shared between the two countries they ought not to think of the consequences. But if it did so happen that a public grant was made, he had no doubt that Parliament would see that it was properly applied in the interests of both England and India.

MISCELLANEOUS.

MILITARY TRAINING.

In the House of Lords on Monday,

The Earl of Lauderdale, in calling attention to the subject of military training in public schools and training-ships, said their lordships were aware that in this country great difficulty was experienced in getting boys or men for service in the Army or Navy. We ought to look to this while England was at peace, because war began now before one knew what he was about, and it was brought to an end before either side had time to train new levies. He was convinced that if boys were to undergo a simple system of military training, the country would have a better class of men. There was nothing boys liked better than playing at soldiers and sailors, but if they were left until they were grown up the opportunity was lost. Referring to the Volunteers, he said too much could not be urged in their favour. They came forward in defence of their country, but they knew they would be of no use unless they trained. He expressed satisfaction with the proceedings of a deputation which a few days ago waited on the Commander-in-Chief on this subject. It was pointed out to his Royal Highness that this drill would not only conduce to the health of the boys, but would engender habits of discipline and obedience. He believed the Government was disposed to do all it could to establish training-ships for the merchant service, and therefore he hoped it would do what it could to further military training in public schools.

The Duke of Richmond said he did not intend to go into the question which had been raised with reference to the position this country would be in if suddenly engaged in war. He should confine himself to the bearing of the question of the military and naval services. His noble friend began by stating that which was not quite in accordance with the fact—namely, that education was now compulsory; because, although no doubt the power of compulsion was vested in the School Boards, that by no means described what prevailed throughout the country. He was quite ready to admit with his noble friend that the drill of the character he described was of great benefit to all boys, whether intended for the Army or the Navy, by imparting to them those ideas of order, regularity, and discipline without which it was difficult to obtain fully-qualified soldiers and sailors. This subject was by no means new to them, for the Code which was issued in 1871—paragraph 24—provided that instruction of the kind might be given, and two hours a week for 20 weeks devoted to this instruction might be counted as school attendance. When, in the same year, a circular on drill was issued by the Secretary of the Educational Department to her Majesty's inspectors of schools, a memorandum was added pointing out that the arrangements for carrying out the drill must be made so as to suit the circumstances of each case. Attention was then called in the memorandum to the fact that the necessary drill could be imparted by Rifle Volunteers or by members of a Militia staff, who during the greater part of the year had not much to do. No objection was raised to this by his noble friend the Secretary of War (Lord Cardwell), so that drill was recognised by the Government, and means were taken to have it carried out in the various schools throughout the country which chose to avail themselves of it. There might be some doubt raised as to what drill was meant in the article he had referred to, and in the Code this year the word "military" was inserted so as to remove all doubts. At present, therefore, all schools might have the benefit of the drill if they choose to avail themselves of it. With regard to the Naval Services, the First Lord of the Admiralty had expressed his readiness to co-operate with the committees of the training-ships in this matter; he had visited the training-ships, and he was prepared to make provisions for having the boys drilled on board ship. With respect to the Mercantile Marine, the Bill now before Parliament would take power for drilling the boys in guns and small arms also. He thought, therefore, his noble friend would agree that, so far as this part of the education of boys in this country was concerned, the present Government was quite alive to the necessity for some step of the kind.

Earl Fortescue thought nothing could be more satisfactory than the statement made by the noble duke as to the plan adopted by the late and extended by the present Government for encouraging military and naval drill as part of the education of the country. The noble duke had spoken of drill as a preparation for the military and naval service, but there was very strong evidence from manufacturing districts that drill was highly valued as a qualification for persons employed in manufacturing operations. Sir Joseph Whitworth stated that a workman who had acquired the habit of moving promptly at the word of command was worth on the average at least 1s. 6d. a week more than a man of equal dexterity who had not acquired the habit. He was sorry drill could not be introduced into the elementary schools, though he thought the teachers of it did not receive from the masters generally the active support and countenance to which they were entitled.

Lord Sandhurst could not agree with the noble earl who brought forward this subject that the drilling of boys at school would largely effect the recruiting for the Army. He was inclined to think that the introduction of drill into the schools mentioned by the noble duke would not have a very great effect on recruiting, although it might improve very much the physical capacity of young men. In his printed notice the noble earl referred to "what is called military training in public schools and public training-ships." He presumed that the noble earl was alluding to schools of a really military character, and everybody knew that training-ships had a naval character. From having an oppor-

tunity of inspecting one of these ships, he was able to say that there was no better system of providing recruits for her Majesty's ships. But there was this important distinction between the Army and Navy:—It was possible, he believed, to employ a very great number of boys in ships profitably, whereas in our regiments the means of employing boys were very small indeed. To this fact the illustrious duke who usually sat on the cross benches (the Duke of Cambridge) drew their lordships' attention last year. It was not his wish to throw cold water on the proposal of the noble and gallant earl. To a great extent he concurred with him, and with the noble duke; but he thought a small matter of this kind ought not to be allowed to interfere with the great question of Recruiting which was to be considered in another place.

The Marquis of Lansdowne thought the teaching of drill would tend to diffuse a military spirit among the people. It had occurred to him that, as before long a number of men belonging to the Reserve Forces would be scattered about in various parts of the country, the Government would do well to consider whether, if the pay of some of them was slightly increased, they might not be made available as drill instructors in schools.

After a few words from the **Earl of Lauderdale** in reply,

The subject dropped.

AN INTERNATIONAL EXHIBITION AT PARIS.

An International Exhibition, comprising every description of machinery, apparatus, implements, &c., employed on board ship, in fisheries, and in all other sea and river industries, will be held in Paris during the ensuing summer, under the patronage of a highly-influential Commission, aided by committees for groups and classes and by foreign delegates. The Exhibition will be in the Palais de l'Industrie, Champs Elysées, in which was held the Paris Universal Exhibition of 1855; it will be opened on the 10th of July, and closed on the 15th November. For the furtherance of the interests of British exhibitors, a London Committee has been formed under the presidency of the Lord Mayor, and comprising 46 gentlemen who are fairly representative of those most concerned in all the classes of objects which will be shown. To this committee, Mr. Edmund Johnson is honorary secretary. In order to afford the fullest information to those who may require it, the committee has prepared a pamphlet, containing the official regulations for the government of the Exhibition, and also the plan of classification which has been laid down.

We learn from this pamphlet that, as might be expected, the total space reserved for British exhibitors is limited, and hence that applications, especially for the admission of heavy machinery, or when water, gas, or steam is required, should be made without delay. The general charge for floor space will be at the rate of 30s. per square yard, and wall space will be charged 15s. per square yard. All stands, glass cases, decorations, and inscriptions, must be furnished at the cost of the exhibitors (the cases not to be more than 10 ft. high), and must conform to special regulations with regard to the depth of space occupied in the respective classes. The Commissioners will, under certain circumstances, cause such works to be carried out by their own contractors at fixed charges. Books or memoirs will be admitted at 6s. per volume, and for these the necessary shelves and fittings will be furnished free of other charge by the Commission. All goods forwarded to the Exhibition will be admitted under bond, subject to the payment of duty on what is sold. Exhibitors will have the right to attach prices to their goods, to effect sales in the building, and to remove articles at hours when the Exhibition is closed to the public, on condition of immediately replacing them by others of similar character. Small portable articles, manufactured in the Exhibition, may be removed at any time; and permission may be obtained, on special terms, for the distribution and sale of samples of wines, liqueurs, and other drinks. All goods must be delivered, at the latest, on the 1st of July, and space left unoccupied after that date will be forfeited.

Exhibitors will be required to bear all expenses incurred in constructing special foundations, and in providing driving-belts, pullies, and such like gear. They will also have to supply the necessary shafting, to make their own connexions, to furnish suitable meters, and to pay for the water, gas, or steam required. Explosive and detonating substances, as such, will be excluded; but spirits, alcohol, oils, and other inflammable bodies, if contained in strong, well-closed vessels, as well as imitations of percussion caps, fuzes, lucifer matches, &c., may be exhibited under special regulations. Nothing will be admitted to the Exhibition which is not distinguished by merit, interest, or superiority of some kind. No photographs, copies, or reproductions of any objects will be permitted to be taken without the consent of the exhibitor; but the Commission reserves the right of taking general views, and the regulations make no mention of provisional patents for new inventions.

The objects exhibited will be arranged in eight groups, which are subdivided in 42 classes. The first group includes the products of seas, rivers, and lakes, whether useful as food, medicine, in the arts, or as manure. The second group includes implements and processes used in fisheries, together with all apparatus employed in the breeding and protection of fish, oysters, and aquatic birds. It therefore takes in nets, harpoons, dredges, tackle of all sorts, aquariums, breeding tanks, and even fountains and decorations. The third group, which is somewhat vaguely described as "general," consists of no less than 12 classes, which include models and sections of vessels of all descriptions, masts and rigging, cordage of all kinds, anchors, steering and lowering tackle, balloons, flags and signals, chronometers and other scientific instruments connected with navigation, including charts; furniture of all descriptions; food of every kind, including cooking apparatus, and pens, coops, and cages for live stock; yarns, threads, tissues, clothing, clothing materials, tents, canteens, and weapons; medicines, medicine chests, and surgical instruments, sanitary and ventilating contrivances, disinfectants, and "insect destroyers." The fourth group includes materials and processes, under which head, besides much that is obvious, we find mention of drawings and models of ports of refuge, basins, moles, jetties, dams, flood-gates, floating docks, bricks, tiles, slate, cement, and other materials; lighthouses, signals, rockets, buoys, &c., telegraphy as applicable to lighthouses, signal masts and semaphores, and coloured, rotatory, and electric lights. The last class of this group includes apparatus and other means of loading, stowing, unloading, and trans-shipping; fixed and travelling cranes, hoists, and shears; modes of packing; boxes and cases; and special vehicles for the shipping and unshipping of goods. The fifth group includes all forms of life-saving apparatus; the sixth, implements and equipments for maritime and coast sport, together with the products thereof, such as furs, skins, hair, feathers, &c.; and the seventh, natural or manufactured productions used on shipboard. The eighth group is educational, and comprises all the appliances, either of past times or in present use, which bear upon the history of navigation or illustrate the methods of teaching it.

In such an Exhibition as this, it is hardly necessary to say, there will be ample room for the display of the inventive ingenuity and maritime skill of Englishmen; and the English-speaking communities, if they put forth their strength, should be able to eclipse all other countries. Unfortunately, Exhibitions are not popular with

us at present. Notwithstanding this, the experiment of an International Exhibition limited to the single class of sea and river-faring people, and to the articles made for their requirements or procured by their industry, is at once novel and striking; and, just because it is calculated to call forth the warm interest of a class, it may possibly be more successful than an undertaking which, appealing to the sympathies of all, failed to touch those of any. It is desirable that the Lord Mayor, and the committee working under his presidency, should spare no effort to secure that this country shall be worthily represented in a composition in which she ought to reap a large share of the rewards—not only of the grand prizes, the diplomas of honour, and the medals in gold, silver, and bronze, which the Commissioners promise to confer upon the deserving, but also of those still more substantial rewards which commerce and enterprise bestow on all who aid them in the attainment of success. —*Times*.

THE OXUS EXPEDITION.

The *Invalide Russe* has lately received the following details as to the progress of the scientific expedition to the Oxus, and the course of the steamship *Perovsky*, which has ascended the river as far as Nukus.

The hydrographical section of the expedition had, by the 24th July, completed the description of the delta of the Oxus, the Gulf of Tusche Bas, and the shore of the Sea of Aral from this gulf to the mouth of the Kitchkiné Daria. The works executed by the expedition consist of a description of the banks of the river, soundings of its depth, ascertaining the speed of its current, and the taking of transverse sections.

The explorations made up to the present time prove that the navigation between the Kitchkiné Daria and the Amoo proper is impossible, first on account of the slight depth of the Ulkun Daria—above the mouth of the Yni Daria and of the branch which unites it with the lake of Dau Kara, in the neighbourhood of the hills of Kushkanet Tau—up to the second half of June, the time of the freshets; and, secondly, because the branches which connect the Amoo with the lakes formed near the spot where the Ulkun falls into the Kitchkiné Daria run across thick cane bushes, separating into numerous streams very sinuous and very narrow. These canes constitute the principal obstacle at this point, for the depth is nearly everywhere sufficient. At the present time communication between the district of the Amoo Daria with Kazalinsk is effected in the following manner:—The steamers, with barges in tow, enter the Kitchkiné Daria, traverse the Ulkun Daria, then the branch which unites it with the lakes, and get up as far as Kara Tau, about 70 versts (50 miles) from the mouth of the Ulkun Daria. There the disembarkation takes place, and both passengers and cargo are despatched either to the town of Chimbaï (45 versts=30 miles from the place of landing), or in the native *kayuks* (canoes) to the fort of Nukus.

The landing at Kushkanet Tau presents serious difficulties, inasmuch as the steamers cannot always near the bank. The slight depth of the river obliges them to lie broadside on, in the canes at some distance from Kara Tau. In the latter case the landing is effected by means of *kayuks*.

All these difficulties have caused the expedition to explore the eastern arm of the delta of the Oxus, discovered to be more navigable by Colonel the Baron Kaulbars, and reputed as such by the natives. The officers of the steamer *Perovsky*, attached to the expedition, were charged, with this intention, to explore the gulf of Tusche Bas, and to enter if possible the Yani Su. Notwithstanding the great difficulties of a navigation in the midst of innumerable shallows, the *Perovsky*, towing a barge, found the mouth of the Yani Su. Ascending this branch, the steamer encountered Colonel Stoletov, captain of the corvette *Zoubov*, and Major Wood, who were coming down the Kuvan Djarma from Nukus. When in the region of the lakes of Dau Kara, the steamer was obliged to make but a few strokes at a time on account of being in only four feet of water (her draught is three feet six inches). Below Dau Kara a very strong current was encountered. All these difficulties were overcome by the valiant efforts of the crew, and the steamer, after having traversed the Kuvan Djarma, entered the Amoo Daria on the 24th August near Nukus, having thus materially aided the expedition by furnishing the means of exploring the Amoo in a steamboat.

Colonel Stoletov is of opinion that definite conclusions as to the possibility of steam communication by Kuvan Djarma and the Yani Su must be postponed for a second expedition when the freshets shall have subsided.

PRODUCTION OF COD-LIVER OIL.

The great centre of production of cod-liver oil is St John's, Newfoundland; Gloucester and Boston contribute also, but on a smaller scale, to this manufacture. St. John's, however, from its vicinity to the fishing ground, does the greatest amount of business, as it is necessary for a cargo of cod to reach port and have the livers under treatment in as short a time as possible.

The process of extracting the oil is as simple as it is complete. The primary operation consists in carefully washing the livers until every trace of gall and foreign matter is removed. The livers are next placed, with a little water, in a boiler made for the purpose and heated to a temperature of 112°. The livers swell, and finally burst, when the oil contained in them rises to the top, and it is at once skimmed off. This portion of the process must be gone through in as short a time as possible, so that the oil may rise rise and be removed before the livers have time to break up and mingle with it.

One cause of the offensive taste and smell that the oil sometimes has, is the mingling of infinitesimal pieces of the liver with the oil, which afterwards putrify in it. After being skimmed off, the oil is reduced, or "boiled away," as we should say, until the water is evaporated.

Filtering is the next operation, and is gone through no less than four times, the last filter being of the finest muslin, which extracts all traces of sediment. The resultant liquid, provided the livers used were not more than twelve hours old, is said to resemble, in appearance, Sauterne wine.

It is almost entirely devoid either of colour, taste, or smell, and possesses medicinal properties of the greatest value in the treatment of pulmonary diseases. The usual yield of oil may be stated, in round numbers, at one gallon to a quintal, and the livers themselves impart about 15 per cent. of their bulk. Owing to the low temperature at which the oil is extracted, fifteen months is the longest time it will keep sweet and retain its original flavour. After that time various ingredients are mixed with it which preserve it, or rather disguise its rancid taste.

Six lectures, by Professor Frankland, on "How to Teach Chemistry," originally delivered to science teachers, will shortly be published by Messrs. Churchill, from notes taken and edited, with Dr. Frankland's sanction, by Mr. Geo. Chaloner, F.C.S.

The Council of the Senate of Cambridge University propose to offer a grace early this term for the appointment of a syndicate to consider the propriety of establishing a professorship of mechanism and engineering.

In 1861 the kingdom of Italy had 5,000 miles of telegraph; in 1874 the total had grown to 13,750 miles. In 1861 there were 225 offices and 400 instruments; in 1874, there were 1,625 offices and 2,800 instruments. In 1862, the net receipts derived from working were £48,000; in 1874, the profits had risen to £300,000.

SCIENTIFIC AND LITERARY SOCIETIES IN INDIA.

The growth of scientific and literary societies amongst the native communities is a very remarkable sign of progress and of intellectual activity which has followed upon the efforts of the Government to accomplish the education of the people of India. Mr. Clements R. Markham in his report states that there have always been societies in India, in which Europeans and educated natives meet on common ground, and such institutions continue to increase and flourish. The Bengal Asiatic Society was founded by Sir Wm. Jones, in 1774, as a centre to which individual inquirers might forward their materials, and from which they might derive assistance and advice, and the Madras Literary Society was formed in 1818. The Bombay branch of the Asiatic Society dates from the year 1804, and in 1817 it was grafted on to the Royal Asiatic Society in England as the Bombay branch. Its Journal was established 1841, and the publication has been regularly kept up ever since at intervals of one or two years. The Bombay Geographical Society, which dates from 1830, was in 1873 amalgamated with the Bombay branch of the Asiatic Society. The Medical and Physical Society, though it languished from 1863 to 1869, has now been revived, and published a large volume of transactions in 1871. The Sassoon Mechanics' Institute has 346 members, courses of lectures, and a good library of reference of 13,935 books. In Calcutta, besides the venerable Asiatic Society, there are the Bethune Society, for the promotion of intercourse between European and native gentlemen, the Dalhousie Institue, for the literary and social improvement of all classes of the community, the Bengal Social Science Association, and others. In other parts of India there are several societies such as the Rangim Literary Society, with lectures and classes established in 1857. In addition to the societies of European origin, there are now throughout India, and especially in Bengal, many associations, some of them literary or scientific, but others political, which were founded by, and are composed entirely of, natives. In Bengal, among others, there are the "People's Association" and the "Radical League." In Oudh there are three native reform clubs, at Lucknow, Faizabad, and Gonda, and three native literary societies. In the central provinces the associations appear to be chiefly formed by schoolmasters, to afford opportunities for self-improvement, but there are also native clubs. In Bombay the Students' Literary and Scientific Society consists exclusively of natives, and has 111 members. Its course of lectures, in 1873, comprised one on Comte's three stages of thought, others on free will and necessity, on the life and doctrines of Buddha, &c. The society supports three girls' schools, with 213 pupils, and has two branches at each of which lectures are also given. The information on this interesting subject from other parts of India is very incomplete, but it is clear that these native societies and institutions are advancing with rapid growth, and springing into existence in all directions.

A committee has just been formed at Florence for promoting an exhibition of mathematical and surveying instruments, to be held in September next, during the congress of Italian engineers and architects, which is to meet this year in that city.

Mr. S. Crozier, of Silkville, Kansas, has raised during the past season 150,000 silkworms, and sold their eggs in France for 1,290 dollars. Two acres of mulberry trees, four years old, furnished the food for the crop. Mr. Crozier says that Kansas will produce the best quality of silk cheaper than any country in the world.

The heaviest item of American manufacture exported is that of refined petroleum. It amounts to the figure of [illegible],000,000 dols. annually. No other manufactured article approximates this value, the next highest being lard, which is [illegible],000,000 dols. of exported value.

CORRESPONDENCE.

CAPTAIN LIERNUR'S IMPROVED SYSTEM OF TOWN DRAINAGE.

SIR,—I notice in the report of the discussion upon my paper upon this subject, that Mr. Rawlinson is stated to have said that the Southport engineer, who formed one of the deputation which visited Leyden especially to examine into this system, told him that they had found several of the Liernur closets (without water) choked up. As a matter of fact they only saw one closet in that condition, which puts a very different complexion on the case. The remark was made in disparagement of these closets, and if true would have been a serious charge, as, although it was admitted that the best water-closets might get choked up, it would have looked as if there was a special liability in the Liernur closet to this inconvenience. I think Mr. Rawlinson might have added, in justice to the system, what he must have also learned from that same engineer, that the deputation declared officially in their report that it was an undoubted fact that these closets were more inoffensive than the ordinary English water-closet. Fortunately there were three gentlemen present who bore personal evidence in confirmation of this, and who had seen no closet ever choked up. I alluded to Mr. Abbott, Dr. Buchanan (of the Local Government Board), and Mr. Flynt. It must be remembered too that water-closets can be used with this system, so that there is no prejudice to be got over by those who have those conveniences and wish to keep them.

I have been asked several times where the report upon this system by the Senior Medical Inspector of Holland, from which I quoted largely, is to be got, and I find from this that I omitted to acknowledge the source from which I obtained it. The account was specially written for, and appeared in, *Public Health*, of 16th October, and 2nd November, 1874. It was the first complete account published in this country, and the demand for it was so great that it is out of print. I have therefore had a reprint of the articles made for myself, and shall be happy to send a copy to any body desiring one.—I am, &c., ADAM SCOTT.

221, Gresham-house, London, E.C.,
16th April, 1875.

WET AND DRY CULTIVATION IN INDIA.

SIR,—In a paper which Mr. Robert H. Elliot read before the Society of Arts on the 2nd of April, he is reported to have said, referring to the contemplation of the Indian Government to introduce covered drainage in India, "There is no doubt this plan will be effectual as regards the efflorescent salts (though it is not expected that the evils will be entirely removed), but a very simple experiment will show that it must be ultimately disastrous, because the water will take up the valuable fertilising constituents of the soil as well, and so wash them down either to a great depth in the soil or into the drains, and so right out of the country, just as so much valuable manure, especially ammonia, is washed out of our well-drained lands in Scotland." Then Mr. Elliot appealed to the Marquis of Salisbury to make an experiment "in the central glass-covered square of the India-office," in order to convince himself of what Mr. Elliot considers to be nothing but his lordship's folly. In making this experiment the Marquis of Salisbury may condescend to be assisted by the experiments on this very subject conducted by Baron Liebig and Dr. Voelcker, chemist to the Royal Agricultural Society of England, and recorded in the following books:—1. Liebig's "Natural Laws of Husbandry" (chapters 2 and 3); 2. Liebig's "Letters on Modern

Agriculture" (letters 2 and 3); 3. Dr. Voelcker "On the changes which Liquid Manure undergoes in contact with different soils of known composition," *Journal of the Royal Agricultural Society of England*, 1859; and 4. Dr. Voelcker "On the Composition of Water of Land-drainage," in the same journal of 1874. I shall not attempt to fill your columns with quotations, but shall simply sum up the results of these experiments in few words. Liquid manure, or, which is the same thing, water dissolving manures from the surface-soil, which has been super-saturated with them, undergoes various changes as it passes to the covered drains, and the principal changes consist in the absorption of manurial substances, like phosphates, potash, and ammonia, by the soil through which the water percolates. This property of soil to absorb manurial substances, till it is saturated with them, cannot be ignored even in the present state of agricultural chemistry. The deeper then the drains are laid, the less will be the quantity of manure carried to them. This percolation of water is the only practical means of manuring subsoil, which must be kept in fertile condition, as several ordinary cultivated plants, not to mention sugar-cane, cotton, &c., send down their roots and rootlets to great depth in search of wood, and there cannot therefore be any waste in manuring the subsoil. In India there are, roughly speaking, five months of rain and seven months of dryness. If the land be manured just after the rainy season is closed, to be followed by months of drought and active vegetation, the danger of the loss of manure by draining when the rainy season comes is reduced to very little. And even then, as vegetation does not stop in the months of rain, the loss of manure through drainage cannot come to much. Supposing there is any loss of manure through covered drains, it is nothing compared with the loss arising from heavy showers of rain, carrying away the manured surface-soil. The advantages of covered drainage would be so great in the climate of India that I may be permitted to enumerate them in a few words—

1. Drained land can withstand drought more than undrained.

2. Drained land is less subject to the evils arising from excess of moisture. I remember to have seen for several years in Bengal, heavy showers in May, flooding fields, when the seeds were just sown, or about to be sown. The evil may not be so great as that of drought, but it is an evil notwithstanding.

3. After the periodical rains have ceased or the flood subsided, drained land will be ready for tillage operations long before the mild season (or winter) has passed away; and therefore there will be little danger of baking, cracking, and fissuring of land. Those who have any practical experience of cultivating land which was baked and cracked under a burning sun, will admit that if covered drainage can avert this misfortune, it needs no other recommendation. Any field that is periodically flooded, must be drained with brushwood as the ancient Romans used to do, or with stones where they are at hand, as was not an uncommon practice in Scotland, and it would be then safe against the drains being choked.

The great drawback of Indian agriculture is that it has been left in charge of men who are not much advanced in agricultural knowledge. The Indian Government is certainly rich enough to secure the services of a few men like Dr. Voelcker or Professor Wrightson, of the Cirencester Agricultural College, who combine "practice with science," and with whom agriculture has been a matter of serious study. Or is it that the Marquis of Salisbury is bound to confine his choice among those civil servants whose passport to lucrative and responsible offices is their knowledge of law, Greek, Latin, &c., but certainly not that of agriculture? It is not true that the people of India have more objection to the systematic study of agriculture than they had at one time to medical dissection and surgery; and the same means of persuasion and just and liberal treatment which has overcome the prejudices in the one case, will, when properly tried, overcome them in the other.—I am, &c., SRINATH DATTA.

Traprain, East Lothian, N.B., 20th April, 1875.

INSURANCE.—HAZARDOUS RATES.

SIR,—In reply to a letter from "A Fire-office Manager" which appeared in your *Journal* of the 9th inst., wherein he says "I am under some misapprehension as to the influence exercised by the 'Fire-office Committee' alluded to in my letter of the 26th March." If such is the case (which I doubt) the responsibility rests with one of its members, a manager of a Continental office having a London branch on whom I waited to obtain quotations on behalf of pianoforte insurers on terms more consistent than those demanded by English offices. He informed me he held a guarantee policy from another office on part of my property at 52s. 6d. per cent., also some on other pianoforte property at 42s. per cent., consequently he could not propose a lower rate, at the same time recommending me to memorialise the committee for reduction of premiums, through its chairman (whose name with other particulars he kindly gave), and to have the same signed by some other influential makers in the trade, further observing he would endeavour to have it "arranged among themselves" that one of the oldest and most respected members of the committee (whose name he mentioned), should propose at their next meeting a reduction of the high rates complained of, through whom, I should, probably, obtain a satisfactory reply.

A memorial thus addressed and signed, was sent on the 24th ult. (of which I herewith enclose copy). It was returned by the chairman, saying, "The committee took no cognisance of such matters, and that I was labouring under a misapprehension," similar terms to those used by "A Fire-office Manager." I would, therefore, ask why I was recommended by a member to memorialise a committee for a reduction of premiums. If no committee existed, as stated, who took cognisance of such matters!

From these facts I think your readers will agree with me, there exists an appointed body of managers, who deem it their interest to demand arbitrary and inconsistent rates disproportionate to the risk, and in excess of those charged by foreign offices for similar risks abroad, whose manufacturing operations are identical with those in England, which foreign rates are, I believe, found to be remunerative.

Your correspondent, "A Fire-office Manager," refers me to Captain Shaw's report on pianoforte factory fires, to justify the rates of premium charged thereon. He reports only on the cause and amount of damage. What we want is a profit and loss account, which I respectfully solicit the offices to supply. Those statistics will settle the question at once. If it can be shown that pianoforte manufacturers are bad customers, and their expressed grievances unfounded, they will continue to pay the present assessment or suggest a remedy by a more economical working by the offices. They might reasonably propose a reduction on the 10 per cent. commission paid to agents on all large insurances at hazardous rates, such agency entailing but little trouble, requiring no capital, and incurring no risks. The fire-office managers must know better than I the influence they have as a united body. We in the trade view the existing arrangement among themselves in the light of a combination to charge us more than we can afford to pay, not to fix a uniform rate, as clearly expressed in my former letter, wherein I stated I was paying 42s. per cent. in one office, while another demanded 52s. 6d., and formerly 63s. per cent. These rates, though charged by the respective offices as stated, press heavily on our profits. There is the strongest desire on the part of all affected to keep up friendly relations with the existing offices, and a reluctance to seek redress from other sources. It is my

earnest wish therefore that the fire-offices generally should more liberally regard our interests. They are a wealthy body, dividing large profits, obtained out of all classes and property, among others of course pianoforte manufacturers and those connected with them, consequently a mutual interest should exist which it would be well for the offices to cultivate, otherwise some means will be adopted to lighten the grievances complained of.

I am, &c., H. Brookes.

139, Hampstead-road, N.W.,
April 12th, 1875.

The following is a copy of the Memorial—

To the Fire-office Committee, Sun Fire Office, Threadneedle-street, E.C.

Pianoforte Insurances.

London, 24th, March, 1875.

Gentlemen,—The rate of premium charged on the above-named business, in which there is a large amount of capital invested, has long been felt disproportionate to the risk, and considerably in excess of foreign charges on like property, and though heavy losses sometimes occur, the accumulated amount previously paid on premiums with interest thereon, has in many instances exceeded the loss sustained by the offices.

For many years the rates have been increasing, and now assume a serious form, the magnitude of which is a heavy charge on our business, and induces us to memorialise your committee to reduce the amount of premiums forthwith for the interest of all concerned. Our opinion is that numerous instances exist where manufacturers are not fully insured, whereas if a moderate premium was charged it would justify a more prudent protection against fire, by which the offices would benefit (as a total loss seldom occurs), the agents would continue to enjoy their percentage on an increased amount insured, and thus give general satisfaction to all concerned.

Awaiting your serious consideration to these suggestions, and your favourable reply thereto,

We remain, Gentlemen, yours very respectfully,
H. Brookes and Co. (and others).

— Tomkinson, Esq., Chairman.

NEW BLOWPIPE.

Sir,—I can entirely confirm the estimate of your correspondent of the efficacy of the blowpipe he has invented. I constructed one about a year ago on precisely the same principle, which was described in the *English Mechanic*, No. 480, p. 303, and a second time, more fully, and with working drawings, in the same periodical, dated February 5, 1875, p. 535. The implement is a very valuable laboratory tool, and with arrangements which I have adopted is capable of being applied to very delicate work, as well as that for which a large volume of intense flame is required. I would, however, recommend that a diaphragm of close copper wire gauze (or some equivalent) should be interposed in the course of the tube, between the flame and the generating reservoir, as a safeguard against a possible explosion of the mixture of air and hydro-carbon vapour.—I am, &c., J. Hippisley.

81, Pulteney-street, Bath, April 14th, 1875.

ENDOWMENT FUND.

Sir,—My attention has been called to the letter which appeared in the last number of the Society's *Journal*, in which your correspondent, writing upon the question of an Endowment Fund for the Society of Arts, suggests that a Building Fund has superior claims upon the purses of its members. I would ask you to allow me to reply to your correspondent by stating that, however much I may sympathise with his desire to see our Society better housed and more adequately accommodated, I cannot but feel that a larger building would, under existing circumstances, only tend to prevent the possibility of the Society carrying out the extended action it has entered upon by absorbing its funds for maintenance and other incidental expenses.

The plan put forward by the Council for the establishment of an Endowment Fund, and in aid of which the Chairman of the Council has asked for the contributions of members, seeks to provide the necessary funds, and thereby secure the carrying on of the sectional work of the Society upon a broad and extended scale. The ordinary income of the Society will then remain free to be applied to the promotion of its general objects. When such special funds as are necessary have been obtained, I doubt not the Council will, with the co-operation of members, seek and obtain the larger accommodation which the continued growth of the Society demands, and which your correspondent, in common with many other members, feels is at present inadequate.

A. R.

THE ROMAN ALPHABET FOR INDIA.

Sir,—That which appeared to Mr. Edward Thomas to be an inaccuracy reported in the proceedings of the 19 Feb., is not so much so as he thinks. I spoke of Mr. Thomas as one of five men who organised the project of the general application of the Roman letters to the language of India; but this was the Rev. J. Thomas, a Baptist missionary. I may, however, say that I was not quite right in counting this latter gentleman with the originators of the scheme. In the middle of the year 1834, the following only were friendly to the plan:—Rev. Dr. Yates, Rev. W. H. Pearce, Rev. Dr. Duff, and Sir Charles Trevelyan; at the end of that year, however, Mr. J. Thomas's name is found in connection with it.

The early history of the movement in favour of Roman is to be found in a book, not known to many, entitled "Original Papers Illustrating the History of the Application of the Roman Alphabet to the Languages of India," edited by Monier Williams (Longmans, 1859). A persual of this will enable one to appreciate properly the labours of Sir C. Trevelyan, Dr. Duff, and others in the cause; I have been much indebted to it. I am not, however, such a plagiarist of the arguments there to be found as might be inferred from the coincidence with them of my own. I had independently thought out almost all that I had expressed to the Society, without being aware of what had been done forty years before.

In conclusion I may be allowed to say that Mr. Edward Thomas's testimony to the adaptability of the Roman Alphabet seems to me of the greatest value.—I am, &c.,

Frederic Drew.

28, Jermyn-street, April 13th.

GENERAL NOTES.

Gresham Lectures.—It appears that the nomination to vacancies as they occur among the lecturers, is alternate between those members of the Gresham Committee who are appointed by the Corporation of London, and those appointed by the Mercers' Company. It is understood that the filling up the present vacancy, occasioned by the resignation of the Rev. Jos. Pullen, the lecturer on astronomy, rests with the Corporation side of the Committee, and that they have determined to commence a reform in the administration of this bequest. They therefore intend to make the appointment annual, dependent on the popularity of the lecturer, to increase the number of English lectures, and to get rid altogether of the useless Latin lecture. It is to be hoped that the Mercers' Company will take up the question in a similar spirit.

Beet-root in Belgium.—The growth of beet-root in Belgium for the manufacture of sugar appears to be falling off, owing to its prohibition by landowners and the unwillingness of the farmers to cultivate it in consequence of its exhaustive nature, a crop of beet impoverishing the soil considerably. It is said, however, that if the farmers could act independently, considerable quantities of beet would be grown, for not only would it then be advantageous to them in a pecuniary point of view, but it would furnish them with a new and valuable food for the use of their cattle and horses. In France, on the other hand, the cultivation of beet is being extended, the pulp, after the extraction of the sugar, proving very serviceable for fattening cattle.

Saving Life at Sea.—A fourth edition of Admiral Ryder's pamphlet advocating the use of cork mattresses, which can be turned into life-belts, has just appeared. The scheme, which is now pretty generally known to the public, consists chiefly in using mattresses stuffed with granulated cork instead of hair. Each of these, tied up in a hammock or a waterproof sheet, can be at the shortest notice transformed into a life-belt, or small raft, capable of supporting a man in the water for many hours. The pamphlet gives a description of the mattresses and of the method of using them, with illustratiens, and sets forth at length the advantages likely to accrue from their use.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

April 28. — "The Protection of Buildings from Lightning." By R. J. Mann, Esq., M.D., President of the Meteorological Society. On this evening Robt. H. Scott, Esq., F.R.S., Director of the Meteorological Office, will preside.

May 5.—"Horse-shoes and Horse-shoeing." By George Fleming, Esq., Veterinary Surgeon, Royal Engineers.

May 12.—"River Pollution, and the Impurities of the Water Supplied to our Towns." By Jabez Hogg, Esq., Surgeon to the Royal Westminster Ophthalmic Hospital, President of the Medical Microscopical Society, Fellow of the Royal Microscopical Society, &c.

May 19.—"The Agricultural Statistics of India." By Clements R. Markham, Esq., C.B.

May 26.—*No Meeting.*

June 2.—"Toughened Glass." By Perry F. Nursey, Esq., C.E.

Indian Section.

Friday evenings at eight o'clock. The following arrangements have been made:—

April 23.—"The Preparation and Uses of Rhea Fibre," by Dr. J. Forbes Watson.

April 30.—"The Growth of the Factory System in India, with especial reference to the Production of Textile Fabrics, and the Relative Advantages of the British and Indian Manufacturer," by Elija Helm, Esq., of Manchester. On this evening Andrew Cassels, Esq., Member of the India Council, will preside.

May 13.—"The Russian Advance in Central Asia in its Commercial and Social aspects towards India and the East," by the Rev. James Long. On this evening the Right. Hon. Lord Napier and Ettrick, K.T., will preside.

[N.B.—The date of this meeting has been transferred from Friday, May 14, to Thursday, May 13.]

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

May 7.—"Alum Shale and its Application," by Sydney Rich, Esq.

May 21.—"Explosive Compounds." By Alfred Nobel, Esq., the founder of the Nitro-glycerine Industry.

Cantor Lectures.

The Third Course of Cantor Lectures is on "Some Forms of the Modern Steam Engine," by F. J. Bramwell, Esq., President of the Institution of Mechanical Engineers. The Course consists of four lectures, the last of which will be delivered on Monday, April 26.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. F. J. Bramwell, F.R.S., "Some Forms of the Modern Steam Engine." (Lecture IV.)
Royal United Service Institution, Whitehall-yard, 8½ p.m. Mr. John Scott Russell, "Naval Guns."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. W. L. Huskinson, "Large Estates and Large Farms v. Peasant Properties."
Royal Geographical Society, University of London, Burlington-gardens, W.
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m. Annual Meeting.
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Bentley, "Classification of Plants." (Lecture IV.)
Birkbeck Scientific Society, Southampton-buildings, W.C. Mr. R. G. Madden, "The Chemistry of Dyeing."

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor P. M. Duncan, "The Grander Phenomena of Physical Geography."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. George Frederick Deacon, "The Systems of Constant and Intermittent Water Supply, and the Prevention of Waste, with Special Reference to the Restoration of Constant Service in Liverpool."
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Rev. Joseph Mullens, "The Origin and Progress of the People of Madagascar." 2. Mr. J. J. Monteiro, "The Quissama Tribe of West Africa." Mr. Francis Galton, F.R.S., will contribute a note on the data and weight of Public-school Boys of the age of 14.

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Dr. Mann, "Protection of Buildings from Lightning."
Geological, Burlington House, W., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 4½ p.m. Annual Meeting.
Archæological Association, 32, Sackville-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 12 noon. Annual Meeting.

Thurs. ...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Mr. H. Sorby, "The Colouring Matter of the Red Group of *Algæ*." 2. Mr. A. G. Butler, "Notes on the Family *Zygænidæ*." 3. Mr. Francis H. Welch, "The Anatomy of Two Parasitic Forms of *Tetrarhynchidæ*."
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. Freeman, "History and Use of the English Language." (V.)
Royal Institution. Albemarle-street, W., 3 p.m. Prof. H. G. Seeley, "The Fossil Forms of Flying Animals."
Zoological, 11, Hanover-square, W., 8½ p.m. Annual Meeting.
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri. ......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. Helm, "The Factory System in India."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. W. N. Hartley, "Action of Heat on Coloured Liquids."
Royal Colonial Institute (at the Pall-mall Restaurant, Waterloo-place, W.C.), 8 p.m. Mr. H. G. Halliburton, "American Protection and Canadian Reciprocity."

Sat. ......Royal Institution, Albemarle-street, W., 1 p.m. Annual Meeting.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,171. VOL. XXIII.

FRIDAY, APRIL 30, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DRILL IN SCHOOLS.

The Chairman of the Council has received the following letter, showing the valuable results attending its introduction in Christ's Hospital:—

Christ's Hospital, London, E.C.
April 22, 1875.

DEAR SIR,—You expressed a wish to hear some particulars of the system of drill as carried on at Christ's Hospital, and its result on the discipline of the school. In the year 1871 instruction in drill was commenced, under my supervision, by a retired non-commissioned officer of the Artillery. The school then consisted of about 750 boys, entirely ignorant of drill, but in the course of a few months such progress had been made that they were able to pass a very creditable inspection in presence of the Commander-in-Chief. From 1871 to the present time 669 boys have passed into the school, all of whom have been taught company drill, and their marching is quite equal to that of most volunteer regiments. The salary of the drill instructor is 30s. a week, and as the whole time available for drill amounts to only about an hour and a half daily, it may fairly be said that, if it had been possible to utilise the spare time of the instructor in drilling other boys, the cost of drilling these 750 boys would have been only 15s. a week, as he could without undue strain be engaged for at least three hours daily at drill, so that the cost may be put at 2s. per 100 per week, or less if more time were employed.

I should add that the periods of drill have not been taken from school time, but that every minute has been deducted from the hours formerly given up to play. This being so, it was not desirable that the hours of drill should be long; and, in fact, two drills a week, of about twenty minutes' duration each, have been found sufficient to keep the boys up to the required standard, four or five drills a week being given to a boy for the first month after his joining the school.

The effect on the discipline of the school, and on the bearing and carriage of the boys has been very marked, and the general tone and character of the boys has shown a decided improvement. The senior boys (monitors), who act as officers of companies, have learned to render prompt obedience to their superiors, and to be more temperate and firmer in exacting it from the boys. The discipline of Christ's Hospital has been from time immemorial confided in a great degree to the monitors, and this system of delegating authority over their fellows to the senior boys, which of course necessitates constant care and watchfulness on the part of the authorities, has worked with increased efficiency, and with diminished hardship to the younger boys, since the introduction of drill, or to speak with more accuracy, the discipline which is the necessary result of drill. I may add that in many instances parents of boys have thanked me for the advantage their sons have derived from their instruction in drill at Christ's Hospital, and that many boys have applied for and received from me certificates of proficiency, with a view to being relieved from preliminary drill on joining volunteer corps.

Having briefly indicated the advantages which have in my opinion been the result of the introduction of drill to the particular institution with which I am connected, I should like to say a few words with regard to the manner in which I think a system of drill could, with least expense and greatest prospect of success, be made part of the education of boys throughout the country. The first and most important point, in my opinion, would be to insure a uniform system of inspection, and this could only be done by appointing one or more inspectors of drill to travel about the country, and report on the progress made by the different schools. These officials would doubtless be placed under the Education Board. By a system of grouping schools in different neighbourhoods a great deal of ground could be covered by a very small staff, and the reports would be much more reliable than if the inspection were carried out as, I believe, has been proposed, by some officer on the staff of each brigade depôt. Any additional expense involved by the payment of such permanent inspectors would, I think, be more than covered by the economy in the salaries of the drill inspectors, who would be appointed to teach several schools in each large town, which schools might be so grouped as to ensure a maximum amount of instruction with a very reduced staff of instructors.

Very little instruction is gained by boys after the first half-hour of drill. One of the great ends of instruction in drill is to habituate boys to give undivided attention, on which alone will follow prompt obedience to orders; and after the first twenty or thirty minutes, attention flags, and the last half-hour undoes the good effect of the first. If it were conceded that half-an-hour's drill at a time would suffice, the attendance for drill might be combined with attendance for some other school purpose, and at the Board schools might well be allowed to count for the grant. Further, whenever practicable, the boys of each school should assemble outside the school-room, and be marched to their class-room, as even the short time which they would daily give to drill, if this plan were enforced, would be of great value.

I am, dear sir,
Yours, very truly,
H. BRACKENBURY,
Major, late Depot. Bat.

Major-General Eardley-Wilmot, R.A., F.R.S.

INDIAN SECTION.

A meeting of this Section was held on Friday evening, the 23rd inst., General F. C. COTTON, C.S.I., in the chair.

The Chairman, in introducing Dr. Forbes Watson, said he would ask the meeting to consider what was thought of cotton fibre when it was first introduced in England. Probably little or nothing was thought of it. It was of very minor importance, and the old ladies thought it mattered very little whether such short fluffy stuff was made into thread or not. They could not, however, blame the merchants or statesmen of those days if they did not foresee what would become of that fibre, for few could foresee that millions would be clothed by it, and that many millions more would be employed in cultivating it, manufacturing it, and in transporting it throughout the world. But by the light of what passed then they ought to look with more interest on what was happening now. Here was a fibre which had nearly every quality possessed by cotton, and which far exceeded it in beauty and strength; it was a fibre which might be developed to any extent, and he hoped

that that night's effort would be one step towards utilising such a valuable material.

The subject brought under discussion was:—

THE PREPARATION AND USES OF RHEA FIBRE.

By Dr. J. Forbes Watson, M.A., M.D., LL.D., &c.
Reporter on the Products of India.

This will not be what is called a lecture, or a formal discourse upon the subject, but I am here for two purposes. In the first place, I wish to lay before you the present position of the question of promoting the use of Rhea fibre, and that of the various mechanical appliances which have been used for bringing it into the market—to explain, in short, how the case now stands. And secondly, I have another object in appearing here this evening, one which led me to accept with readiness the invitation I received to bring this subject before your notice. There are certain points which should be submitted for discussion, because it is expected that the Government may possibly take some action in the matter, and do a little more towards the development of the fibre, in trying to foster the growth of the plant in India, and in applying the fibre to useful purposes. I shall indicate its position, in order that I and others may get the benefit of the remarks of the many practical men who I know are present here this evening. I will make no longer preamble, because my object is to be brief, but I must say a word or two with regard to what has been done in the past. I do not go far into the past, but I may mention that it is now about 70 years since the attention of the East India Company was first directed to this fibre, and they then, as they frequently did, took some very active steps in order to see what could be done at that time in the matter. There then occurred a gap of 40 years, but in consequence of the steps then taken, attention was again directed to the fibre about 25 years ago. I shall say no more upon that stage of it, but come at once to the year 1869, when the Government of India determined to see whether something could not be done to foster the development of the trade in the fibre by obtaining the means of cleaning and preparing it for the market; and I may mention to those who are not practically acquainted with the subject, that rhea is almost identical with the China grass of commerce—it is practically the same fibre. The Chinese have been in the habit from time immemorial of preparing their so-called China "grass" by hand; they take the individual stems, break them at the top, then tear down one side and then the other; and after carrying on the operation for a time, they get a series of little bundles, which they put either on their knees or on a board, and scrape very carefully. The result of the scraping is that they get a fibre in the state you see here, and this, after being further prepared, is made into the beautiful "grass cloth" handkerchiefs and other fabrics with which we are acquainted. The preparation of the fibre is a very tedious operation. Some say that a man cannot clean more than a half a pound in a day, but from two to two and a half pounds seem to be the amount which can be cleaned by one pair of hands in China. As there are upwards of 2,000 lbs. in a ton, it is a very slow process when we want thousands of tons to produce a large trade. The slowness of the operation means dearness, and therefore, at the root of the whole trade there stands the difficulty of getting a machine which will rapidly extract the fibre from the stems in a clean state. The character of the plant to be dealt with in order to accomplish this object may be seen by the stems here, which will give a very good idea of the characteristics of the plant as grown. Here is a plant some seven or eight feet high, and I shall presently have something to say of its probable functions when grown to this length. Here is another specimen of the same plant produced in the same district, but which has been grown for a shorter period, and consists of quite slender stems. The fibre which will be produced from the plant allowed to grow to such a height will be coarser than that from the slender stems. I will now refer to the question of what happened in the year 1869. In that year the Government of India offered a prize of £5,000 for a machine which would extract the fibre from the rhea plant at a cost not exceeding £15 a ton, which fibre would be worth £50 in the market. On the other side, the Government attached conditions for which no doubt very good reasons existed, but which tended to diminish considerably the value of the prize. India is a long way off, and in the competition which took place in the year 1872 there was only one machine exhibited. I may mention that there were upwards of twenty machines entered for competition, but when it actually came to the time there was only one machine present at the competition. And this evening I am to lay before you the fibre which resulted from that machine. Having been tested, it was found that the cost of production was considerably over £15 per ton, and the fibre, when submitted to valuation, was declared to be worth only from £22 to £28 per ton. The Government, therefore, did not award the prize, but, in consideration of the enterprise shown by the firm which sent this machine for competition, gave the exhibitor and competitor a *douceur* of £1,500, and I think he very well deserved it. So far up to the year 1872. So far as the action of the Government up to that time was concerned, it had proved a failure. The theory was, and in many minds still is, that it is necessary to have the plant in a green state in order to prepare it successfully. That is a very natural conclusion, because we find that the Chinese always prepare it in a green state. They do not allow it to dry, and we know that the very best fibre has been prepared by them. Then another doctrine is, that it is impossible to "rett" the stems and so remove a certain portion of the gum. Consequently it has been thought absolutely necessary, in order to get a good mercantile article, to have a machine to operate upon it in the green state. The prize, therefore, was given for a green machine, so to speak. Others, however, in this country, who had been experimenting with the large stock of dried stems which had been sent over here, said that it was all very well to say that the Chinese fibre was the best, but that they could produce samples from the dried stems which, if not worth as much as it in the market, were worth a good deal, and the result of their experiments has been to show that a good

ticle can be produced from the dried stems. This is an important result, because it means that we can put the production of rhea upon the same footing as that of flax and hemp; whereas, if we can only deal with it in the green state, we must have all our appliances for working it up directly, and in the end there is certain to be a loss of time. It would be difficult to keep up a supply of fresh stems all the year round, so that the machines would be at a stand-still during a certain portion of the year, and the hands at a loss for something to do. To get the rhea plant therefore in a dry state, so as to work it like flax and hemp, is a matter of great importance. It is quite possible that in operating upon the green stems that you may produce a better fibre, but after all it comes to a question of cost. It seems, so far as we have come up to the present point, that by operating upon the dry stems you can prepare a fibre which will be worth from £25 to £35 a ton in the market, whilst, as before mentioned, the fibre obtained at the trial in India with fresh stems from the same plantation was valued at from £22 to £28 per ton. I wish now to say something with regard to the £50 a ton value which has been put upon the fibre. It is clear from various reasons, which I will not give in detail now, that £50 a ton is too much if we are to have the article coming into commerce to any great extent. We want a cheaper fibre than that, and cheapness is at the root of its advancement. Look at what occurred in the case of jute, which for years was sold at £8, £10, £12, and £14 a ton. We want cheap rhea fibre, and if we had it I think the same results would follow with regard to it. Then we come to the question of what will be a sufficiently cheap fibre. I simply have to offer the opinion of practical men upon this subject; and, as far as I can gather them the price at which rhea should come into the market should not exceed £35 a ton, it might be less, but we ought to get it down to £25, and I hope we shall do so. But at the root of getting it cheaply stands the question of being able to prepare it well from the dried stems. When we can do that it is very desirable to see whether it is not also possible to get a machine to operate on the green stems. But the difficulty which opposed the experiments in India was this—although there was a large quantity of rhea in India, the people who could manipulate it were some thousands of miles off. The problem was how to get to the plant the people who had the brains and understanding for manipulating it. The plant did not grow in this country, and therefore the machines had to be sent to India for competition. Another disadvantage was this, that the man who had really done something towards getting a machine had not the green stems to experiment with. It so happened that shortly after these samples were sent home for valuation, my attention was directed to the fact that this plant was being grown in the South of France, and I at once put myself in communication with a gentleman who had an estate—so it was said—devoted entirely to its growth. To my gratification, I was informed that he had a very considerable portion of ground under crop at that moment, and that in two or three months he would be able to supply my department with 25 tons of the green stems. This at once suggested an excellent opportunity for allowing the machine makers to see the plant in its green state, for although they had had tons of dried material, they had not had any of the green. The matter was laid before the Government, and sanction was given for obtaining from the South of France the whole of this crop of 25 tons. Every arrangement was made; announcements were put into the papers that each machine maker who wished would receive a certain quantity of the green stems, and an active and intelligent assistant was sent to the South of France to bring back the 25 tons. Various experiments were made in order to learn how the green stems could be carried, because it was necessary to find that out, and a good deal of thought was given to the subject. However, when our agent went to the South of France he found that the crop had dwindled down from 25 tons to 3 tons, so that I only succeeded in getting three tons of imperfectly grown stems in the green state. However, the best was made of the matter, and they were distributed for the first time to the machinists in this country, who had thus an opportunity of seeing what the green plant was like. It was one thing to deal with the dried plant, and quite another to deal with the green succulent plant. This was one step towards getting the plant, and a certain number of experiments were made. At the end of the same year, having ascertained that there were one or two other places in another district where they were growing the plant, and that it was possible to obtain more of the green stems, arrangements were made for obtaining another supply in October, and the second expedition, I am happy to say, was more successful, for several tons were obtained, most of it of a fair quality, and an opportunity was given to a considerable number to test the plant in its green state. Up to this point therefore something has been gained. A number of experiments have been made with the dried stems, and a certain number of as yet only partly satisfactory experiments have been made with the green stems; and my object this evening is to present the result of these experiments. This group consists of all the fibre which has been prepared from the dry stems, and on these cards, which will be here for some days for examination, are the different samples from the green. I may mention shortly, as the result of these experiments, that I am told by the men who have devoted time and trouble to the subject, that they have one and all, without exception, so far as the machinists of this country are concerned, come to the conclusion that it is the dry stems which should be operated upon. At the same time other persons, particularly in the Southern States of America, have been directing attention to it, and it is said that two or three machines have been lately invented which are quite capable of dealing with the plant in its green state, and I have had most promising samples sent me, said to have been turned out from these machines, but which I should have liked to have seen prepared with my own eyes. It is one of the things that one must see to be sure about it, because a very little manipulation after it is turned out of the machine will make the fibre look very nice, and one must, in order to have a fair test, see the whole thing done at the time, and see that there is no hand labour given to it, because the moment you introduce hand labour it means expense. All I

can say is, that up to the present time we are holding our hand, and there is nothing to show absolutely that any machine as yet exists which will deal successfully with this material in the green state.

I have now indicated, I think, all the practical points which it is necessary to lay before you up to this time, and I now come to the question of what is to be done next. There are a number of machines which have been invented for dealing with these stems in the dry state. It is very important that we should know which of these machines can turn out the fibre from the dried stems in the best condition. That is one point. Going back to the other problem, it is very important that we should, as far as possible, discover whether there is any machine to operate upon the green stems, and turn out a good fibre in that state. Now comes the question, whether the Government is to institute a series of experiments to test this point. I think it is likely, when the plan is laid before the authorities, that it will be decided that it would be well to extend these experiments, and have a competition between those who make machines for dealing with dry, and those who make them for dealing with the green stems. The question is, when and where the experiments should take place, and how they can best be managed? We have on hand at the present moment a sufficient quantity of dry stems for instituting a very practical series of preliminary examinations for testing the first set of machines, namely, those which deal with the dry. As regards fresh stems a good deal has been done to extend the cultivation of the rhea in the South of France, and it will be quite possible now, I think (although my French friend failed me sadly, and I do not mean to have anything more to do with him) to get twenty-five tons or more of the green plant if wanted. But, in addition to France, we have Algiers to fall back upon, where they are growing rhea to some extent, although I cannot say exactly to what extent. We have the opportunity of having, I believe, as much as 40 tons of green rhea, or *ramie*, as it is called in France, by October next. There are two crops cultivated in the course of the year in the South of France, as well as in Algiers, one of which ripens in August and the other in October. I give up all idea of suggesting, for the purpose of such experiments, the summer crop, because, in the first place, it is not so good as the second crop; and, in the second place, it is very difficult at that season of the year to carry a large quantity such as we should require in order to produce it here fresh; but later on, as my experiments at the end of last year showed, it is easy to have the stems here sufficiently moist for all practical purposes. Indeed, as a mere experimental matter, I received last autumn from Algiers some 40lbs. weight of fresh stems; and they were quite green, a few of the outside ones only being a little dried. Therefore we have proved that it is quite possible to bring from the South of France or even from Algiers green stems in a state ready to be operated upon. My idea would be this, that it would possibly be desirable to have first a preliminary series of experiments with the machines for dealing with the dry stems. We have the means of doing that to a certain extent, for there are several tons weight of dry sticks on hand, and each ton gives some [illegible] to 28 per cent. of dry fibre. I think of suggestin[g] to Government to have, in the course of two [or] three months from this time, a competition be[-]tween the persons who make the dry machines, a[nd] I expect that this will have the same result [as] the experiments conducted in Manchester [a] short time since to test the cotton-gins. We ha[d a] competition for cleaning cotton, and after the f[irst] series of trials it was proposed to have anoth[er] series, which rather shocked the exhibitors, beca[use] those who had done well did not want to ha[ve] anything more to do with the matter, but look[ing] on the first set of trials as a schooling for anoth[er] series, it seemed important to get as soon as possi[ble] the benefits of that schooling. The result of th[e] second competition was that machines which [in] the first competition turned out from 40 to 50 lbs. [of] cotton per hour, turned out the second time upwa[rds] of 100 lbs. per hour—the very same machines. I th[ink] we should have a competition operating upon [the] dry stems, and then at the end of the year anoth[er] competition, still operating upon the dry ste[ms,] for which competition a quantity could be obtain[ed] from India in the meantime. We should thus [see] the result the first schooling had produced. At [the] same time it is quite possible to have a thorou[gh] practical experiment with the green stems, [if] sanction might be given for having a certain p[or]tion of the crop, which ripens in the beginning [of] August, conveyed to this country for experim[ent] by those machinists who wish to experiment w[ith] the green stems preparatory to a competiti[on] which would take place in November, [that] being about the right time. That is one of [the] points regarding which I hope some remarks [will] be made by those present to-night. With re[gard] to the conditions of such a test, it is all very [well] to have fancy tests, but a test is wanted wh[ich] will really, thoroughly, and fairly test the qu[ali]ties of machines, and do it under conditions wh[ich] would prevent all cavilling as to the fairness [with] which the experiments were carried out. If th[e] trials do take place, the same programme fo[r in]suring a reliable result will be carried out as [was] adopted in Manchester, where everyone, I beli[eve,] had full confidence in the fairness of the result[s of] the competition. All the conditions to be app[lied] to these competitions would be publicly annou[nced,] and I will not take up your time now in sugg[esting] what they should be.

There are many other interesting points [con]nected with this fibre which I will just indi[cate.] Is it worth while to take all this trouble abo[ut it?] If we can only get it cheap enough it coul[d be] made good use of for an immense number of thi[ngs;] some persons think that it would compete wit[h the] finest qualities of flax, and others that it coul[d be] used in combination with the finest qualiti[es of] wool. It would also be very useful for ma[king] paper, by giving greater tenacity to it. It ma[y] be too expensive to be used by itself for pa[per-]making, but a small dose would give gre[ater] tenacity than the paper made with the Ch[ina] clay, now so much used, possesses. In fact, th[ere] is no fibre which has such a range of uses, a[nd] there is none for which a greater number of u[ses] will be found, if it can only be got cheaply. Th[at] is the key-note.

The prize offered by the Government of Ind[ia]

excited at the time a deal of attention, and it is necessary to consider whether it would be well to offer a prize now. I think, myself, it is unnecessary, for the great prize would be the success of one or more machines which might come to the front at the competition, because it by no means follows that one machine will be the machine *par excellence*. The fibre from the young stems is capable of being made into very fine fabrics, whilst that of the larger stems will compete with the strongest hemp grown in Russia. The machine, therefore, which deals with the young stems will be different from the one which deals with the large ones, and therefore at the end of a series of experiments it may be found that we have two or three machines, each good for different purposes. It by no means follows—and it is a root of the difficulty with regard to prizes—that one machine will be the particular machine. It was all well and necessary for the Government to offer a large prize so as to induce people to bring their machines to India, where they had the green stems to deal with, but if the Government comes forward and says—We are going to give you an opportunity of competing in this country by placing at your disposal all the conditions necessary for this purpose, then I believe many will think with me that it has done enough.

I think I have now said quite sufficient for the purpose of initiating the discussion which, I hope, will take place, for I have not the least doubt that amongst the gentlemen present this evening there are many who have paid great attention to the subject, and others who, if they have not yet turned their attention to it, are capable of doing so. The question whether any such trial as those alluded to will take place or not will soon be decided, as the matter will now very shortly come under consideration; and possibly there are some present who can give information of a practical description which may act as a guide in laying before the Government suggestions which may bear upon this question.

DISCUSSION.

The Chairman, in inviting discussion, said with regard to the proposition of having no prize, he happened to be with Dr. Watson in Manchester at the time of the cotton-gin experiments. There was no question about prizes being offered there, but the eagerness with which every one watched the success of the experiments, and to see that those conducting them were perfectly fair, showed that they understood there was a prize to work for, although there was none offered. He had no doubt it would be the same in this case.

Mr. Collyer said he had been for many years engaged in the distribution of China grass and rhea fibre, and would therefore put before the meeting the commercial aspect of the question. Dr. Watson had spoken of the difficulty in producing the fibre, but the difficulty now was greater than ever to find what to do with it when you had it. There was plenty of fibre in the country, but he was sorry to say the consumption, which used to be 100 or 200 tons a year, was almost *nil*; in fact, in the Bradford district, it had become quite a dead letter for all textile purposes. He could not say the reason for that. It was certainly not the price, for that week he had sold rhea fibre at £19 per ton, and China grass at £31, which was less than it could be imported at. This fibre had been used in Bradford for the last twenty years, he himself having sent 2,000 tons to that district, but they had now given it up, finding that goods produced from it did not sell. Up to the year 1872 the consumption was increasing, but since then there had been an absolute stoppage of demand, and the stocks which they had then on hand they had been obliged to dispose of at ruinous prices, for cordage and common purposes. It could be sold now at less than half the price manufacturers used to give for it, but yet they would not use it. It was only the previous week he was told that the last use for rhea fibre had died out. Whether it had anything to do with the invention for dissolving silk, and, if you may so call it, electrotyping yarn with it, he could not say, but certainly cotton stuffs could be produced equal to anything made from rhea fibre. Therefore, during the last two years, he had come to the conclusion that there was only one mode of bringing it into use, and that was by producing it as nearly like Russian hemp as possible, and introducing it for cordage purposes. If the opportunity afterwards arose for using it for finer purposes, no doubt it would be taken advantage of, but he was satisfied it was not for the advantage of those concerned to attempt to do too much at first. The samples on the table were very pretty, but they did not know what to do with them. At that moment he had 10,000 lbs. weight of beautiful white fibre, which he should be glad to sell at 1s. 6d. per lb., though he had previously obtained 2s. 6d. and 3s. 6d. for it. The percentage of fibre in the rhea plant was small as compared with jute, so he feared they would not be able to lay it down in London at a remunerative price to the producer. If, however, it could be imported at from £20 to £25 a ton suitable for cordage, it would command plenty of purchasers; but, as far as he could learn, they had not nearly approached that point yet. If anyone wished to try experiments on this fibre he had about 30 tons similar to the rougher samples on the table, which he should be glad to dispose of in small quantities. There was one objection to it, viz., in bulk it was crimped, and when it came to be spun into yarn by hand or machinery this was found very objectionable, causing the fibre to crinkle up, which rendered the spinning more difficult; and there was not only bark, but a considerable portion of wood in the fibre. Within his own knowledge £50,000 to £100,000 had been spent by various persons trying to introduce the fibre, and he knew one gentleman who had lost £20,000 in attempting to import China grass. He had heard before of the fibre getting into a silk mill, but the objection to it getting into silk was that when it was mixed with the silk, and the whole came to be dyed, it was impossible to get a clear even colour. The China grass received the dye differently to the silk, so that instead of getting a black colour, it looked speckled. It was not used with alpaca as it used to be. There was only one person, to his knowledge, dressing the fibre, and he dressed about one-tenth of the quantity he did four or five years ago. He did not wish by any means to throw a damper on the proposals for introducing the rhea fibre, which was admittedly stronger than any other, for he thought if it could be introduced, as he had suggested, for rope-making purposes, it would gradually make its way. During the last two or three years he had sold for such purposes something like 600 tons, and there would always be an unlimited outlet for it for such purposes, if it could be got cheap enough.

In answer to a question,

Mr. Collyer said he believed it was much stronger than hemp, Dr. Forbes Royle having given it at two and a-half times the strength. He only knew the price in the English market. With regard to the price in India he could only say that in 1870 he sent out an order through a large house for fifty tons similar to the fine sample in the centre of the table, at £65 a ton, but did not get it. In 1860 the brokers were selling China

grass at £120 a ton, and could not get a supply; in 1864, the price was £80; since when, the great bulk had been sold at from £40 to £50. The price was now being further reduced, and they were selling less than ever.

Dr. Watson said he might at once make one or two remarks with regard to the preparation of the fibre, in its bearing on the question of the demand for it in the English market. A great deal of attention was now being devoted to preparing the fibre, without going so far chemically, as was sometimes done, as to take away all the gum from it. If it were to be used so as to compete with flax, it must not be prepared in that form, although it might be very suitable for wool purposes when so prepared. A number of experiments were being made at the present time with the object of producing the fibre in such a state as still to contain a little of the gum. It was well-known that if the whole of the gum were taken out of flax, it was not so genial to work, and the same problem had to be performed with regard to this somewhat stiff article. Some of the experiments in this direction which had recently been made appeared to promise success. On the other hand, it had been considered in some quarters that the great thing was to get it in the beautiful silky state shown in some of the samples. For certain purposes no doubt that was the best, but he thought they had pretty well come to the end of those, and from what he had seen he thought the problem at present was to produce it in a fit state to compete with flax, and there were samples which promised very well. At Bradford it was used for some time for working up into ladies' skirt pieces, but there was one fatal objection to it, that it creased. That, however, had been got over, or was being got over by mixing it with wool, and some fabrics suitable for clothing were still being manfactured from it by one enterprising firm in Bradford. It had also been converted into *noils*, in which state it was being sold at 11d. per lb. At the present time there were only one or two people really giving much time to the development of its manufacturing uses, and as it happened simply to be an adjunct to other things, they could not expect very much attention to be devoted to it. It certainly seemed rather shocking to take beautiful long fibre like that and convert it into what was called "noils," a condition like tow, but it would probably pay to do so. The fact was, that notwithstanding all that had been done, the trade in this fibre was still in its infancy, and therefore he thought there were good grounds for believing that the present state of the trade which had just been described would not continue.

Mr. Cassels asked if it was as exhausting a crop to grow as jute.

Dr. Watson said if there were three or even four crops a-year, which was aimed at, there was no doubt it involved manuring. Nature never allowed a plant to grow up and be cut three or four times a-year without something being supplied to the soil in place of what was removed. At present in India it was simply being cultivated on a large Government farm for the purpose of experiment, and at one other place by a private individual. It was the same in America, in France, and in Algiers. The moment, however, there was machinery that would clean the fibre and produce it fit for manufacture there would at once be a rapid spread of cultivation. It grew very rapidly, some of the smaller stems then exhibited being probably the growth of less than six weeks.

In answer to a question whether it required irrigation,

Dr. Watson said it depended on the season of the year. During the rainy season, of course, no irrigation was required, and he thought it would be a question whether it would not be desirable in the rainy season to let it grow to its full height, because if you required dry stems to operate upon, it would be difficult to obtain them in that state during the rainy season, and therefore he thought it would perhaps be better to let the plant grow during the whole of the rainy season, and then cut it and prepare it for manipulation during the dry weather, whilst the shorter crop to be used for finer purposes might be grown during the dry season. The plant required a good soil. He believed the percentage of fibre when dry as compared with hemp was about equal.

Mr. Routledge said if that were the case he should agree with Mr. Collyer that there could be no doubt about its coming into extensive use as a substitute for hemp, because, from what had been stated, it could surely be produced as cheaply.

Mr. Collyer said the price of hemp here was about £ per ton.

Mr. Routledge said if the rhea fibre could be put at the same price, being much stronger, it would command a large sale. Retting would certainly take the kink out of it.

Dr. Forbes Watson said it was a moot point at present whether it would stand retting.

Mr. Routledge said he had received samples of it which he had tried in all ways, but he found the best method of treating it was by retting the dry stems.

Dr. Forbes Watson said that M. Moerman, in Belgium, had given great attention to the mode of treating the dry stems, and he represented that they could be retted successfully. However, that question was still, to a certain extent, *sub judice*. In some parts of the world, Sumatra for instance, they did rett it, and he himself believed it was quite possible, and the moment that was established it would compete with hemp.

Mr. Routledge said he knew a man in Java who grew it and treated it in the same way. He himself had used it for the purposes of textile manufacture; but speaking from a paper-making point of view, he should be only too glad to make use of it, and could endorse all that had been said as to its quality. There was no doubt it was about the strongest fibre you could get, and if a plentiful and cheap supply could be afforded them, paper makers would very soon get the gum out of it.

Mr. Culper asked if it was not the fact that jute was being grown in much larger quantities than ever, and although the trade in Dundee was not increasing, that was probably owing to the number of jute mills being put up in India. He should like to know whether the cultivation of jute was increasing?

Dr. Forbes Watson—Very largely within the last few years.

Mr. Culper asked if the natives in India grew the fibre, or got it wild and worked it up in large quantities.

Dr. Forbes Watson—It is not produced in quantity for any native purposes.

Mr. Culper also asked if in Dr. Forbes Watson's opinion the rhea grown in France would have the character of the straight stems now shown, because he believed a great deal had been grown in the South of France which was so very branchy that it was almost impossible to treat it in the same machine. He thought possibly by the use of ice, green stems for experimental purposes might be brought from India.

Dr. Forbes Watson said all the straight stems on the table were grown in France. In answer to a further question, he said there was no doubt the climatic influences of different countries would affect the growth of the plant to a considerable extent.

Mr. Collyer said the best he ever saw was grown in Siam. It was different to the Indian altogether, and was even preferred by the manufacturers at Bradford to China grass. It was a soft yellow fibre.

Dr. Forbes Watson, in reply to a question, said the rhea plant was grown to a small extent at the Botanic Gardens, Regent's-park, and he directed attention

specimens of the stems and leaves which had been sent him by Mr Sowerby. The plants there were cut down and had grown up again season after season for the last twenty-five years, and were very good stems. A considerable quantity was also grown in the Duke of Wellington's gardens at Strathfieldsaye, the produce of which had for the last two years been forwarded to him for experimental purposes. It would never pay, however, to grow it in this country, because only one crop a year could be obtained.

Mr. Routledge said the proper rule for growing such a plant was laid down in that room some years ago by Dr. Watson, namely, to sow it wide for seed, so as to produce a coarse branching plant, but when grown for fibre it should be set as thickly as possible.

Mr. Collyer said that week he had had some from California, and he had also seen some from the Mauritius, and in Queensland it grew very well.

The Chairman said probably there were considerable varieties of the plant, and very likely the specimen from Siam, referred to by Mr. Collyer, was a particular variety. With further knowledge and experiment they would know which was the best to cultivate.

A Member asked if the fibre was grown near the coast, and if not, whether the cost of transport would be heavy.

Dr. Forbes Watson said the cost of transport would depend upon the locality and the facilities afforded. Of course it would come much more cheaply where there was railway accommodation. The natives grew it in Assam to some extent, and besides the Government farm, it was also cultivated at Mussoorie. It could be grown near the coast if necessary. He believed an intermittent flow of salt water would be injurious to it. It was said, however, to have been grown upon a portion of the Sunderbunds, which had been reclaimed, and where the land was still saltish. He could not speak positively, however, as to the fact. He did not think it could possibly grow in salt swamps.

Mr. Culper said he heard some years ago that it was grown on the Sunderbunds.

Dr. Forbes Watson said he knew of £3,000 or £4,000 having been sunk in the experiment, which was a total failure; but he understood it had been set about in the most unpractical way, so that success could not fairly have been expected.

Captain W. Walker said he had had one single stem to experiment with, which he had put through a rolling machine in the green state, but there seemed to be a good deal of woody matter with it, so that he thought it could never be imported profitably to this country either in the dry or green state for manufacture, as the freight would kill it.

Dr. Forbes Watson said the object of getting it in the green state was simply for experimental purposes, and he believed enough could be obtained from France for that without having recourse to the expedient of using ice.

Captain Walker said he doubted very much if it were necessary to have such long fibre, because it was generally broken up when it came to be spun. He did not consider the mercantile value at present of any consequence, because he had known common jute sold as low as £5 a ton, whereas it was now worth £20 to £22. Again, Italian hemp, which was used largely in the navy, was worth about £50 a ton, so that price need not be an obstacle. The finer samples had been employed for articles depending upon fashion, and, of course, a thing which was in fashion to-day was looked upon as rubbish next year, there being no demand for it, until in the course of time it came round again.

Dr. Forbes Watson, in answer to a question whether it was difficult to grow this plant from seed, said they could not as yet grow it from seed in India. The plant was one of those in which the male and female flowers being separate and situated on different parts of the stem, the production of seed was uncertain and usually dependent on insects, and it had been thought that the absence of fertile seed from the plants in India might possibly be caused by the insects which frequent the plant in China not being indigenous to India. The plant was very readily propagated, however, by means of cuttings. He had obtained from France, and sent out to India, seed which grew very well.

Dr. Jeannerett said this question was an old tale to him, he having gone through the same thing many years ago with regard to another fibre of a similar nature—the *Phormium tenax*, or New Zealand flax. He would suggest to Dr. Watson that the influence of the Society should be rather employed upon novel products, leaving this in its present state to the manufacturers, who would be sure to make something of it if possible. It would be impossible to force the fibre on by any kind of premium, and indeed he considered it would be injurious to attempt to do so, especially looking at the immense loss which persons might incur by bieng induced to take up a matter of this kind rashly. £5,000 might not appear a large sum to the Government of India, but he certainly thought, in a political point of view, it would be a great mistake, and in fact morally wrong, to expend money in endeavouring to force forward the development of any particular fibre.

Mr. Collyer said it occurred to him that there were two kinds of machinery required in the preparation of this fibre. If used for textile purposes they wanted a machine which would entirely get rid of the brown cuticle, whilst for cordage that was not of so much importance, so that the same machine would hardly do for both.

A Member asked whether the condition of this fibre in the market was not almost parallel to that of New Zealand flax, and in a lesser degree of jute. He believed that recently jute had been sold at a lower price than ever before known.

Mr. Collyer said it was quite true the price was very low, but the consumption had not decreased, and with regard to New Zealand flax they were stopped by short supplies. With regard to this fibre, however, they could not dispose of what they had notwithstanding the low price.

Mr. Linney said as the subject of *Phormium tenax* had been introduced, he might venture to say a word or two, having taken a great interest in the question. He thought the object of that Society was as much as possible to promote the introduction of any fibre from any part of the world which was likely to be useful to the manufacturers of this country, and therefore while he felt much indebted to Dr. Watson for his able paper, he must confess to feeling that if the New Zealand flax had had the same amount of talent and attention bestowed upon it as had been devoted to this fibre by the Indian Government, and similar premiums offered for its production, it would have reached a far higher point of development. He had no jealousy of any particular article, but he thought it would be well if the Society paid attention to other fibres also.

The Chairman said the Society of Arts would no doubt be extremely pleased if Mr. Linney would read a paper on the subject of *Phormium tenax*, which would probably lead to useful discussion. The Society was doing a great deal of useful work by collecting information, and they were very greatly privileged in being able to obtain the assistance of Dr. Watson. Mr. Collyer had given very valuable information as to the state of things in Bradford, and he (the Chairman) agreed with that gentleman that a progressive attempt such as he suggested was worth much more than any attempt to force the whole material into use at once. He thought anything of this kind must be done gradually. Here was a fibre which

everybody admitted must be very useful as a substitute for hemp, and when its use was firmly established it would no doubt go on growing far beyond that point. It was now entirely in its infancy, and they knew very little of what could be done either to improve the plant itself or to utilise it. No doubt there were endless varieties of it, and further experience would show which was the most desirable to cultivate. The mode of cultivating was also entirely in its infancy, as in fact was agriculture itself. No doubt the plant would be found to be better for being grown rapidly or slowly, but all these matters would be cleared up in the course of time. He concluded by proposing a vote of thanks to Dr. Forbes Watson, which was carried unanimously.

NINETEENTH ORDINARY MEETING.

Wednesday, April 28th, 1875; Robert H. Scott, M.A., F.R.S., Director of the Meteorological Office, in the chair.

The following candidates were proposed for election as members of the Society:—

Bain, George, Mansfield-house, Hampstead, N.W.
Corzanego, Senor Don Antonio, University of Valencia, Spain.
Hall, Frederick, 1, Jermyn-street, S.W.
Hardy, Edward Septimus, 67, Strand, W.C.
Haynes, Edward, 5, Maida-vale, W., and 227-231, Edgware-road, W.
Keith, Thomas William, 6, Pembridge-crescent, Bayswater, W.
Russell, George, 1, Sussex-place, Hyde-park, W., and Golfhill, Geelong, Victoria, Australia.
Schwabe, Alfred James, 9, New Bond-street, W., and Raleigh and Grafton Clubs.
Sim, William, 1, Danes-inn, Strand, W.C.
Simmons, William Henry, 247, Hampstead-road, N.W.
Smith, James W., 2, Warrington-crescent, W.
Tasman, William James, 7, Adam-street, Adelphi, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Chintamon, Hurrychund, 4, Addison-terrace, Kensington, W.
Francis, George Futvoye, Eaton-chambers, Buckingham-palace-road, S.W.
Hannaford, Charles, 25, Pembroke-sq., Kensington, W.
Harper, H. Lewis, M.D., 19, Addison-road, W.
Hayllar, James, 15, Mecklenburgh-square, W.C.
Hewetson, John, 8, St. James's-terrace, Regent's-park, N.W.
Hilton, James, 60, Montagu-square, W.
Holden, Caleb, 51, Lupus-street, Pimlico, S.W.
Horton, Captain William, R.N., Livermore-park, Bury St. Edmunds, and 52, Grosvenor-place, S.W.
Jackson, Richard Belgrave, F.R.G.S., 16, Addison-terrace, Kensington, W.
Julyan, Sir Penrose G., K.C.M.G., C.B., 12, Spring-gardens, S.W.
Kelly, William F., 117, Ladbroke-grove-road, W.
Oppenheim, Henry, 17, Park-lane, W.
Pointer, G. H., Cheesehill Brewery, Winchester.
Sherard-Kennedy, Edward, 6, Bedford-gardens, Kensington, W.
Waller, Rev. Horace, Twywell Rectory, Thrapston.

The paper read was:—

THE PROTECTION OF BUILDINGS FROM LIGHTNING.

By R. J. Mann, M.D.,

President of the Meteorological Society, &c.

In bringing the subject alluded to in this communication under the notice of the Society of Arts, the author intends to mark the present state of exact science in regard to the matter, and to describe as compactly as may be done, consistent with intelligent and sufficient explanation, the way in which buildings may be most conveniently and certainly secured against damage from lightning.

As, however, it is the purpose of this paper to deal intelligently, rather than dogmatically and prescriptively, with the theme, attention must in the first instance be drawn to certain established principles of electrical science which underlie the explanation that has to be given. This is essentially necessary in this case, because the most absurdly inefficient, and often dangerous, attempts to protect buildings from lightning are continually encountered, and because these constructional blunders can almost always be directly traced to ignorance or misapprehension of simple and well ascertained electrical laws.

It is a familiar, and at the same time an all-important fact, that the electric force is transmitted readily through certain kinds of bodies, such as metals and moist substances, which are therefore termed conductors; and that it is transmitted with comparative difficulty through other substances, such as glass, gutta-percha, and resins, which are called "insulators."

It should be, however, understood that the rigidly scientific interpretation of this difference is, that dissimilar bodies, of whatever kind, vary in the resistance which they offer to the passage of the electrical energy, and that that passage is effected easily and readily when the resistance is small, but slowly and with difficulty when the resistance is great. In strict accuracy there is probably no such thing as an absolute electrical insulator. If a rod of glass and a rod of metal be presented to an excited electric, the electrical charge will escape through both, but very nearly the whole will go through the metal, and almost none will go through the glass. The precise proportion that will traverse each will be determined by the relative powers of resistance inherent in the glass and in the metal. The matter is spoken of, in loose terms, as if all the discharge went through the metal and none through the glass; and this answers very well for purposes of familiar explanation, because the quantity that escapes through the glass is so very trifling that it is incapable of producing any perceptible mechanical effects.

All forms of electrical machines which are constructed for producing artificial manifestations of electrical force are produced by so arranging insulators and conductors as that the force may be generated on the surface of the insulators, and then collected and conveyed by the conductors in an accumulated form, the conductors that effect the accumulation being in their turn insulated, so that the gathered force may not escape as immediately as it is engendered, and therefore before its mechanical or other obvious effects can be manifested and examined.

But the action of artificial electrical machines is also in a very large degree dependent upon another fundamental law of electrical action which is less easy to explain, but which is of such universal importance that it must be thoroughly understood and indeed be kept constantly in mind, as the great ruling power in most of the phenomena that

law next to be considered. The influential law which is here alluded to is the one which is involved in all that is recognised as "electrical induction." Whenever an insulated conducting body is brought near to another electrically-excited body, but in such a way as that it is not in actual contact with it, the insulated conductor immediately shows signs of being, as it were, sympathetically affected by the mere presence of the excited body. When the excited body is withdrawn, the sympathetically-aroused excitement in the insulated conductor subsides; when it is brought back into close neighbourhood the excitement immediately returns. This is what is called "induced electrical action," or "induced electricity."

The effect is very easily shown, in a suitably dry atmosphere, by placing an insulated conductor near to, and not in contact with, the excited prime conductor of an electrifying machine, and then taking the induced electricity from the separate conductor by means of a small carrier of copper foil, fixed upon the end of a glass or ebonite handle, and communicating the charge to the cap of a gold-leaf electrometer. The leaves of the electrometer immediately diverge, manifesting the presence of the electric force that is communicated to them. The experiment may be very pleasingly varied by making a living human body the seat of the inductive disturbance, if an operator stands upon a glass-legged stool with the finger of one hand touching the cap of the gold-leaf electrometer, and with the other arm stretched out so that an assistant can bring a long well-warmed glass jar that has been rubbed with silk and amalgam, and in that way electrically excited, over the extended arm and about a quarter of an inch away from it. Electrical disturbance is immediately produced inductively in the body of the operator, and made manifest by the divergence of the gold leaves of the electrometer; and the divergence is produced and subsides over and over again, as the excited glass jar is brought near to the arm, or is taken away. The explanation which science offers of the very remarkable phenomenon is to the effect that the insulated conductor has intrinsically mixed up with its own molecules two distinct kinds of electrical influence, be that what it may, whether essentially a specific molecular condition, as is most probable, or some superadded, and, so called, imponderable agency, and that these two kinds of electrical force are quiescent, and inappreciable, so long as they are equally balanced, and, as it were, united, throughout the entire superficial mass of the conductor; but that they become operative, and appreciable, whenever the two kinds are torn apart and held asunder. The mere approach of the excited body effects this disturbance of the natural quiescent state, and this tearing asunder, and one of the kinds is then accumulated at one end or side of the conductor, and the other kind is collected at the opposite end or side. There is a neutral point nearly midway between, but nearer to the end that is towards the exciting body, at which no electrical influence of either kind is manifested. If the exciting body is itself positively, or vitreously, electrified, the end of the excited body which is nearest to it is negatively excited, and the opposite end is positively excited; the terms positive and negative being here understood simply as convenient terms invented to distinguish the two different kinds of electrical state, or force.

The test of induced electricity, viewed in contradistinction to a communicated charge, is virtually that the state is called up and removed merely by the nearness and withdrawal of an electrically excited body. If a charge of electricity were communicated from an excited body by a momentary contact, the electrical condition would continue in the insulated conductor after the exciting body was taken away, instead of instantly disappearing as it would in the case of induced action. Also the same kind of electrical force would then be found at both ends, and all over the insulated conductor.

But here there arises a very curious, and again most important, consideration. Under the circumstance of electrical excitement being called up in an insulated conductor by the near approach of an electrically excited body, the opposite ends manifest opposite electrical conditions, and on the removal of the excited body the induced action disappears. If, however, when the disturbance has been inductively produced, the insulated conductor is momentarily touched at the far end by another conducting body in contact with the earth, as the finger of an operator, the inductively separated force belonging to the insulated conductor, which is of the same kind as that of the exciting body, rushes off to the earth; and then when the exciting body is removed, the insulated conductor does not return, as it would otherwise have done, to its natural and quiescent state, but manifests an electrically excited condition all over its surface of a kind opposite to that of the exciting body. It behaves, indeed, in all particulars as it would have done if an actual charge of that opposite kind of electrical force had been communicated to it by contact with a similarly excited body.

When the glass cylinder, or disc, of an electrical machine is positively excited by friction against the rubber, the metal points, which are in metallic communication with the insulated prime conductor, and therefore the conductor itself, become inductively electrical. The negative electricity of the inductively disturbed conductor flows off from the points to the glass to saturate its positive disturbance, and the prime conductor is consequently left overcharged with its own abandoned positive force. That is the explanation of the way in which streams of positive electricity are generated in the prime conductor of a machine by continuously rubbing its glass cylinder, or plate, against a mercurialised cushion.

It will be understood that the kind of electrical force which is manifested when a glass rod or surface is rubbed is called positive or vitreous electricity, and that the opposite kind which is produced when sealing wax, or other resinous substance, is rubbed, is called negative, or resinous electricity. These names were first used by the early discoverers in electrical science, and no more convenient or expressive designations for the conditions which they represent have since been found.

It has been shown, from the long-continued and most carefully conducted observations of De Saussure, Ronalds, Quetelet, and Lamont, that in dull fine weather the surface of the earth is always in a negative state of electrical excitement, and that the surrounding air is commonly in a posi-

tive state. M. Peltier attributes this positive tension of the air to the state of inter-planetary space. He considers that the vacant spaces of the universe are in a constantly positive state, and that the surface of the planetary spheres is kept in the opposite state of negative excitement by the influence of induction. In the absence of any more definite evidence on this point, it is, however, perhaps more philosophical and satisfactory to consider, as many other authorities do, that the positive state manifested by the air is effectively seated in the particles of moisture contained in the atmosphere, and that it has been carried up with them from the earth when they rose through evaporation. M. Becquerel has shown that the surface of the sea, and the air lying immediately over it, is as constantly in a state of positive electrical excitement as the land is in a state of negative excitement. The fine-weather positively electrical state of the air only appears over the land at some considerable elevation. This also, it must be added, is influenced in some material way by the varying positions of the sun. It is strongest in the season of short days, and weakest in the season of long ones; and there are also in every day two periods of comparatively strong, and two of comparatively weak, electrical excitement, which recur approximately at the same hours of the day and night. The positive electrical state of the higher regions of the atmosphere is also considerably diminished by deposits of moisture in the air, and with very copious and rapid deposits sometimes disappears altogether, and becomes even replaced by the opposite negative state.

It may perhaps be well here to remark incidentally that the distinguished electrician, Auguste de la Rive, inclined to attribute the electrical states, which ascend to the clouds upon the aerial vapours, to chemical changes, brought about by the reactions of the inner surface of the earth's solid shell and the subjacent molten rock with probable infiltrations of the waters of the sea into that subterranean alembic. Chemical changes of the surface-material of the earth, and the composition and decomposition of complex surfaces, no doubt have to do with electrical manifestations and disturbances, But it must also be added that human science has not yet penetrated very far into this region of research. It is, perhaps, the one field that is most immediately open to further investigation.

We are, nevertheless, after this brief glance that has been given to preliminary considerations, now fairly in a position to understand that there are present in the cloud-sustaining air all the conditions which are essential to convert it into a mighty machine for the production and accumulation of electric force. The broad masses of insulated cloud are conductors ready to receive large charges of the developed energy; these are the prime conductors and the Leyden jars of the apparatus. The surrounding spaces of clearer and drier air are the insulators that imprison the accumulating charge. And the vapours that ascend from the earth, and drift in with the winds from side regions, are the carriers and feeders of the charge; they play the part of the revolving cylinder or plate. All that is necessary for the production of a thunderstorm under these arrangements is the rapid agglomeration in one spot of very dense clouds, a result which can more easily be brought about in summer than in winter, because then the air is more abundantly charged with water, and because then a very slight degree of chill suffices to throw down copious deposits of the aqueous load. When a strong current of very abundant vapour ascends from a tract of moist and heated land into the higher regions of still calm air, where there is no moving wind to scatter the condensing vapours as they form, a powerful electrised mass of dense thunder-cloud is as sure to be formed as the prime conductor of an electrical machine is sure to become charged with sparks when its cylinder or plate is rubbed against the cushion. It will be here understood, however, that the real function of the cloud is simply the bringing into continuous electrical communication a wide stretch of electrically-charged air. It is the air-substance which receives the electrical force, and the condensed and closely-packed moisture of the cloud merely enables large tracts of it to come simultaneously into play as a continuous and connected charge. Sir William Thomson especially insists upon the fact that clouds are not indispensable to aerial charges, and disruptive discharges, of electricity. They properly act to the aerial charge exactly as the metallic coating of the Leyden jar acts to the charged glass. They facilitate the concentration of the full force of the entire connected charge upon one spot.

When a charged thunder-cloud is thus generated in the upper regions of the air and hemmed round by its circumscribing insulation, all the complicated phenomena of induction immediately appear. Other neighbouring masses of insulated and conducting cloud have their quiescent state sympathetically or inductively disturbed, and the primary mass of the storm-cloud being positively charged, their nearer parts manifest negative energy, and their further parts the opposite positive state. If an intervening layer of other cloud floats between the storm-cloud and the earth its bottom becomes positive towards the negative earth, and its top negative towards the storm-cloud. The inductive influence of a highly-charged thunder-cloud is extended in this way to almost incredible distances, amounting even to several leagues. Very commonly the inductive power of clouds quite on the far horizon is indicated by delicate instruments, like the atmospheric electrometer of Peltier, or Gourjon, in which two or three thousand turns of a wire brought from a metal globe, or a tuft of fine platinum wires, raised high in the air and continued to the ground. are wound on the way round a sensitive and delicately-poised magnetic needle. The air-space surrounding a positively charged storm-cloud is always in a state of negative excitement from the influence of induction. When a storm-cloud drifts over a fixed station a delicate electrometer first indicates the presence of negative electricity as this approaches; it then shows positive electricity while actually engaged with the cloud, and then again manifests negative excitement as the cloud passes away. When a storm-cloud hangs low over the earth, the negative reaction of that part of the ground is very largely intensified by induction, and the positive charge of the lowest portion of the cloud is in its turn also strengthened by the same agency. Storm-clouds are for the most part positive in their actual com-

muniated and accumulated charge. But it sometimes happens that negative vapours are poured out suddenly from the moist heated ground for some unascertained reason, and then negatively active storm-clouds appear. It has been found that hail-storms are generally connected with these abnormal negative cloud-charges.

When a charged thunder-cloud hangs low over the earth, all projecting bodies rising from the ground are most powerfully influenced by the inductive action, and conducting bodies, such as rods, tubes, and sheets of metal, more powerfully than bodies that have less conducting capacity. All such prominent bodies become highly charged with electrical force of an opposite character to that which is concentrated in the cloud, and which strains to escape to the cloud at the same time that the electricity of the cloud in its turn tends to escape to them. If no passage of the electrical force takes place between the prominent objects and the cloud, it is simply because for the time being the intervening layer of insulating air affords a sufficient resistance to prevent such occurrence. The cloud is then drawn nearer to the earth by the influence of the mutually tending forces, and, perhaps, is at the same time driven into closer propinquity by the wind, until at length the narrowed resistance of the air is overcome by the simultaneously heightened tension of the accumulated electricities. The lightning stroke then flashes between, and the tension is lessened. In this lightning stroke some positive electricity passes from the cloud to the earth, and some negative electricity from the earth to the cloud. The positive escape releases the negative induction of the objects placed on the ground, and the negative escape saturates and satisfies the positive charge of the cloud. In some circumstances the lightning stroke may take place through very large distances—according to Delisle and Petit as large as even nine and ten miles—especially if a kind of interrupted trail of partially conducting material is laid along its course. But for ordinary circumstances the striking distance varies between 500 and 6,500 feet.

When the lightning stroke finally takes place, it of necessity occurs through the line of smallest resistance that is open to it. It invariably falls upon the most prominent conducting substances that are offered, and this constitutes the provision upon which all proceedings for protection against lightning are primarily based; and it should here be understood that there is no doubt, or uncertainty, of any kind involved in this part of the consideration. An electrician will present a metal rod and a glass rod to the charged conductor of an electrical machine in the positive certainty that the spark will dart out upon the metal, and not upon the glass; and he will perform the experiment a thousand times without any variation in the result. That the lightning will strike upon a good conducting surface in preference to a bad one, provided the entire course of the discharge through the good conductor is an open and an easy one, is as certain as that a ball of metal will be struck by the spark of the electrical machine in preference to a lump of resin or glass.

But there is a second consideration of scarcely less consequence in the arrangements for defence against injury from lightning, namely, the well-proved fact that even the most powerful electrical discharge passes through substances affording an easy way and offering small resistance without disturbing the molecular condition of those substances in the slightest degree. It is only when it has to force its way through badly conducting bodies, which afford considerable resistance to the passage, that it effects destructive mischief, which it then brings about by severing their component molecules, so as to split up and disintegrate the mass. When good conductors are of very small dimensions, they, in their turn, also afford considerable resistance to the transmission of the electric force. But in their case the resistance tells, not in shattering the resisting mass, but in heating it. A very fine wire is rendered red hot by the passage of a powerful electrical discharge, and it may, if the discharge is energetic enough, be melted, and so disintegrated by the passage. But it is never explosively shattered, as bad conductors are, under any circumstances.

The lightning which is seen in a dark sky flashing between a storm-cloud and the earth, or between two storm-clouds, is a trail of intense sharply-defined light, often appearing to move along a zig-zag course, and occasionally dividing into two, or possibly into three branches. The duration of the light does not exceed the thousandth part of a second. This has been very ingeniously demonstrated by Professor Wheatstone, by causing a wheel with a number of spokes to rotate so rapidly that the spokes disappear, unless when the wheel is lit up by a flash of lightning, when the spokes of the rotating wheel are seen distinctly, and the wheel itself looks as if standing still, because the illumination is for so brief a time that it has ceased before the advancing spokes have materially changed their position. Professor Tyndall shows this result very prettily in his lectures at the Royal Institution, by lighting up the rotating disc by the successive discharges of a small Leyden jar, so placed that the spark occupies the focal point of a concave mirror looking towards the disc. The disc is rotated rapidly by a multiplying wheel, and the electrical machine is worked continuously, so that the Leyden jar keeps on discharging itself by overflow at repeated intervals. With each discharge the radiant spokes of the disc present themselves to the eye as if they constituted for that instant a stationary object. The exact rate of the rotation of a wheel being known, it is easy to calculate the duration of a light which lasts only long enough not to allow the onward movement of a spoke to be discovered. The lightning flash is most probably often formed of numerous successive discharges following each other in the most rapid succession, and when this is the case the duration of the light may be somewhat prolonged. The author of this communication has distinctly seen the lightning in the subtropical districts of Southern Africa quivering for quite notable instants from this cause, and seemingly widened into straps or bands, having an appreciable breadth. The broad sheets of lightning-illumination, which are commonly observed during the prevalence of a storm, are, however, quite distinct from these lines of luminous discharge. They appear to be due to the leaping of electric discharges of much lower intensity, from cloudlet to cloudl-

as the re-distribution and re-adjustment of the electric force takes place within the constituent masses of the cloud, exactly as happens in the "spangled pane" of the electrician when the electric discharge is made through the diamond-shaped masses of tinfoil distributed upon glass. The sheet lightning of the horizon is merely the reflection of the light propagated from discharges that are taking place beyond the visible part of the earth's curvature.

There is yet another form of lightning which is of exceeding interest to the electrician, and which is characterised by prolonged endurance and slow movement. This form has the aspect of a ball of fire, often as large as a child's head, which travels slowly and perceptibly along the ground, and finally explodes like a bomb-shell, with a loud detonation, scattering zigzag rays in all directions. These ball lightnings have been watched in their slow march through the air, even as long as eight and ten seconds, and they constitute the kind of lightning that has been most commonly noticed in the interior of houses. They are essentially the lightnings that "disappear up the chimney!" Their true character is, perhaps, yet but imperfectly understood. They certainly differ in essential particulars from the ordinary lightning stroke. They are not electrical discharges pure and simple. Auguste de la Rive inclined to consider them of the nature of compact balloons of explosive gas generated by electrical agency, and shining by inherent luminosty before being finally exploded. Mr. Varley suggested the very ingenious probability that the ball is really a luminous brush discharge from a negatively charged cloud, leading gradually up to the final burst, and moving slowly forward with the charged mass, of which it is the escaping terminal.

The luminous line marking the course of a lightning discharge is really a "crack" produced in the resisting substance of the air when the pent up and accumulated force finally breaks a way through the resistance. Sir William Thomson speaks of it as being as much a crack as the fissure made by the escape of an over intense charge through a weak point in the glass, the only difference in the two cases being that the crack remains in the glass, but is immediately effaced in the substance of the air. "The path is prepared beforehand by induction." Mr. W. H. Preece has very graphically and admirably expressed the actual state of the case in an excellent paper read in 1872 to the Society of Telegraph Engineers, in which he says:—"The particles of air or other matter in the path are raised to such a high state of polarisation that they are in a state of 'tottering equilibrium,' and the slightest acquisition of force or diminution of resistance, either by the approach of the conductor or increase of quantity, destroys this condition, and we have a discharge with all the effects of light, heat, and mechanical energy. A ship sailing calmly over the ocean, a moving railway-train, a horseman galloping home for shelter from the approaching storm, may prove the last straw to break this camel's back."

The light which is seen along the course of a discharge of lightning is unquestionably incandescent matter distributed along the track. This is now definitely proved by the employment of the spectroscope. M. Fusinieri, who gave much attention to this bearing of the subject, had, however, arrived at this conclusion long before the spectroscope was known. He satisfied himself that lightning always contains material substances, and super-eminently iron, sulphur, and carbon in a state of great division, and also of ignition and combustion. M. Fusinieri conceived that the lightning derived this substantial pabulum of its fires from the molecules of these substances that are always floating about as impalpable impregnations in the air. But it is most probable that particles are taken up by the electric discharge from the conducting bodies that form part of its course, and carried along with it. Numerous very curious instances of this absorbing and transporting action are on record. The remarkable case spoken of by M. de la Rive, in which a gold bracelet was taken up from the arm of a lady closing a window during a flash of lightning, without doing her any material harm, is well known. There are instances in which particles of gold seemed to have been transported through the actual substance of thick plates of silver. The removing of the gilding from the frames of pictures by lightning is of frequent occurrence. The author of this paper remembers one case, in which the particles of gold had been stripped away from the picture-frames in a room that was damaged by lightning, and attached to the walls in spangles at different places. One very curious instance of the influence of the electrical discharge upon metallic masses was brought under the author's notice by his friend Mr. Shepstone, the Secretary for Native Affairs in the Colony of Natal. A settler's homestead, known as the "German House," on the road leading from the seaport to the capital, was struck by lightning, and burnt down. In the situation of a box which had contained money there were found afterwards lumps of metal formed by the fusion of gold and silver coins. But near to these were a sixpence and a half sovereign lying face to face which had been both drilled with a large hole, and at the same time firmly soldered together round the circumference of the hole. The stamp mark in the sixpence was entirely effaced. It is only however, when metallic substance is in comparatively small mass, or when it forms the termination of a conducting track, upon which concentrated charge is received, that this disintegration and absorption of metallic bodies occurs. The electric discharge passes through a sufficiently large metallic mass without producing any molecular disturbance, or manifesting any mechanical effect at all.

We are now in a position to return advantageously to the consideration that when a lightning discharge falls from a charged cloud to the earth, it of necessity takes the line of least resistance that is open to it, whatever that may be, and if that line lies along sufficiently large and absolutely continuous metallic substance, the effective resistance to its passage is so small that no mechanical violence, or heating effect of any consequence ensues. This, therefore, at once indicates what the first expedient in providing artificial protection from mechanical injury must be. A continuous rod of good conducting metal must be carried from the top of the building to the ground. The

when the stroke of lightning chances to fall upon the building, it goes by the easy way, and flows harmlessly and silently through the metallic rod to the earth, and the less perfect conducting materials of the house, such as bricks, mortar, cement, and wood, are not touched. In order, however, that this desirable result may be brought about, it is essential that the metallic rod shall be large enough to carry quietly and harmlessly the largest discharge that may have, under any circumstance, to pass through it. As a rain-water pipe must be made large enough to carry safely away the largest rainfall that can occur, if flooding is to be avoided, so the lightning conductor must be made large enough to carry the heaviest lightning that can strike. And it is even more important that this should be secured in the case of lightning than in the case of rain, because an overflow of fire is a more serious matter than an overflow of water. Some electricians consider that an insufficient lightning conductor is better than none at all, because there have been instances again and again where buildings have been saved from mischief on the discharge of lightning, although the lightning conductor that has effected their protection has been burnt up and destroyed. As in such cases, however, a new lightning-rod has to be immediately supplied, it would have been obviously better that the conductor of double capacity should have been erected in the first instance. The author of this paper must also add that he has some reason to look upon the conclusion itself with doubt. There is always danger from fire if a lightning conductor of insufficient dimensions happens to be carried along near combustible materials. The lightning stroke is certainly more likely to fall where a lightning conductor, of whatever kind, is placed than it would be if there were no such appliance. The lightning conductor, in such circumstances, may be "the slight acquisition of power which detroys the tottering equilibrium; the last straw which breaks the camel's back;" alluded to by Mr. Preece. There certainly is as much danger in the interpolation of a lightning rod in such tottering equilibrium as there would be in "a horseman galloping along over the ground." What the damage is that a conductor of insufficient size may effect is well illustrated in the practice of firing charges of gunpowder in mines by the platinum fuse. A fine wire of platinum is made part of a current of electrical communication in the midst of a charge of gunpowder. When a current of electricity is passed through the wire it becomes red hot, on account of not having sufficient size to convey the electricity without derangement of its molecules, and the red hot wire fires the gunpowder. If the platinum wire had had the thickness of a pencil, instead of a hair, the same charge of electricity would have passed without the explosion of the gunpowder. Another very telling illustration is supplied by the not uncommon occurence, where a small soft metal gas-pipe is attacked by a powerful discharge of lightning, and the gas-pipe is fused, and the gas set light to. What the dimensions in a lightning conductor are that would fulfil this essential condition of giving sufficien capacity for the safe transmission of the largest possible discharge is yet an unsettled question. In his excellent monograph already alluded to, Mr. Preece argues that a No. 4 telegraph wire of galvanised iron, which is a quarter of an inch in diameter, is sufficient for the protection of most dwelling houses, because No. 8 wires, of only half this capacity, are found practically to protect telegraph posts from damage by lightning. It is, however, most probable that in the case of telegraph wires a lightning discharge is distributed among several of these protectors, as several are brought into the system by the conducting telegraph wires above. Mr. Preece alludes to two No. 8 wires having been fused and destroyed by lightning in one season. M. Arago gives the case of a chain 128 feet long, formed of successive rods of iron, one quarter of an inch in diameter, which was fused through its whole length by a lightning discharge. On the other hand, rods of iron, three-quarters of an inch in diameter, have been known to convey very powerful lightning strokes to the ground harmlessly and safely. In the instructions of the "Académie des Sciences," drawn up by Gay-Lussac and Pouillet, 1823 and 1824, a square iron bar, three-quarters of an inch in diameter, was adopted as ensuring ample capacity for all practical purposes. An iron pipe, having the same sectional mass of metal, is better than a solid rod, because the electrical force is transmitted by the surface of the conductor, and a pipe obviously has more surface than a solid rod of the same relative mass. Galvanised iron is better than uncoated iron, in the first place because its surface is protected against rusting; and in the second place because the zinc conducts with three times greater facility than iron. A rope of galvanised iron consisting of 42 strands of sixteenth of an inch wire is a very convenient form of conductor, on account of its ready flexibility, for purposes of conveyance and adaptation to angles and irregularities of a building, and on account of the long stretch that can be made in continuous lengths. If a conductor is made of several pieces, it is indispensable that those pieces should be joined together by absolutely perfect metallic union, or there will be greatly increased resistance to the passage of the electric force in consequence of the gaps. In strands of galvanised iron the galvanic surface affords a very easy path for the electricity, and the iron core is a stubborn metal in reference to heat, and not readily destroyed. A 42-strand wire rope of the character that has been described affords as much surface, and is in all respects as good a conductor as a strip of stout galvanised iron four inches broad. Copper is a five times better conductor than naked iron. A rope of copper wire, one-sixteenth of an inch thick, and with 28 strands, would be as efficient as a galvanised iron wire rope of 42 strands. Dimensions of this value are recommended, because they are unquestionably equal to any demand that can be made upon them, and because there is yet some measure of uncertainty in regard to the possible intensity of the electrical discharge in exceptional cases. It may perhaps be necessary to point out, in regard to this particular bearing of the subject, that the sole reason why telegraph engineers incline towards conductors of smaller capacity is that reduction in cost virtually increases the number of lightning conductors that are used. This is a very important practical consideration. But, in the face of it, and after patient and long-continued weighing of the whole subject, the author of this communication, in his experience as

a lightning engineer in South Africa, notoriously a favourite haunt of the thunder storm, adopted the 42 strand rope of sixteenth of an inch galvanised iron wire, and never found any reason yet to regret his practice on this point. The provision is ample for buildings of considerable elevation. The mistake of employing too small a conductor is a very common one. Within the last few weeks the author of this paper himself, in company with his excellent friend, the Secretary of the Society of Arts, came upon a lightning conductor attached to a very handsome recently restored church in the vicinity of London, in which a single very small galvanised iron wire was used, where a lofty spire was part of the structure, and where, apparently, the thin wire passed down the face of this spire along a casing of wood shingles. The author submits that if this is not one of the "last straws that might break the camel's back in the circumstance of a tottering equilibrium," it ought to be. The advantage of copper, in contrast with iron, for employment as a lightning conductor, is simply that it heats less easily under an electric discharge, is very stubborn to melt, and that it is the best of all conducting substances. Its disadvantages are, that it is much more costly than the galvanised iron conductor which furnishes an equal facility of passage, and that, as a metal, it undergoes a molecular change, from the frequent passage of strong currents of electrical force, which materially affects its conducting power. It must also be remarked that copper is a very much better conductor than brass. Copper costs about one-third more than brass, but it transmits electrical currents eight times as well. Messrs. Sanderson and Proctor, of Huddersfield, and of 18, Queen Victoria-street, have recently contrived a copper tape, or strap, for lightning conductors, which costs about one shilling the foot, and which is so flexible that it possesses in a very considerable degree the advantageous properties of rope. It can be bent round the inequalities of a building with the utmost facility, can be manufactured in continuous lengths to any extent, and can even be coiled for convenience of transport. This copper tape is three-quarters of an inch wide, and an eighth of an inch thick, and therefore contains a sectional area of a little more than a tenth of a square inch of solid metal. This will most probably be found to be ample for all ordinary purposes, and it can, of course, be readily doubled in any case where lofty buildings have to be protected.

The French electricians, who are unquestionably very high authorities in matters of this class, commonly employ metallic ropes, in preference to bars, for the main stretch of the conductor, because they possess a larger sectional area than solid rods of the same diameter, are more easily placed, and adapt themselves to irregularities of structure without the trouble of forging, because they can be readily made of any continuous lengths that can be required, and, in the case of iron, can be easily galvanised, and because they are so supple and more manageable. They consider that an iron cable should have a diameter rather more than twice and a half that of a copper cable (27·3 millimetres against 1 centimetre) to have the same efficiency. M. Callaud, an eminent French electrical engineer, who has very recently printed an excellent book on the "Paratonnerre," records that a rope of copper, four-tenths of an inch (one centimetre) in diameter, employed as a lightning conductor at the church of Sainte Croix, at Nantes, and which was made of seven strands, having each seven threads of wire of a gauge of 0·039 of an inch (one millimetre) in diameter, had certainly transmitted several very heavy electrical discharges without suffering any injury in its own substance, and that a similar rope of one-fifth smaller diameter (eight millimetres) previously employed had been injured by lightning discharges. Copper bars a fifth of an inch (exactly five millimetres) have been known to be as much injured by a single storm as by ten years of exposure and rust. M. Viollet Leduc, on the other hand, states that copper ropes seven-tenths of an inch (eighteen millimetres) in thickness were burned at Carcassone. From a consideration of these facts and some others of a similar character, the French electricians of the present day employ ropes of copper of from four-tenths to eight-tenths of an inch (one to two centimetres) for each 82 feet of height. Mons. R. Francisque Michel, who has printed an interesting notice of the faulty state of the lightning defence of the public monuments of Paris, with some allusion to the views of M. Callaud, in *Les Mondes* of October, 1874, considers that a rope of galvanised iron wire should have a diameter of eight-tenths of an inch, to afford efficient protection under ordinary circumstances. M. Callaud prefers that metallic ropes should be constructed upon hempen cores, on account of the greater pliability which this contrivance gives. It has been already observed that lightning conductors require to be of larger size in proportion to their length. The law which rules this proportion is simply that the facility of electrical transmission in any conductor is in the exact ratio of the co-efficient of the conductibility of the metal of which it is composed, multiplied by the number representing the section of the rod, and then divided by the number representing its length. The durability of any rod is, in general terms, in proportion to the square of its diameter. M. Melsens, a high French authority, prefers that there should be several conductors of small size rather than one large one; and it is at any rate generally agreed that a large building should be furnished with several conductors, and that when several conductors are combined into one stem, that stem must be of a size sufficient for the safe transmission of all the electrical force that can be furnished to it by the contributory branches.

If it so happens that metallic cables have to be joined, the individual wires of the connected ends must be untwisted, and spliced or mingled together, and then be bound tightly round with wire in such a way that the whole can be dipped into melted solder, or solder be carefully run in over a fire. Cables may be satisfactorily connected with rods by turning a spliced loop upon their ends in this way, and by then binding this loop in upon the rod by means of strong screw nuts. Monsieur Michel, in speaking of the need of renewing the efficiency of the public lightning conductors of Paris, makes the excellent practical suggestion, that the ends of rods requiring to be spliced in continuous electrical communication should have plates of soft lead firmly nipped in by screw power between the ends that are to

ake contact, the entire joint being afterwards nclosed in a sufficient investment of solder.

The disintegrating energy of an electrical discharge is mainly expended upon the extremities of conductor. It effects the most marked molecular disturbance on the part where it first falls, here most probably the first meeting of the two antagonistic forces occurs, and where the terms of new alliance have to be arranged, and also on part by which it has to issue from the conductor to the ground—the great natural reservoir the reserve of the energy. On this account lightning conductors require to be expanded and fied both at their summits and at their roots base. The French Academie des Sciences ted that the top of the conductor should be of iron two-and-a-quarter inches in diameter, ther square or round, tapering up to a blunt al copper point, shaped to an angle of thirty rees. The pointed termination of the conducis a matter of some practical consequence, e it establishes a slow and gentle discharge accumulation of electrical force at high tenas is illustrated in the ordinary experiment the charged conductor of an electrical ine is quietly discharged by the presentation sharp needle to it. De la Rive held that a allic ball was quite as efficient for an upper inal as a point. But when a great number of ning-conductors are brought near together, protecting the buildings of an extended there is no doubt that if they are pointed at p they serve to saturate an approaching and to deprive it of its sting before it comes striking distance. After the city of Pieterburg, in Natal, had been largely supplied pointed lightning-conductors, under the r's fostering influence, the actual discharge lent lightning strokes within the area of the became almost unknown. During several the only cases that came under the author's were the tops of two chimney-stacks somedamaged, and a few lofty blue gum trees ed.

account of the facility with which it could pplied by ordinary workmen, the author ted a terminal for the upper end of the conr in the colony of Natal, which proved very ive and satisfactory. In this arrangement p of a galvanised iron rope was inclosed in a of stout sheet zinc, finished at the summit, sake of ornament, by a gilded ball of turned above which the strands of the wire were ed into the form of a sort of brush. Each ctor, in this way, had 42 points of its own, and augmentation of terminal capacity was secured addition of the external zinc tube. The also supplied a ready and convenient means tching the conductor to chimney stacks, or ther protruding parts of the building.

e special function and power of points is very ngly and completely illustrated by a series of experiments devised by M. Gavarret, Proof Natural Philosophy to the Faculty of ine at Paris. He first charges the prime ductor of an electrical machine to the highest t of tension that it can contain; he then places to it an earth-connected rod, furnished with point directed towards the conductor, and he ows that the tension which can be produced in the conductor diminishes constantly as the angle of the neighbouring point is made less. He next provides a Leyden jar that discharges itself by spark through a given neighbouring point, and unscrewing this point, and replacing it by a crown of points, he shows that thenceforth the same jar will only discharge itself silently, and without a spark. He then so arranges the jar that it discharges by sparks below the plane of a neighbouring terminal point, and on fixing lateral points below that plane the spark-discharges immediately cease.

Perhaps, however, the most telling proof of the beneficial influence of points in relieving the tension of an excited electric is that which is given by a very simple and pretty experiment, most easily performed. If a living man stands upon a stool with glass legs, and is placed in electrical communication with the prime conductor of an electrifying machine at work, with a gold-leaf electrometer on the table three or four yards away from him, and holds in his hand a sewing needle, with one finger pressed over the point, the gold-leaves of the electrometer show no manifestation of the electricity in the operator, until he unmasks the needle by withdrawing the finger from its point, when the gold-leaves immediately start asunder, under the influence of the stream of electricity which is poured out upon them through the point, even at that distance. Or yet, again, if a large tassel of strips of light tissue paper is made to throw its several strips out into a divergent brush, by electrifying the tassel from a machine, the tassels of the paper collapse together immediately upon unmasking upon them a needle point held in the operator's hand at the distance of two or three feet away. There is one very important result of the employment of terminal points to lightning rods which should never be lost sight of. A lightning rod with efficient points, and in satisfactory operation, might be grasped by the hand of a living man, even when in action, with entire impunity, because, on account of the continued drain set up by the points, the rod can never assume any dangerously high tension. A conductor acting without a point, on the other hand, is in a state of very considerable tension when it effects its first discharge, and if it were grasped in the same way by a hand, would, in all probability, strike through that hand some very inconvenient and possibly painful proportion of the discharge. Conductors that have been acting silently with points have been seen to be struck by sinuous tracks of fire, indicating dangerous discharges of high tension, when they have been disarmed of their points.

Platinum has very generally been recommended for the construction of the terminal points of lightning rods, because it is one of the hardest known metals to melt, and because it is also not easily oxidised. The points are shaped to an angle of from 7 to 10 degrees at the top, and are made a trifle less than 2 inches (5 centimetres by the French) long. In this form they are screwed firmly into the top of a rod of copper, which is then in its turn connected with a cable or metallic bar below. The terminal rod is usually made of augmenting size as it descends, and is generally projected from 12 to 20 or 30 feet above the building that is to be protected. Platinum points

are specially made for lightning conductors in Paris. They are supplied by Collins, of 118, Rue Montmartre; Beignet, of 96, Rue Montmartre; and Detouche, of 222, Rue St. Martin. The cost of a platinum point at these houses, grafted on brass, and from 50 to 70 centimetres (1.9 to 2.7 inches) long, is from 16 to 22 francs. For better finished work, with larger needles of platinum, grafted upon copper, the cost is from 60 to 200 francs.

M. Francisque Michel considers that the points may be quite as advantageously made of silver alloyed with copper, in the same way that it is when used for coining silver money, that is, containing 165 parts of copper to 835 parts of silver. Such points have the unquestionable recommendation that this alloy possesses a very much higher conducting power than platinum, which has 12 times less conducting power than silver and 11 times less than copper. Messrs. Sanderson and Proctor construct their points very neatly, by simply twisting the copper tape spirally at the end, after the fashion of an auger, and then filing away the termination of the flat metal into the shape of a sharp angle. The entire terminal is also gilded over the copper to the extent of eight inches. This kind of point has the very obvious recommendation that it forms a continuous portion of the actual rod, and needs no joining or attachment.

The French electricians strongly recommend, upon the ground of the experiments of Professor Gavarret, that the lightning-rod should be terminated by a cluster or a crown of points, instead of by one alone, and M. Callaud has given two sketches, in his treatise, of forms of terminal points that have been adopted in France, in one of which a circle of ten points radiates at an angle of 45 degrees round the base of the principal terminal, which rises some inches above them; whilst in the other a kind of plume of points feathers out from the base. M. Beignet, of the Rue Montmartre, exhibits a model of the multiple point which the French electricians most affect. Mr. Francis, of Southampton-street, Strand, constructs a very simple and efficient multiple point of copper. The Hotel de Ville at Brussels, which is a very large building, and which has been furnished with lightning rods upon a very complete scale, by M. Melsens, a distinguished Belgian electrician, is literally bristling with points. It has 228 points of copper, and 36 points of iron, in its system.

The lower termination of a lightning conductor requires the exercise of even more care than its upper end, because it is less constantly and less generally under observation, and any shortcoming or mistake in reference to it is fatal to the efficiency of the rest of the arrangements, however judiciously they may have been carried out. A faulty termination of the earth connection is, of all else, the most common and frequent blunder, in relation to lightning conductors, that is made. As that is one of the terminations of the artificially provided conducting track, it must be of enlarged dimensions, as has been already explained. It must be in very intimate communication, not merely with the ground, but with the freely conducting portion of it. If a moist contact can be secured by insertion of the rope or rod into constantly damp soil, the contact need only be large enough to diffuse what is known as the electrolytic action—that is the chemical disintegration of corro[…] metals at moist contact when electric currents [are] operative—over a fairly extended space. If th[e] contact is made with dry earth, the surfaces [must] be very large indeed. The drier the material th[at] is involved—unless it be an extended system of con[-] tinuous metallic substance, such as the undergr[ound] iron tubes of water and gas supplies in tow[ns,] which are among the most efficient ground term[i-] nals that can be adopted—the more expanded [must] be the surfaces of communication and contact.

It is worth while here to make a passing allu[sion] to a few flagrant instances of faulty constru[ction] in the establishment of earth contacts of light[ning] conductors on account of the strength of the il[lus-] tration that dwells in such failures. In a well kn[own] case of a lighthouse at Genoa, which was inj[ured] by lightning, and which was presumed to [have] been furnished with seemingly efficient protec[tion,] it was found that the bottom of the conductor [had] been plunged into the interior of a stone [rain] water cistern, primarily constructed especially [to] keep out the infiltration of the sea, and there[fore] well adapted to prevent that moist contact [with] the mass of the earth which is essential t[o the] object in view. Mr. Preece has drawn atten[tion] to a very similar case at Lydney, in North M[on-] mouthshire, where the hollow of an iron ga[s…] intended to protect the church, was inserted [in] the substance of a loose stone that was […] imbedded on dry pavement. One of the [most] sublime instances of this form, not mere[ly] superfluous but of actually dangerous care, [came] under the author's own observation a few [years] ago, when he found in the case of a chur[ch in] Norfolk, which was injured by lightning, alth[ough] the tower was furnished with an apparently [ef-] ficient conductor, that the metallic rod was [carried] through the necks of glass bottles where[ver it] was attached to the masonry, and that the sy[stem] of precaution was finally consummated at the [base] by putting the bottom of the rod into a […] bottle buried in the dry earth. But a few m[onths] since, the author undertook to see to the [pro-] tection of the residence of a friend in the n[eigh-] bourhood of Kensington Gardens, in wh[ich an] exceptionally lofty house, even for that s[…] neighbourhood, had to be defended. A s[…] copper rope was brought down from an iron b[alus-] trade that surrounded the summit of the r[oof,] it so chanced that this was left lying at the […] end on the stone pavement of a sunk ba[sement] floor, before the permanent earth contacts ha[d been] established, and that a thunderstorm s[…] burst over the neighbourhood while the sys[tem of] protection was left in that unfinished state. [The] head of the household, in the absence of his [scien-] tific adviser, was, however, equal to the emerg[ency.] He had the bottom of the rope carefully […] away into the interior of a wooden pail, determ[ining,] most probably, that if the lightning did come [down] the rope, it should at any rate be kept in the […] until it could be carried away by some comp[etent] hand. In one very instructive instance, a b[…] Natal, which had been furnished with one o[f the] author's galvanised wire ropes for a conductor, [but] not under his personal superintendence, was inj[ured] by lightning. The house was a low-hipped st[ruc-] ture, of one story. The rope had been brou[ght…]

from the top roof ridge, which was of metal, along one of the hip angles, then down a corner post, and buried in the ground. The lightning, however, had perversely preferred to go down an opposite hip, where there was, so far, a metal road, and had then leaped through the wall, taking some iron sash weights of a window by the way, and shattering the brick work and doing other damage in its course. The author went down, as soon as he had heard of this accident, to investigate its cause; and the cause was simply this:—The lightning conductor had been plunged into a tract of dry sand at the corner of the house. But at the other corner, by which the lightning had effected its own escape to the ground, was an old pool of water that had been filled up with sand, but was still saturated with moisture, and still connected with ramifications of infiltrated soil. In this case the lightning, when it struck the roof of the house, had divided itself between the two routes which were offered to it, the conductor and the dry sand contact of insufficient area, and the wall, with its stepping stones of sash weights, and its abundant wet contact beneath. The proportion of the discharge which had taken the different routes was determined by the specific resistance of each way, and in the course that involved the leap through the non-conducting wall, the amount which passed was sufficient to produce the destructive disruption which occurred. Competent electrical engineers are now keenly alive to the automatic electrolytic action that is likely to take place in the earth contacts of a lightning conductor, and urge that it is not enough merely to construct an efficient lightning conductor in all its essential particulars, but that the arrangements must be examined from time to time, to make sure that no derangement has taken place. Such examination may readily be effected by making short circuits through the conductor with the wire of a galvanometer, so as to prove by the movements of the needle that the electric path is sufficiently clear.

From the instant that an earth contact is established for a lightning conductor, destructive damage of the surfaces of contact begins, and, sooner or later, the power of the conductor is materially impaired from this cause. This action, known as the electrolytic disintegration, requires to be constantly watched, beyond all else, and all the more because it proceeds in a region where the conductor is removed from observation by the eye. It is most fortunate that such watching may be so efficiently and satisfactorily accomplished by so ready and convenient a means as the employment of the galvanometer. M. Wilfred de Fonvielle has indeed proposed that every lightning conductor should have an arrangement of a short circuit wire with the galvanometer attached permanently to it, in a form which he terms *Le Controleur des Paratonnerres*, and which is so designed as to be always ready for the use of the observer. The author was once very indeed so furnishing, at his own cost, a proof of the material need of some test and evidence of this character. He had supplied his own residence in the capital of Natal with one of his galvanised ropes, with the zinc tube and brush so demonstratively displayed above as to be a constant object of observation and remark to his compatriots and neighbours. The finial was placed so as to be a sort of advertisement of the enlightened practice of the owner of the house, and a standing reproof to the negligence of those who would not follow so excellent an example. The earth contact was very efficiently made, by carrying the rope along the muddy bottom of one of the streams of constantly running water that, in the old Dutch settlements of South Africa, are always found fringing the streets; and during many very severe thunderstorms the author sat in his easy chair, priding himself on the completeness of his arrangements. He subsequently, however, by mere accident, made the astounding discovery that for a considerable length of time the tail of his lightning rope had not been trailed in the wet mud, but was carefully packed away along a stretch of dry ground, under the shelter of a thick-set hedge, that served effectually to conceal its presence there. On some unhappy occasion, when the author was away, the water-courses had been undergoing cleansing and repair by the civic authorities, and the workmen, finding the metal rope in the mud, had taken considerable pains to pack it away in the drier and cleaner place in which it was ultimately discovered. If any accident from lightning had in the meantime occurred to the house, this case would certainly have lived in the annals of Natal, for a couple of centuries at least, as a remarkable proof of the inefficacy of lightning-rods, and the great lightning doctor himself would have been held to have brought down the vengeance of the clouds upon his own ignorance and presumption.

The French electricians have contrived a very excellent expedient for making an efficient earth contact. They construct a stout harrow of galvanised iron, with recurved teeth, connect this carefully with the end of the cable or rod, and then bury it, imbedded in a mass of broken coke, in moist earth. The cable or rod is conducted to a suitable site for this terminal in channels of curved tiles, well filled with broken coke, or even sealed up in leaden tubes, if there are ammoniacal vapours to be encountered by the way. M. Callaud has a still more ingenious and admirable plan of effecting this purpose. He hangs at the bottom of the cable a galvanised iron grapnel, with four upturned and four down-curved teeth, and entangles these within a basket of netted wire, and then packs in this basket with fragments of coke; and the basket, coke, and grapnel are afterwards sunk into a pit or well, or buried deep in moist earth. M. Callaud prefers coke to charcoal, on account of its greater porosity and accessibility to moisture; and he has made some careful experiments to satisfy himself of the size which this earth terminal should have. According to the experiments of M. Pouillet and M. Ed. Becquerel, pure water conducts the electrical force 6,754 million times less freely than copper, and therefore, for free transmission, the earth contact, if effected by pure water, should have 6,754 million times the area of the main conducting cable or rod. This theoretical argument is, however, very materially affected by the fact that the water in the earth contains conducting principles of considerable power, and by other analogous considerations; and an earth contact of 1,000 square metres (1,196 square yards) has been fixed by the best French authorities as sufficient for all practical purposes for a conductor of copper, that is, one centimetre (four-tenths of an inch)

square. M. Callaud calculates that in order to accomplish this purpose his earth-basket must contain one hectolitre (two bushels and eight-tenths) of broken coke. In order that a lightning rod may perform its work perfectly, it is obvious that there must not be any greater resistance to the passage of the electrical discharge at its earth-outlet than there is in the rod, or main channel of the discharge. Very commonly in badly-arranged lightning rods, it is found that there is ten thousand times more resistance at the outlet into the earth than there is in the main rod of the conductor. When this altogether excellent expedient of M. Callaud's cannot be adopted, a bore, four or five inches in diameter, should be sunk sixteen or twenty feet into damp soil, into which the cable should be inserted, and then the bore should be filled round the cable with broken coke, and the whole be firmly rammed down; or radiating trenches should be cut as deep as possible in the ground, and corresponding branches from the cable be then packed into these with an investment of broken coke. M. Francisque Michel gives an unqualified approval to the attachments of the lower terminal of the cable to iron service-pipes, whether of water or gas, in towns.

In Gay-Lussac's report to the French Academy of Sciences, in 1823, it was held that all large metallic masses contained in any building should be brought into metallic communication with the main system of conductors, and that there was no need whatever for the employment of insulating supports in attaching the lightning rod to the structures that it is intended to defend. These conclusions of Gay-Lussac's have been generally acted upon since his time, and no very marked case has ever occurred to stamp the practice that has been adopted in these particulars as radically wrong. In my own practice, in the colony of Natal, I have almost invariably acted upon them, and no single instance of insufficiency of protection has ever come under my notice in consequence of the arrangement. The point is, however, one upon which there is now some difference of opinion in high quarters. M. Callaud, for instance, in his recently-printed treatise on the Paratonnerre, insists upon the adoption of insulating supports for the rod, and unconditionally condemns the electrical communication of the rod with the metallic masses contained within the building; and he states in one part of that work that M. Pouillet has to some extent given in his adhesion to these revolutionary views. M. Francisque Michel, on the other hand, upon a full review of all M. Callaud's arguments, maintains the old doctrine that the conductor may safely be attached to the masonry of the building by ordinary staples or holdfasts, or any convenient way, and that insulating supports are of no use whatever, and that all masses of metal contained in a building should, as a general rule, be metallically connected with the main line of the conductor. Professor Melsens, of the Royal Academy of Belgium, one of the highest Belgian authorities, contends, upon experimental grounds, that the well-known laws of derived electrical currents apply with equal force to the transmissions of electrical force of high tension, and that scattered masses of metal in any building should be metallically connected with the conductor by closed circuits constituted by contacts with two distinct points of the rod. This divergence of view among high authorities is of notable import, because it is virtually the only material difference of practice that is encountered in the treatment of this subject by well qualified scientific men, and it may therefore be very readily admitted to be an affair that yet requires a more searching investigation, and further severe question by observation and experiment. In the meantime it is of some importance that the exact bearing of the doctrine advocated by M. Callaud should be understood.

In illustration of his argument M. Callaud takes the case of an iron balcony supported in front of the window of a house at some elevation from the ground, and considers the possible result to living men and women contained in this balcony at the time of a severe thunderstorm, accordingly as the balcony is, or is not, electrically connected with an efficient lightning rod. He argues, if the balcony is connected with a lightning rod, a living person standing upon it, or leaning against its rail, is very much more likely to be struck by a discharge of lightning, than if the balcony had no such connection. In the former case, the living body is likely to be made the stepping-stone for the lightning on its way to the rod. He holds that in the case of a lightning stroke the chances are a hundred to one that a lightning rod is struck in preference to any part of a building, but that if the conductor is faulty in any particular, and scattered metallic masses are connected to it, this is tantamount to attaching the hundred chances of danger to the metallic masses and the living people placed near them. He says, in effect, a satisfactory and perfect lightning-rod should be so placed that it efficiently protects every part of the structure it is attached to, and that if it does this no scattered mass of metal within the building can possibly be struck by a discharge. Therefore connection of the rod with scattered masses of metal is superfluous and useless where the rod is efficient and perfect in itself, and objectionable and dangerous when the rod is not in an efficient acting condition. And perhaps the greatest force of this argument falls upon a fact which is very earnestly pressed by M. Callaud, that a lightning rod is a merely passive piece of mechanism, which does not give visible or palpable signs of its own derangement, like a clock, but which may furnish fatal proof of its imperfection too late, by killing the person who places unmerited and undue trust in its efficiency and excellence. M. Callaud remarks with some force, "Lightning cannot strike a structure that is well protected. If the lightning finds at the side of the Paratonnerre an electric conductor that is superior to itself, the structure is then inefficiently defended. A Paratonnerre ought to dominate, to cover, to protect, a building in all its parts, and in all its details, or it is better away." The gist of the whole matter, therefore, is, take care that your conductor is perfect and efficient in all its parts, and that it is in every sense adequate to the work that it is required to do, whatever may be the size of the building, and then it becomes a matter of small moment whether scattered masses of metal comprised in the building are connected with the rod or are not connected, and whether the rod is connected to the building by insulating or by non-insulating supports.

Calland's conclusion, however (and it is the one upon which he states that M. Pouillet has given in his adhesion), is substantially, "Connect any masses of metal with the Paratonnerre that are of necessity removed from the occasional close presence of living people, but on no account ever connect such masses with the Paratonnerre when they may at any time have living people in their close neighbourhood." Pending further investigation of this very interesting point, there can be no doubt that this distinction is a prudent and a safe one to be adopted in practice, and that it is more prudent and more required in proportion to the inefficiency of the arrangements of the conductor. Conducting masses which are connected with the earth by less readily conducting substances occasionally give rise to a curious effect, which is technically known as the return-shock, and which is altogether a result of inductive action. When a powerfully charged electric comes within a moderate distance of them, an electrical charge of an opposite character is drawn into them by induction, but this secondary charge escapes back towards the earth the instant the inducing tension is removed. The production and character of this return shock, caused by inductive action, admits of very complete illustration by electrical apparatus. An insulated conductor of long cylindrical form, but with its glass supports only half the length of the glass pillar of a prime conductor of an electrical machine, may be placed parallel with the prime conductor, but about an inch away. The secondary conductor is then to be raised to the same height as the prime conductor, by fixing its glass pillar upon the top of a pillar of wood, a fine wire being carried from the metal cylinder to the wood. A wire is then also to be carried from the secondary conductor to the earth, but is to be so arranged that a small gap may be left in some convenient part of its course. When the prime conductor is charged positively by the machine, the positive electricity of the secondary conductor is inductively driven out through the wire and the wooden pillar to the earth, and the conductor itself remains negatively charged. But when the working of the machine is stopped, and the prime conductor is deprived of its positive charge by a touch of the finger, the negative charge in the secondary conductor is also set free from its condition of inductively maintained constraint, and positive electricity leaps back from the earth to restore its proper balance and saturation, and as it does so is seen passing as a spark through the gap in the earth-wire, because that gap affords less resistance to the passage of electricity of tension than the supporting pillar of wood. If a little gun-cotton, or some other suitable inflammable substance is placed in the gap, it is fired by the spark at the instant of the discharge. Professor Tyndall, in his lectures at the Royal Institution, shows the production of this sympathetic inductive discharge in a very magnificent form. He has a flat coil of copper wire imbedded in a mass of insulating resin, through which he can pass the discharge of the powerful battery of the Institution, consisting of fifteen Leyden jars; and he has also a second flat coil similar to the first, which he can place parallel to it and about an eighth of an inch away, the two ends of the second coil being connected with a wire presenting a small gap of continuity. When the discharge of the battery is passed through the first coil a powerful sympathetic discharge rushes at the same instant through the secondary coil, and makes itself manifest by a bright flash and a loud snap in the gap of the connecting wire. The discharge of an electric cloud in this way not uncommonly produces a number of sympathetic minor discharges from neighbouring bodies. The induced discharge is sometimes quite strong enough to produce mechanical mischief in resisting bodies that lie in its path. The shocks experienced by living people on the instant of a discharge of lightning, without fatal results, are generally of this character. It was to meet the case of these incidental induced charges, and the consequent "return shocks," that the expedient of connecting scattered masses of metal with the conductor was originally devised. The return shock resulting from a limited inductive disturbance may be strong enough in some circumstances to cause death by the mere arrest of the vital action of the nerve structures through which it passes, without leaving behind it any trace of mechanical violence, such as is generally produced by the true lightning stroke.

The old practice of protecting buildings from lightning consisted in erecting rods of metal upon wooden frames, near to, but not in actual contact with, the walls of the house. When the author of this article first visited Natal, in 1857, the houses in the two principal towns, that were defended at all, had independent conductors of this class, of the rudest possible kind, erected by the side of the one-storied houses upon ungainly wooden frames. The conductor was composed of an iron rod, joined in three lengths, and rudely pointed above, and it was made of three different pieces—a comparatively thick one below, and a comparatively thin one at the top. This practice was primarily based upon an investigation which was conceived to demonstrate that all structures lying within a conical space, which had the conductor itself for its height and a breadth for its base equal to four times the height of the conductor, were safe. This estimate gives a fair approximation to a truth, but it is by no means absolute, and must not be empirically relied upon. It, however, furnishes a very good indication of the way in which the upper termination, or terminations, of the rod must be arranged. The terminal point should go some considerable distance above the housetops, and then if any projecting parts of the house extend beyond the surface of a line having perhaps a somewhat more acute figure than the one which has been named, other subsidiary points must be reared up from the line of the conductor above such conical slopes. Mr. Preece, in his paper, considers that the lightning conductor should only be held to afford absolute protection within a conical space in which the base is as large again as the height of the line. When, however, the general idea of the limits of this lateral protection is once clearly conceived, it becomes very easy, indeed, to render the arrangements of the upper terminals perfect for any individual case. It is only necessary that all prominent masses of metal shall be connected with the system of metallic communication, and that an additional branch of the system of defence shall be carried out whenever outlying parts of the structure get near to the conical limit of protection. This is

virtually what has been done in the case of the Hotel de Ville, at Brussels, with its terminal of 264 points.

When Sir William Snow Harris, now some years ago, turned his attention to the protection of ships from lightning, he devised a plan of making the lightning conductor a part of the original design and essential construction of the ship. Now all large and well-contrived vessels are always built with the lightning rod included in their structure. It is almost incredible that up to this time the same course has not been taken with houses. It is hard to understand why lightning conductors should be objects of exceptional luxury, and rain pipes objects of daily need, and the more so when rain pipes themselves can be so easily turned by a little forethought and mechanical ingenuity into lightning conductors of the most efficient character; they only need that their joints shall be made mechanically continuous, that their earth contacts shall be perfected, that all masses of metal, with perhaps the limitation that is contended for by M. Callaud, shall be brought into metallic communication with them, and that metal terminals shall be distributed from them to the roofs above, upon the principle that has been explained. Mr. Preece has thrown out one very excellent suggestion which well deserves further thought; it is to the effect that metal ventilating pipes carried up from the sewers over the roof of the house may advantageously be made part of the arrangements for protection against lighting. The familiar case of the Monument of London is continually adduced as a proof of the readiness with which the accidental features of a building may be turned to account for this purpose. The metallic emblems of flame at the top of the column are continuously connected with the ground by means of a very thick balustrade of iron that runs as a hand-rail down the stairs; the structure is 200 feet high, and towers above all neighbouring buildings, and yet it has now stood within three years of two centuries without ever having been injuriously touched by the lightning.

It was conceived, until recently, that St. Paul's Cathedral had been efficiently protected in some similar way by the arrangement of water-pipes, and some supplementing of them by metallic rods, added by a Committee of the Royal Society some 120 years ago. Mr. Faulkner, of Manchester, however, found, in a careful examination made subsequently to 1872, that the system had become entirely inefficient for the purpose for which it was intended, by the formation of thick incrustation of rust on the contact surface of the rods, and by the interpolation of blocks of dry granite, some nine inches thick, in places, into the actual line of electrical conduction. The entire building has now been most efficiently protected, under the skilful direction of Mr. Faulkner, by carrying eight octagonal half-inch ropes of common wire from the Cross, Ball, and Golden-gallery through the metal-work of the roof of the dome, and through the metal work and rainfalls of the lower parts of the building to the sewers, where the conducting strands terminate in copper plates pegged into the moist earth. In carrying out this work every important metallic portion of the building was separately tested by the galvanometer, to make sure that the electrical communication with the earth was virtually and substantially clear. The galvanometer was first made into a circuit with a metallic gas-pipe; and then the circuit was opened out, so that earth was made in one direction through the gas-pipe, and in the other through the metallic portion of the building for the time under examination; and the test was not considered satisfactory until the deflections of the galvanometer were the same under both alternatives. In arranging methodical architectural plans of this kind it must always be carefully borne in mind that small gas-pipes of easily fusible metal must on no account form part of the connecting lines of conducting circuit. Gas-pipes are most easily fused by a stroke of lightning, and when they are so fused the gas which escapes from the extemporised orifice is invariably set light to.

One point which was expressly urged by Mr. Preece, and by Captain Douglas Galton, in the discussion of Mr. Preece's paper at the Society of Telegraph Engineers, should be most carefully kept in view in any structural plan matured for the protection of buildings, namely, the including of all fireplaces or stoves, and soot-blackened chimneys in the system of connected construction. To adopt Mr. Preece's own statement of this point—"It must not be forgotten that a chimney lined wlth a thick layer of soot, up which a current of heated air and volumes of smoke are ascending, and terminated by a mass of metal (the grate) is an excellent but dangerous conductor, for it ends in the room, and not in the earth."

Since the first preparation of this paper two pamphlets by Messrs. Gray and Son, of Limehouse, have come into the hands of the author, which are valuable and interesting on account of the details which they contain of a considerable series of instances of damage from lightning. Mr. W. Gray, of this firm, was originally concerned with Sir Wm. Snow Harris in perfecting his plan for protecting ships, and obviously possesses a large amount of practical information in regard to accidents that have occurred. Space now only serves to say that the Messrs. Gray endorse the practice of connecting all metallic masses in a structure with the main line of conduction, and especially urge the surrounding of all prominent objects, such as the tops of tall chimneys and church towers, with continuous bands of copper brought down into direct connection with the discharging rod.

The great length to which this paper has already extended itself alone prevents some allusion being here made to the views of Professor Zenger, of Prague, who advocates the use of circular roof-like or ring-shaped conductors, embracing within their span the objects which are to be defended from injury.

There is no sufficient ground for the popular idea that accidents from lightning are of such rare occurrence that it is scarcely worth while to incur the trouble and cost which artificial protection involves. The figures of the statistician prove that accidents are very frequent indeed. The Escurial in Spain has been set fire to four times by lightning in less than three centuries. As many as 1,3[illegible] persons were ascertained to be killed by lightning in France between 1835 and 1852. Some time ago the mean number of deaths from lightning in each year was marked at 3 in Belgium; 9 in Sweden;

22 in England; 50 in the United States of America; and 95 in France. M. D'Abbadié records the destruction of two thousand sheep by a single discharge of lightning. Mr. Preece tells of 897 telegraph instruments injured by lightning in the first six months of 1872 in a staff of 9,475 instruments. Mr. G. J. Symons, one of the secretaries of the Meteorological Society, has given, as the list of accidents that he had ascertained to have happened during two severe storms in June, 1872; 10 deaths and 15 cases of injury to human beings; 60 houses struck and 15 burned down; and 23 horses or cattle, and 99 sheep killed. It need scarcely be said that many accidents also occur every year from lightning, over and above those which get publicly spoken of or placed on record. In large towns damage to property is more frequent than destruction of human life, but in the open country destruction of life is the more frequent occurrence. In the face of figures like these, and of the fact of the slowness of man to avail himself of the ready defence which science places at his command, unfortunate humanity certainly stands very much in need of the consolation which the physiologist affords when he tells us that all danger from lightning is past when the flash of the electrical discharge is seen, and when he further states that when men are killed by lightning they are dead before they have time to know anything about the fact, or indeed to be conscious of the fatal blow; a conclusion by the way which is strikingly corroborated by an unintentional experience of Professor Tyndall's, who upon one occasion passed the full charge of the powerful Leyden jar battery of the Royal Institution, by accident, through him, and was perfectly unconscious of any shock. It is something, at any rate, to have this comfortable assurance when the sense of neglected opportunity comes over the mind in an exposed situation and in an unprotected house during a severe thunderstorm. But it is humbly submitted, as an appropriate last word of this paper, that to men of well-regulated minds a good lightning conductor may, in such emergency, be found to be an even greater satisfaction and comfort.

DISCUSSION.

The Chairman said there was no time for the discussion of the subject which had been so ably brought before them, but if any one had any question to ask he was quite sure Dr. Mann would be very happy to answer it. If there were no questions he would propose a cordial vote of thanks to Dr. Mann.

The motion having been carried,

Dr. Mann said he was quite sure the Council of the Society would be glad to afford an opportunity for discussion on a future occasion if it was desired. There were one or two points which might well be discussed, and if any one felt desirous of entering upon them he should be glad if they would communicate with him before the next session, and he would then endeavour to make arrangements for the subject being again brought forward.

The copper tape and spiral terminal of Messrs. Sanderson and Proctor; the copper multiple points, and copper earth plates of Mr. Francis; and the octagonal copper rope used in the protection of St. Paul's, with specimens of broad and solid copper bands, used in the protection of large buildings, and of the screw contacts adopted with these large flat conductors, of Mr. Faulkner, of Manchester, were exhibited to the meeting through the kindness of these gentlemen.

MISCELLANEOUS.

THE POLLUTION OF THE SEINE.

The following is the report of the Commission charged with the preparation of measures to prevent the pollution of the Seine in the neighbourhood of Paris:—

On the 22nd August, 1874, a Commission was formed by order of the Minister of Public Works for the purpose of suggesting measures for the prevention of the pollution of the Seine near Paris. On this Commission were placed the scientific representatives of the Department of Public Works, of the branches of administration under the control of the Prefect of the Seine, and the Prefect of Police. Amongst the Commissioners may be mentioned the name of M. Mille, Inspector-General of the "Ponts-et-Chaussées." The Commissioners find the state of the Seine above Paris, where it enters the capital, as well as between the fortifications and Asnières, tolerably satisfactory, at least after a superficial inspection. The improvement effected by the drainage of Paris and construction of main sewers is apparent. Here and there along the river banks streamlets of impure water may still be seen issuing from various industrial establishments, from the sewers of the suburbs, and even from some of the sewers of Paris which have not yet been connected with the main sewers. But these streamlets are soon lost in the volume of fresh river-water. The stream is filled with fish; vegetation of a superior order flourishes on the river banks; the river bottom is covered with white sand. During the heat and drought of last summer the public had full opportunity of judging of the satisfactory state of the Seine in all these particulars.

But below the bridge of Asnières we find a very different state of things prevailing. On the right bank of the Seine is the mouth of the great sewer of Clichy. An inky current flows from this sewer into the river, forming a parabolic curve. This curve varies with the stream. In ordinary weather it occupies the middle of the river, but after heavy rain it approaches the left bank. The appearance of the water is disgusting; it is loaded with all kinds of organic refuse, vegetables, skins, hairs, dead cats and dogs, &c.; the surface is covered with a greasy scum, which accumulates on either bank, according to the direction of the wind. Banks of grey slime and organic *débris* are thus formed, which rise at certain seasons to a considerable height above the surface of the water, and can only be removed by a continual and costly process of dredging. This mud is the seat of active fermentation; hence the surface of the water is broken by innumerable bubbles of gas, which attain a considerable size during the hot weather. In rising from the mud these bubbles bring to the surface a quantity of black and putrid matter, which immediately may be seen following the course of the stream. The passage of a boat disturbs waves of scum, and produces a state of ebullition which lasts several minutes in the wake of the vessel. In 1870 these phenomena were only visible on the right bank of the Seine, and only the first of the three arms formed by the river at Clichy was seriously polluted, but now the second arm has been infected, and a change has begun to take place on the right bank of the last branch. Neither fish nor vegetation are to be met with on the right arm; in the central arm fish begin to re-appear, and are found again in the left arm of the river. After heavy rains, when the volume of sewer

water invades the whole of the stream, fish are destroyed—even in their habitual resorts—by the general, though temporary, pollution of the whole river. In the central arm the vegetation is moderate; in the left arm it is extremely strong and vigorous.

Beyond the Isles of Clichy as far as the Isle of Saint-Denis the pollution continues, and is more or less visible on the surface; the water preserves an inky hue; the right bank is bordered with the greasy scum; the left banks are also covered with organic *débris* and a sheet of greyish slime.

The chemical analysis of the water is too long to be given here. The Commissioners proceed to dismiss as follows the various remedies proposed; of which they say the enumeration alone will suffice to prove the inefficiency.

1. The prolongation of the main sewers to the mouth of the Seine, or to the sea. This project would involve enormous expense, and simply remove the pollution to the sea-coast.

2. Prolongation of the main sewers to the confluence of the Oise. This would simply remove the evil to the banks of the Oise, without obviating the cause, *i.e.*, the fermenting matter.

3. The dilution of the sewage in the drains and at their mouth by the addition of clean water. Dilution would merely have the effect of extending the infection over a wider surface. This, like the two preceding methods, would prevent any utilisation of the fertilising ingredients of the sewage for agricultural purposes.

4. Filtration of sewage through different substances. The result of this process is always incomplete; solid argillaceous matter and matter held in solution passes through the filters. The filters also require incessant renewing, and constitute, moreover, with their adjoining basins, a source of danger to the public health, and the operation is costly.

5. The establishment at the mouth of the sewers of large reservoirs, where the sewers can be cleared by the solid matter sinking to the bottom. The reservoirs would have to be very large, and would consequently become hotbeds of disease. The process would be most unsatisfactory, and the utilisation of the deposits attended with great inconvenience.

The same objections apply in part to those processes in which the precipitation of the solid ingredients is aided by chemical reagents.

Sewage water, containing as it does a variety of mineral and organic ingredients which generally produce an alkaline reagence, lends itself to the chemical processes of which it becomes an element. When a gelatinous or flaky precipitate has been produced, this precipitate falls to the bottom of the reservoir, carrying with it all the solid matters, and leaving the water tolerably clear.

At the suggestion of M. Chatelier, Inspector-General of Mines, the City of Paris made a series of experiments with sulphate of alumina, which was found to present various advantages over the lime and other reagents in use in France and England. Reservoirs of purification were established at Clichy, and others, larger and better arranged, were in action on the lands possessed by the City of Paris on the Plain of Genevilliers. On the 11th of October the Commissioners witnessed the action in one of these reservoirs; 600,000 to 700,000 tons of sewage water were subjected to the treatment and left the reservoir clarified.

It would be a mistake, however, to imagine that this water, though clarified, was pure. The sulphate of alumina being decomposed by contact with the alkaline ingredients of the sewage, the alumina sinks to the bottom as a gelatinous clotted substance, carrying with it the solid particles by a simply mechanical action. The ingredients held in solution, amongst which is comprised organic matter in a state of fermentation, remain in the clear water, as is abundantly proved by analysis. The following table gives the result of chemical examinations carried on in the years 1867-8:—

	Sewage water.	Sewage water purified by sulphate of alumina.
	K.	K.
Nitrates	0·037 ..	.. 0·021
Combustible and volatile substances ..	0·029 ..	.. 0·240
Mineral ingredients..	2·038 ..	.. 0·724
Total	2·804 ..	.. 0·985

The clarified water thus contains two-thirds of the amount of nitrates found in the sewage water, and one-third of the volatile or combustible ingredients, which consist, to a great extent, of organic matter.

It must be added that on the discharge of the sulphate of alumina a certain amount of sulphuric acid is usually left; this acid acts as an antiseptic, and prevents decomposition taking place in the clarified water to the extent that it does in the sewage water. Still it is not fit to be used even for the roughest domestic purposes; it is not drinkable, and its discharge into the river, though an improvement on the present state of things, is not without disadvantages. Moreover, by this process, when employed on a large scale, enormous quantities of muddy deposit are left in the reservoirs. It must not be forgotten that the annual volume of solid sewage is about 260,000 cubic yards. Let such a quantity be imagined drying on a surface several acres in extent, and manipulated for transport by land or water. These solid deposits have, moreover, no great agricultural value. Long experience has shown that they are not worth much more than good mould, and only fetch about 5s. to 9s. a ton in the market. To produce this manure in the reservoirs costs from 5s. to 9s. a ton in reagents alone, without counting the expense of pumping the water, transports, manipulation, all of which operations raise the cost to a very considerable extent.

The financial question would of itself suffice to prevent the application of this system to the whole sewage of the city. The purification would cost 1c. per cubic yard for reagents alone, which would amount to £40,000 for the 100 millions of cubic yards poured forth by the main sewers. To this must be added all the other incidental costs, and it would be seen that such an expense would be quite out of proportion to the results obtained.

The Commission is therefore of opinion that the solution of the question must be sought not in chemical purification, but in the combined action of sun and vegetation on the sewage. By application to a permeable soil the sewage becomes not only inoffensive, but productive and fertilising. The public health will be benefited, at the same time that the soil is enriched by a manure hitherto lost for agricultural purposes.

When the sewage water containing ingredients partly dissolved, partly held in suspension, is applied to a permeable soil, this soil commences by acting as a filter, separating the particles held in suspension by a simple mechanical process. It was proved by the Commission that a case two yards in height, or even a glass vessel half a yard in height filled with earth and sand from the Plain of Gennevilliers, suffered to clarify for months together the most polluted sewer water poured over the surface. To prove the extreme powers of filtration possessed by certain classes of soil, the case may be mentioned of the alluvial district of Caux, where five or six yards of slimy deposit on a bed of porous chalk does not prevent the permeability of the soil. After this mechanical superficial filtration, the water sinks through the upper layer of earth till it comes in contact with the roots of the plants which absorb the ingredients still remaining. By chemical analysis, the quantity of sewage water necessary for supplying to certain classes of vegetables the elements of alimentation, such as nitrates,

the alkalis, phosphoric acid, is found to be about 7,800 cubic yards of sewage water per acre; thus for three successive crops, 23,400 cubic yards would be required per acre, without counting losses and the amount consumed by parasitic plants, which means that 23,400 cubic yards of impure water have been purified, and the impurities usefully applied. After the experiments above mentioned, it was found that the sewage water, after passing through the vessel of earth, contained no trace of decomposable nitrates, whereasit had contained rather more than 2 oz. of nitrates to the cubic yard before being applied to the soil, and there was only a very small proportion of nitrates left in the form of mineral ammonia, about equal to the amount contained by the Seine water before being polluted with the influx of the sewers. A very considerable proportion of nitrate ingredients was recovered, however, when the surface of the soil was free from vegetation. By the act of percolating through a porous soil the water is sufficiently aerated; the sewage water when applied to the surface of the soil in the laboratory experiments contained scarcely 0·1 cubic inch of oxygen to the pint; on emerging from a layer of gravelly soil about two yards deep, it contained nearly 0·5 cubic inch per pint. Thus the sewage water aerated, and fully purified, instead of being merely clarified, passes away through the natural channels or drains into the river without causing any pollution.

The Commission has examined with attention the results of the experiments made by the Municipality of Paris on the Plain of Gennevilliers, where the municipal engineers continued and extended, in 1869, the experiments commenced at Clichy by M. Millé, in 1867-8.

The sewage is raised at Clichy by centrifugal pumps, which, owing to the absence of valves, have the advantage of allowing the free passage of any solid matter brought by the current of the sewer. Steam-engines of ...-horse power up to 1873, and now of 150-horse power, set these pumps in action, and drive the water to a height of about 11 yards into metal conduits, about from ... in. to 40 in. in diameter, which reach the Plain of Gennevilliers by passing under the foot pavement of the bridge of Clichy. On the side of the departmental sewer a construction of brickwork, about 5 ft. high by about 3 ft. in diameter at its rise, has been established between the ... of La Chapelle and the bridge of St. Ouen. The slope of the ground allows all the sewage which leaves Paris from this side to be brought in this channel to a distance of 3,300 yards by the action of gravity alone. The steam-engines at Clichy can pump on an average ...000 tons of water a day, and the amount from St. Ouen would be of an equal volume. The waters from these two sources unite now in a long channel of brickwork about 2 yards in width and 1,500 yards long, established on the dykes of Asnières and Gennevilliers; a sunk conduit 24 in. wide and 1,960 yards long, a brickwork channel about 7 ft. wide and 2,250 yards long, and 10 to 14 miles of ditches in the ground, complete the net-work of distribution. This net-work compasses an available surface of 353 acres. Of these 353 acres, 273 acres had received the sewage wage on the 1st of October last. The sewage is distributed over the surface of the soil by means of furrows divided by ridges. These furrows are cut in the fields by the plough, in those plots of land devoted to market gardening by the spade. The plants grow on the ridges, their roots creep down towards the moisture and nourishment in the furrows, the green leaves are never touched by the sewage water. The quantity of sewage water absorbed since 1869 amounts to more than ...,000 tons. The amount applied every year per acre has been from 20,000 to 40,000 tons.

The reservoirs for purification had been established in 1868 on a piece of ground belonging to the City of Paris; after having clarified, in 1869, 320,000 tons, and in 1870 57,000 tons of sewage, the reservoirs ceased working because of the great development given to the system of irrigation.

The Commissioners have examined from a sanitary and economical point of view the results of the operations on the Plain of Gennevilliers. They must first observe how very favourable the soil of that region is for any undertaking of the kind, consisting as it does of a vast bed of alluvial depost 7 to 10 yards in depth, composed of flinty sand and covered with a thin layer of vegetable mould. Thus the Plain of Gennevilliers forms an immense natural filter, eminently suitable for the absorption and purification of sewage water. The Commissioners caused some water to be drawn from a pond formed in the midst of the irrigated land. This water was perfectly limpid, without any perceptible taste, and resembled the water found in the springs throughout the region between Rueil, Courbevoie, and the Seine. When analysed this water was proved to be free from any fermentable matter, and to be purer than the water of the Seine above the sewer's mouth. The Commissioners regard this as conclusive evidence of the purifying properties possessed by the soil of Gennevilliers.

The Commissioners do not believe that the powers of absorption in the soil will become exhausted. The example of the region of Caux, cited above, shows that the ground may remain permeable even after a layer of slime several yards in thickness has been formed, and at Gennevilliers the deposit formed on the surface by the sewage does not amount to a thousandth part of a yard in thickness; the deposits are moreover not of a slimy character, but silicious and crumbling, so that they mingle every year with the soil, and have no further effect than to increase the layer of light arable mould. This process of the filtration of the water and incorporation of the solid particles with the soil ensures the healthiness of this system, as regards the neighbouring villages. No water remains standing, and the action of fermentation and oxidisation takes place in the bosom of the earth, instead of in the waters of the Seine. Around the irrigated ground a village has sprung up, and the fact that no inconvenience has been felt by the inhabitants even in the midst of the channels of sewage water, is a sufficient proof of the harmlessness of the system. As regards the agricultural and economical results, the Commissioners are able to attest the flourishing condition of the irrigated fields. In various allotments, about 12 to 14 acres in extent, let out to market gardeners, the greatest variety of products may be seen, from vegetables of all kinds to flowers and fruits. In the fields vegetables predominate; the cabbages and artichokes particularly attracted the attention of the Commissioners. Part of the ground is devoted to the culture of plants for perfumery and other manufacturing purposes, especially peppermint, which is distilled in the neighbouring works of the perfumer, M. Chardin-Hadancourt. Fields of grass, rye, and beet root may also be seen in perfection. In the month of October the lucerne was still vigorous, though it was the fourth or fifth crop; the fields of beet root yield about 88,000 lbs. of produce per acre.

According to the reports of the municipal engineers the vendible value of the irrigated land has risen considerably, namely from £1 10s. or £2 per acre, to £3 5s., or £4 18s., and even £6 18s. per acre. The City of Paris lets its land at about a half-penny the square yard, which is equal to about £8 per acre. The extent of irrigated land has been increased from 323 acres in 1872, to 355 acres by the free action of private individuals, who have availed themselves of the benefits of the sewage irrigation, and there is every probability that the enterprise will continue to spread in the same proportion.

A careful examination of the system carried out on the Plain of Gennevilliers has convinced the Commissioners that the only remedy for the pollution of the Seine is the direct application of the sewage water to agricultural purposes, and that a permeable soil like that of Gennevilliers is favourable to the utilisation of

the sewage for the cultivation of market-garden produce, plants for manufacturing purposes, and grass, without causing any danger to the health of the inhabitants of the irrigated regions.

The Commissioners have therefore endeavoured to ascertain how the system at work on the Plain of Gennevilliers might be applied to all the sewage of Paris, and they are enabled to state the following facts:—

A vote of £40,000 granted in 1872 has enabled the present system to be established, which comprises:

The connection between La Chapelle and St. Ouen (departmental sewer) between the Clichy sewer and the pumping works ..	£18,120
The first part of the pumping apparatus, comprising the purchase of land, &c. ..	15,240
Metal pipe for crossing the Seine at the bridges of Clichy and St. Ouen	6,666

By a second vote of the same amount made in 1874 a network of conduits will be permanently established on the Plain of Gennevilliers, enabling the sewage to be carried to any part of the plain between the Seine and Fosse de l'Aumone. These works are estimated at £30,000; the irrigated surface is about 2,470 acres, which require a volume of about 20,000 tons of sewage per acre, which amounts to 50 million tons a-year, or about half the total volume carried by the sewers. The total expense of all the works when completed will amount to £104,600, which will enable about from one-half to three-fifths of the whole volume of sewage to be applied to the soil.

There remains now one-half of the total sewage of Paris to be disposed of. The municipal engineers called attention to the fact that to the west of the present municipal lands at Gennevilliers there was an available tract of land from 2,470 to 2,964 acres in extent, eminently suited for the purpose in every respect; that an expense of from £91,000 to £200,000 would complete the works necessary for the entire purification of the Seine. The Commissioners are convinced of the practicability of this further development of the system, which will, however, require some little time to carry out. A tract of land from 2,470 to 2,964 acres in extent, near the Forest of St. Germain, between Maison Lafitte and St. Germain, has also been pointed out to the Commissioners. This land is of little value, and would, owing to the position and nature of the soil, be suitable for the utilisation of the remaining half of the sewage water of Paris. The Commissioners desire to call the attention of the municipal engineers to this locality also.

It only remains now to the Commissioners to consider the disposal of the night-soil, of the the refuse water of manufactories, &c., and of those sewers along the river-bank which have not yet been united with the main sewers.

The common sewer of Bondy, which enters the departmental sewer of St. Denis, is undoubtedly one of the principal causes of the infection of the Seine at that point. Everyone knows of the existence at Paris, at the Route d'Allemagne, of a depôt for the night-soil, which is not taken by the scavengers to their own private depôts. From this depôt all the matter is driven mechanically to the municipal common sewer in the Forest of Bondy, where it has hitherto been chemically treated by a succession of companies, the last of which, after having sunk some £200,000 in the undertaking, has ceased working, leaving all the matter to be carried down into the Seine, which causes the filthy state of the river at St. Denis. It has been the object of the Commissioners to discover some means of obviating this evil, and they recommend in this case, as in those which have gone before, the application of the deposits direct to agricultural purposes.

For several years some agriculturists have been in the habit of applying a quantity of the deposits at Bondy to their land, and have obtained good results. At Choisy-le-Roi the company of Lesage added to their works about 337 acres of land. To this land they applied the deposits in their natural state, as well as the refuse water from the works. The application of the refuse water might be effected still more simply and economically by a means of the arrangement made by the City of Paris, for collecting the waters of the departmental sewer. This sewer passes very near to the common sewer of Bondy. It would not be difficult to convey the refuse water through the departmental sewer to the Plain of Gennevilliers, where it might also be applied to the soil.

Lastly, as regards the secondary sewers, which have not been connected with the main sewer, and the waste water from the manufactories, the same principle would be applicable. In the first case, the evil must be met by an extention to the suburbs of the system of main sewers connected with the land devoted to irrigation; and in the case of those manufactories which, from their position, are prevented sending the waste water into a public sewer, it would be desirable that arrangements should be made for utilising the refuse on land attached to the premises, as is already done in many cases, among which may be mentioned the names of M. Wurtz, M. Dailly, proprietor of a large distillery at Trappes, M. Gérardin, and others.

Finally, the Commissioners sum up their report by saying that the solution of the question of the purification of the rivers must be sought in the combined action of the sun and vegetation, by which those substances which in their natural state are detrimental to the public health are converted into a mine of wealth and fertility. Public health and agriculture are alike benefited by compliance with the great natural law of restitution.

CORRESPONDENCE.

FUSEL OIL.

Sir,—As some reference to this oil was made in the discussion on Mr. W. Scott's paper on adulteration, the following information may be of service.

Fusel oil is a bye-product separated from [illegible] spirit, and is formed during the process of fermentation of all kinds of grain and cereals, under circumstances which at present are not fully understood; [illegible] principal constituent is amylic alcohol. Thus, although fusel oil differs somewhat in smell and taste according to the kind of grain or cereal it is produced from, yet it is identical so far as being principally composed of amylic alchohol. Other ingredients present give it characteristics sufficiently distinctive, so as to render the fusel oil from particular sorts of cereals or grain recognisable; thus the fusel oil separated from spirit made from grain, when diluted with pure spirit, is similar to whisky, and no doubt all whisky owes its characteristic flavour to its presence in a more or less degree. On the other hand, fusel oil from potatoes is distinguished by an odour most disagreeable and persistent, but in other respects is identical with the oil from grain. Indeed, the experienced dealer in plain or neutral spirit can frequently detect from what source the spirit is obtained, through traces of fusel oil remaining in it.

When the fusel oil and other extraneous bodies are removed from spirituous or fermented liquors the spirit thus separated is in all cases identical, with this exception, that a variable amount of water may be present. Thus the alcohol from lime, rum, malt, potatoes, [illegible] grasses, and various other sources, is the same in quality, provided all other solid and liquid impurities [illegible] removed.

In the course of the discussion it was stated by Mr. Branston—"The great adulterant of alcoholic liquors was *Cocculus indicus* in beer, and fusel oil in spirit. The fusel oil was not put in artificially by the dealers, but

arrived in this country in the form of a spirit from Hamburg and the north of Europe, and was made from the potato."

If Mr. Branston possessed a practical knowledge of the immense importation of what is known as German spirit (which is made principally from the potato), he would not speak of this spirit being largely contaminated with fusel oil. A large practical experience convinces me there is not any other spirit submitted to the English market which more nearly approaches pure alcohol than this very much maligned potato spirit. The quality and purity of this spirit is proved from the circumstance that it costs the spirit-dealer as much as British spirit. Its importance on the spirit market is so far recognised that the price of the German spirit in a great measure rules the price of British plain spirit.

Mr. Scott states in his reply, "That there were very large quantities of what were called 'feint spirits,' or weak spirits—weak as regards alcohol, strong as regards fusel oil—which could be bought at a cheap rate, and which formed a considerable part of the stock-in-trade of the peripatetic individuals who go about making up people's wines and spirits to the required flavour."

The accuracy of this statement is doubtful, simply from the circumstance that the duty of ten shillings per proof gallon on spirit is so much greater than the intrinsic value of the spirit, that it would be comercially unprofitable for the distiller to pay duty upon his low wines or feints, more especially when he can at a very small cost re-distil these feints, separating the impurities, leaving an alcoholic liquid perfectly pure and neutral in its character. That a heavy duty frequently proves a guarantee of quality, we have illustrated in the case of tea. I refer to the time when the retail price of tea was from 8s. to 9s. per pound. At that time it was a practice to destroy all tea that was damaged or of an inferior quality, tea of a low class not being worth the risk of paying the duty upon. The same risk would apply to the description of spirit described by Mr. Scott.

The next question, Is fusel oil an adulterant? To this I reply, when present beyond a trace in plain or neutral spirit, it is an impurity which deteriorates the commercial value of the spirit, therefore it is not consistent to suppose that it would be added by the trader. If plain or neutral spirit should be found contaminated with it to a large extent, it would be through the negligence of the distiller in not having separated it during the process of manufacture. It may be suggested, if the distiller was under a penalty, it would obviate an inadvertence of this kind. That suggestion would be quite practical in the case of distillers of plain or silent spirit, but the whisky distiller would have to be exempt from this penalty in consequence of the fusel oil formed during the fermentation of the barley or grain being the basis of whisky flavour. To produce whisky free from fusel oil would be simply manufacturing plain or silent spirit. I have no doubt the above statement will be most emphatically contradicted by admirers of the "delicious old mellow spirit;" nevertheless, it is most certainly true, and is proved by this circumstance.

The separation of fusel oil by distillers of plain or silent spirit, when only the old-fashioned pot-still was in use, was a source of much trouble and expense, and was only accomplished by repeated redistillation. Not until the introduction of improved distilling apparatus constructed on most scientific principles could this difficulty be overcome with comparative ease and certainty. The still now known as Coffey's is so complete in its action that it produces a spirit direct from the wash, commercially pure, in one operation. It was thought, when this still was first introduced, that it would be equally successful in the production of whisky, but experience has proved that only the old-fashioned pot-still is capable of producing a spirit possessing the characteristics so much admired by the consumer.

Inland Revenue officers of large experience can testify to the fact that at plain spirit distilleries quantities of fusel oil are either destroyed or disposed of as a bye product, but at whisky distilleries this bye product does not appear in quanties of any importance. Thus, it may be seen, it would be most difficult to treat fusel oil as an adulterant.

I most cordially endorse the remark of the chairman, that we are laying the blame upon adulteration for the injurious results produced by excessive indulgence in intoxicating beverages, when the true source of the evil exists in the alcohol.

Take the case of gin. Dr. Richardson, in the "Cantor Lectures" on Alcohol, condemned the use of this spirit, because of the diuretic properties of the oil of juniper, which constitutes its principal flavouring. Dr. Thudichum states, "The madness of drink was undoubtedly caused by these, to which class belonged salt, pepper, mustard, the oils of cinnamon, juniper, cassia, and turpentine."

Thus we have Dr. Richardson denouncing gin on account of its diuretic properieties, and Dr. Thudichum because the oil of juniper produces madness. Let us hope madness is avoided when salt, pepper, and mustard are introduced into the system unassociated with alcohol, otherwise a careful revision of the members of the cruet-stand is eminently urgent.

That the excessive use of any one of these ingredients in an undiluted form may produce the baneful effects before mentioned is well known. Shipwrecked sailors who persist in drinking sea-water become mad, but would it, on that account, be consistent to prohibit the use of salt?

Let us see what quantity of gin it would be requisite to imbibe to introduce into the system a minimum medicinal dose of oil of juniper.

The following is an extract from Dr. Royle and Dr. Headland's "Materia Medica," page 662:—

"Oleum Juniperi B., oil of juniper (distilled in England from the unripe fruit).

"Action—Uses. Stimulant; diuretic. Considered very certain in its effect in doses of m.iv—m.vj."

The same work states that the juniper berry contains 1 per cent. of the above oil.

Thus one hundred pounds of juniper berries contain one pound of volatile oil.

One hundred pounds weight of juniper berries, when distilled with spirit, will impart the flavour of gin to 3,262 gallons of gin at 36 per cent. under proof (that being the average strength of gin as consumed).

Consequently, 3,262 gallons of gin will contain one pound weight of volatile oil of juniper.

One pound weight of volatile oil of juniper is equal to seventeen ounces, or 8,160 minims.

The smallest medicinal dose to act as a diuretic being four minims, one pound will be equal to 2,040 doses.

As 3,262 gallons of gin contain one pound of volatile oil of juniper, and one pound of juniper oil being equal to 2,040 doses, therefore 6,262 gallons contains 2,040 doses of juniper oil.

Thus it will be seen it is requisite to take not less than one gallon and a half of gin to convey a medicinal dose of four minims of the essential oil of juniper into the system.

The above figures, with regard to the quantity of juniper berries used in making gin, are based upon facts, and any considerable excess upon those proportions would render gin unpalatable to the consumer.

A careful analysis of the amount of the various essential oils, ethers, &c., which produce the flavours of wines, brandy, rum, whisky, &c., I feel certain would prove them so infinitesimal compared to the amount of alcohol present, that I am confident the baneful results arising from the persistent and excessive use of alcoholic liquids may be traced by the unprejudiced investigator to the alcohol, and not to the flavouring matter.

If, in place of medical men proclaiming that this disease, or that evil, arises from the use of certain flavours used in certain beverages, they were to urge that the

true source of the evil consists in the alcohol, they would be exercising a most patent influence on the public mind as a deterrent from the excessive use of stimulants.—I am, &c., A. Z.

GENERAL NOTES.

Philadelphia Exhibition.—The applications for space in the British Section of this exhibition are numerous, and of a satisfactory character. In consequence, however, of arrangements recently communicated by the American authorities, whereby the time for foreign commissions to make definite application for amount of space required is extended, it will be possible for the British Executive to receive applications from intending exhibitors, addressed to 5, Craig's court, Charing-cross, London, up to the 15th of May inclusive.

Citizen Soldiers and Chemistry.—The following extracts are taken from a review of Ellis's life of Count Rumford, published in *Nature*:—"He tells us that the fundamental principles upon which he proceeded were to unite the interest of the soldier with the interests of civil society, and to render the military force, even in times of peace, subservient to the public good;" and further "that to establish a respectable standing military force which should do the least possible harm to the population, morals, manufactures, and agriculture of the country, it was necessary to make soldiers citizens, and citizens soldiers." "I have long maintained that every father who is able and willing to qualify his son to attain a high degree of success either as a man of business, a soldier, a sailor, a lawyer, a statesman, or in any other responsible department of life, should primarily place him in a laboratory, where he will not merely learn the elements of science, but be well trained in carrying out original physical research, such training being the best of all known means of affording that systematic discipline of the intellectual and moral powers upon which all practical success in life depends."

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

May 5.—"Horse-shoes and Horse-shoeing." By George Fleming, Esq., Veterinary Surgeon, Royal Engineers. On this evening Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, will preside.

May 12.—"River Pollution, and the Impurities of the Water Supplied to our Towns." By Jabez Hogg, Esq., Surgeon to the Royal Westminster Ophthalmic Hospital, President of the Medical Microscopical Society, Fellow of the Royal Microscopical Society, &c.

May 19.—"The Agricultural Statistics of India." By Clements R. Markham, Esq., C.B. On this evening Andrew Cassels, Esq., Member of the Indian Council, will preside.

May 26.—*No Meeting.*

June 2.—"Toughened Glass." By Perry F. Nursey, Esq., C.E.

Indian Section.

Friday evenings at eight o'clock. The following arrangements have been made:—

April 30.—"The Growth of the Factory System in India, with especial reference to the Production of Textile Fabrics, and the Relative Advantages of the British and Indian Manufacturer," by Elija Helm, Esq., of Manchester. On this evening Andrew Cassels, Esq., Member of the India Council, will preside.

May 13.—"The Russian Advance in Central Asia in its Commercial and Social aspects towards India and the East," by the Rev. James Long. On this evening the Right. Hon. Lord Napier and Ettrick, K.T., will preside.

[N.B.—The date of this meeting has been transferred from Friday, May 14, to Thursday, May 13.]

Chemical Section.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

May 7.—"Alum Shale as an Economical Means of Purifying Town Sewage," by Sydney Rich, Esq. On this evening W. J. Russell, Esq., Ph.D., F.R.S., will preside.

May 21.—"Explosive Compounds." By Alfred Nobel, Esq., the founder of the Nitro-glycerine Industry. On this evening F. A. Abel, Esq., F.R.S., will preside.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Farmers' Club, Salisbury-square, E.C., 5½ p.m. Mr. [illegible] Corbet, "The Use and Abuse of Fashion in Breeding Stock."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Ernest Spon, "The Use of Paint as an Engineering Material."
Royal United Service Institution, Whitehall-yard, 8½ p.m. Lieut.-Col. Home, C.B., "The Organisation of the Communications of an Army, including Railways."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. 1. Mr. J. E. Howard, "An Examination of the B[illegible] Address from a Scientific point of view." 2. Rev. [illegible] M'Dougall, "Present Day Materialism."

Tues.... Royal Institution, Albemarle-street, W., 3 p.m. Dr. Gladstone, "Chemical Force."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on Mr. Deacon's paper "On Constant and Intermittent Water Supply."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C. [illegible]
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m.

Wed. ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. G. F. Fleming, "Horse-shoes and Horse-shoeing."
Microscopical, King's College, W.C., 8 p.m. Mr. [illegible] Slack "The Relation of Angular Aperture to [illegible] Markings and Accurate Vision."
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Thurs... Linnean, Burlington House, W., 8 p.m.
Chemical, Burlington House, W., 8 p.m. 1. Mr. Walter Flight, "An Examination of the Methods for [illegible] the Quantitative Separation of Iron, Sesqui-Oxide, Alumina, and Phosphoric Acid." 2. Mr. N. Story Maskelyne, "Andrewsite and Chalkosiderite." 3. Mr. W. Ramsay, "Sodium Ethyliosulphate." 4. Mr. W. Williams, "A Milligramme Thermometric Scale."
London Institution, Finsbury-circus, E.C., 7 p.m. [illegible] Freeman, "History and Use of the English Language." (VI.)
Royal Institution, Albemarle-street, W., 3 p.m. Prof. H. G. Seeley, "The Fossil Forms of Flying Animals."
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Fri....... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. Rich, "Alum Shale."
Royal United Service Institution, Whitehall-yard, [illegible] p.m. Vice-Admiral R. Collinson, "Some account of the Observations recently made by the Corporation of the Trinity-house on Fog-Signals."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Prof. Cornu, "On the Velocity of Light."
Civil and Mechanical Engineers' Society, 7, Westminster-chambers, S.W., 7½ p.m. Mr. Willcocks, "Railway Companies as Carriers."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. Mr. [illegible] "French Sounds in English." (I.)
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
Social Science Association (at the House of the Society of Arts), 11 a.m. "Conference on Primary Education."

Sat...... Royal Institution, Albemarle-street, W., 3 p.m. Rev. Mark Pattison, "A Chapter of University History."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, MAY 7, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of this Section was held on Friday evening, the 30th April, Mr. ANDREW CASSELS (member of the Indian Council), in the chair.

The Chairman, in introducing Mr. Helm, said the duties on imports into India were only imposed for revenue purposes, not, as was avowedly the case in Australia, with the object of protection, for such an idea would never cross the mind of an Indian statesman. But still there was a very important question, whether India would again become a great manufacturing country, without any artificial aid to her great natural advantages, or whether the Lancashire manufacturer, with his skill and enterprise, could successfully compete with his Indian rival, if unweighted with import duties. There was also the question, whether English capital could be profitably embarked in mill speculations in India. On all these points there was need for discussion and information, and he was therefore very glad that a gentleman so well able to treat the subject had come forward to read a paper dealing with it.

The paper read was:—

THE GROWTH OF THE FACTORY SYSTEM IN INDIA, WITH ESPECIAL REFERENCE TO THE PRODUCTION OF TEXTILE FABRICS AND THE RELATIVE ADVANTAGES OF THE BRITISH AND INDIAN MANUFACTURER.

By Elijah Helm.

It is not surprising that the recent rapid growth of the cotton and jute industries in India has excited a large amount of public attention both in that country and in England. For many years it had become a habit here to regard India as a purely agricultural country, destined for an indefinite period to draw manufactures from us in exchange for the products of her soil, and even ceasing to use in due time those hand-made fabrics for which the country had long been famous; and up to a certain point this view was supported by the actual course of events. Until about fourteen years ago there was a steady increase in the exports of British cotton fabrics to India. Then came the civil war in the United States, and with it a long period of abnormally high prices for cotton, when Indian consumption declined rapidly, in common with that of the rest of the world. Afterwards, when prices had settled down to what may now be called their ordinary level, the exports to India recovered, but they no longer showed the elasticity and steady growth which they did before the war, and which have characterised other sections of our foreign trade. This change has occurred simultaneously with the development of steam cotton factories in India to a formidable extent, and it is impossible to escape the conclusion that the slow progress which has of late years been observable in the export of cotton goods to India is mainly due to the rise of this new industry in the dependency.

The first experiments in the mechanical production of cotton fabrics in India were made in 1854, when two mills were erected in Bombay. Others were built during the two or three years which followed the doubling of the import duties on cotton goods in 1859. In 1862 the duties were reduced, and some check was given to the progress of mill extension. In the autumn of 1869 there were in Bombay nine mills at work, containing 262,000 spindles and 3,263 looms. There were also two mills in Calcutta, and one each at Cawnpore, Coorla, Ahmedabad, Duskeohie, Broach, and Surat—making a total of seventeen mills in all India, containing 390,500 spindles and 3,952 looms. At the present time there are at work in Bombay seventeen mills, containing about 500,000 spindles and 5,200 looms; and in all India there are about 700,000 spindles and upwards of 6,000 looms, besides at least half-a-score of mills in course of construction. The amount of capital sunk in buildings and machinery in the factories already at work may be estimated at about £2,780,000. Thus we see that within the space of twenty years, and most notably within the past six years, the factory system of our Eastern empire has gained a position of first-rate importance. One may well ask how it came to pass that up to a given point India showed no sign of being able to sustain an important manufacturing industry which has thus all at once sprung into existence. I do not think that I can fully discover the causes of this rapid change, but I trust some light may be thrown upon them in the course of our inquiry.

I need not insist upon the magnitude of the questions to which this movement has given rise. How far it is due to the duties upon imported manufactures; whether or not it is likely to make further progress; or whether there is any limit beyond which it cannot pass. How far it is likely to affect the consumption of European manufactures, and whether the application of steam-power and machinery will spread to other fields of manufacturing industry in India; and if so, to which. These are some of the leading and most immediately interesting inquiries. One or two of them may, perhaps, be answered with tolerable certainty, but others are it is to be feared beyond our reach at present, because many of the conditions of the problem are as yet unknown or imperfectly understood. One of the most perplexing elements of the question arises out of the general laws according to which the labour and capital of any country are, under natural conditions, applied to productive industry; and as this law is scarcely ever sufficiently recognised in discussions of this nature, you will, I trust, pardon me if I dwell upon it somewhat emphatically.

Of the three great requisites of production labour, capital, and raw material, the distribut thoughout the earth is obviously most ur We see in some countries an overwhelmir

dance of raw material, of some kind of natural advantage, in the shape either of minerals, or fertile soil, or varied vegetation, or favourable climate, and yet there may be no profitable production, because capital and labour cannot or will not go thither. Elsewhere we see such a plethora of labour, or of capital, that they tend constantly to exceed the available supplies of raw material. It follows, therefore, that a recital of the natural advantages of any country or district, in regard of any particular industry, is of itself no ground for supposing that that industry will flourish there. It must also be shown that there are no effective obstacles to a free flow of capital and labour in that direction. But further. Assuming that the natural advantages are there in sufficient abundance, and that there is nothing to prevent or to discourage capital or labour, the question next arises —In what order will the natural resources of the country be developed? It is clear that in the absence of artificial regulations, such as protective duties, the capital and labour will first be applied to those resources which will yield the largest proportionate rewards, all other advantages being neglected, however great. Roughly speaking, it may be said that the order of development is usually this. First comes the extraction of the precious metals, wherever they exist in quantity, and are easily accessible. Secondly comes the cultivation of fertile soils; then the extraction of the baser metals and minerals; and lastly, the establishment of manufactures. Thus, in any country in which there is a supply of gold or silver within easy reach, and out of proportion to the available capital, agriculture will be neglected, be the soil never so fertile. Similarly, wherever the precious metals are not known to exist, and the fertile soil is in excess of the capital, the prevailing industry will be pastoral or agricultural, although there may be vast and inexhaustble stores of iron and coal close to the surface wholly untouched, and not to be touched until the fertile soil has become fully supplied with capital. Of the first of these two cases, we have an example in the Australian gold discoveries, which, as every one knows, drew away with almost magical rapidity the labour and capital of the country from pastoral industry and the cultivation of the soil. Thus, notwithstanding that she possessed an almost boundless extent of rich and virgin land, Australia became from that time an importer of grain, and was, indeed, in 1858, dependent upon the produce of foreign soil for more than one-half of her whole food supply. Of the second instance, a striking illustration occurs in the Southern United States, where the most easily available and most profitable natural resource lies in an enormous area of rich land, vastly beyond the present means of cultivation. Here, notwithstanding that great quantities of coal and iron lie immediately below the soil, the latter is cultivated with iron implements, and the produce conveyed over iron rails imported from Europe, in face of the most serious artificial discouragements. These implements and rails are made by means of coal and iron obtained through a larger expenditure of labour than would be necessary in the mineral districts of the Southern States themselves. The obvious explanation of this apparent anomaly is, that any country which happens to possess special facilities in the production of a particular commodity will find it to its advantage to devote its powers to that end mainly or entirely—satisfying its wants in regard of other things by exchange, and neglecting other resources which, although they may be superior to like resources in other countries, are yet much inferior to the particular resource in which its own preeminence is most marked. It would, therefore, have been foolish to tell the Australians that with their unbounded agricultural facilities they ought to produce their own food, at a time when a common labourer might earn on an average £1 per day in gold mining. And so the Southern United States prefer to devote their energies to the production of cotton, in which their advantages are unrivalled, and with their cheaply grown cotton to purchase the manufactures of Europe—notwithstanding the discouragements of oppressive import duties—rather than utilise their boundless supplies of coal and iron, to the neglect of their still more profitable resources in a hitherto unlimited quantity of rich cotton land.

A further consideration ought not to escape notice. There is a constant tendency towards rapid accumulation of capital in long-settled and well-governed States within the temperate zone, which does not exist within the tropics. Several of the reasons for this peculiarity are clearly stated by Mr. Mill in his "Political Economy;" but there is a further one which is especially applicable to the differences existing between India and England in this respect. Europeans, and especially Englishmen, furnish by far the largest part of the skill and enterprise used in developing the resources of the tropics. They therefore share very abundantly in the resulting wealth, and as they commonly return home to settle, and bring with them most of their earnings, there is a constant stream of accumulated capital homewards, leading to a plentiful supply in this country of one of the three great requisites of production, and constituting a permanent advantage in all such industries as require large investments of capital. This advantage is indicated by the low average rate of interest ruling here in comparison with that which prevails in India, or indeed in any tropical country, and it is one which, from the nature of the causes producing it, is likely to be permanent.

Applying these principles to the relative situations of England and India, we may, I think, advance to the following general propositions:—1. That whatever may be the comparative advantages of the two countries in respect of raw material and labour, England holds, and will always hold, a superior position, so far as capital is concerned. 2. That the prospects of a large and profitable field for any particular kind of manufacturing enterprise in India depend not alone upon its possession of the requisite raw material and an abundance of labour, but also upon whether there are not other fields in which such capital as is available may be more advantageously employed. You will not, I am sure, expect me to follow up these propositions by showing with anything like exactness what are those spheres in which capital can be most profitably used in India. The useful purpose which this more general view serves in our present inquiry is to prevent a too exclusive concentration of attention upon the industries more especially under consideration,

and a neglect of others which may nevertheless by their superior attractiveness keep manufacturing industry in abeyance. That there is a vast field for the profitable employment of capital in India, no one who has paid much attention to its economical condition can doubt. It might perhaps be supposed, in view of the large population of the country and of its long settlement, that the productive powers of the soil are now fully developed, and that any larger supplies of capital must necessarily flow into manufactures. But this is by no means certain, and indeed, there are weighty reasons for believing that even now, under natural conditions, agriculture presents a much more attractive prospect than manufactures. We have only to remember the large tracts of still unoccupied land in India, the poverty of large masses of farmers, and their primitive methods of cultivation, in order to have some notion of the vast progress which is still possible in the extent and variety of the agricultural production of India. As a matter of fact, the amount of fresh investment, and especially of European investment, in the cultivation of the soil within the past fifteen years has been considerably greater than that devoted to manufactures. I find that the paid-up capital of the tea-growing companies of India, nearly all of which have been established within the past fifteen years, is upwards of £2,600,000. But besides this there is the amount invested by private individuals in tea-gardens. And when we remember how remarkable has been the recent growth in the exports of other agricultural products from India; of oil seeds, of jute, of coffee, silk, and wool, it seems clear that there must have been an enormous addition to the capital devoted to agriculture. Nor are there any indications that the characteristic feature of Indian foreign trade, viz., the export of agricultural produce in exchange for manufactures, is likely, within any period at present assignable, to undergo serious change. The great extent of cultivable land not yet brought into productive use, and the fact that the system of cultivation is, throughout large districts of the country, primitive and inefficient, are enough to show that there is room for an indefinite and profitable application of capital to agriculture in India. It is no part of my purpose to discuss the hindrances to agricultural investment, nor the measures necessary for their removal, but in any fair estimate of the prospect of manufactures, the possibility of a larger and still more remunerative field in the cultivation of the land cannot be shut out of sight. The movements of capital take place very impartially, and it will naturally flow into those channels in which, making due allowance for difference of risk, it will yield the largest return.

I come now to consider in detail the special advantages which India enjoys in regard of cotton manufacture. The first and most obvious of these is proximity to the raw material. That cotton should be conveyed some thousands of miles away from the place of its growth for the purpose of being manufactured, and then returned for consumption in the regions where it was produced, seems, at first sight, unnatural and likely to be unprofitable. And there can be no doubt that the charges incident to this double transit constitute the most important element in favour of the Indian producer. The extent of this advantage may be stated at about ½d. per lb., or about 36 per cent. upon the value of the new cotton in Bombay. A second benefit enjoyed by the Indian cotton spinners lies in the absence of any legislative restriction upon the hours of labour, and the larger production which is consequently realised. The Bombay mills work 6½ days per week, each day during summer consisting of 13 hours, and of 10½ hours in winter. The average of the whole year is about 11 hours. Allowing for holidays, the working year comprises 312 days, of 11 hours each, making 3,482 hours per annum. English mills are now restricted by law to 56 hours per week. Allowing one week in the course of the year for holidays, the English working year may be stated at 2,856 hours. It thus appears that the Indian mills work 578 hours per annum or 20 per cent. in excess of the limit allowed in England. The out-turn per spindle is therefore larger in India, but not in proportion to the longer time worked. For example, the production of 20's twist, half mule and half throstle, is at the rate of 1·4 lb. per spindle per week, whilst in England it is only at the rate of 1·2 lb. per spindle per week. Thus, whilst the working time is 20 per cent. greater than in England, the production is only a little more than 16 per cent. in excess.

It is very commonly supposed that the abundance of labourers, and the low rate of wages in India, is an economical advantage in the production of cotton goods there; but I cannot find that there is any difference in this respect, for, although the rate of wages is considerably lower than in England, the number of persons required for a given production is much greater. Thus, whilst in this country two men and a boy can attend to a pair of mules, in Bombay eight men and boys are needed. It is, no doubt, quite possible that in course of time the Indian operative may acquire greater skill, and be able to turn out a larger amount of work. But it is scarcely likely that much progress can arise from this source, because the cotton industry has already been established in India for a period sufficiently long to have secured a generation of trained hands. Higher wages and shorter hours might perhaps promote the efficiency of the worker, but both these changes would involve an increase in the aggregate cost of production. It has been thought by some persons that the tight hydraulic packing of the raw cotton exported to Europe from India, is the cause of some deterioration in its spinning qualities, and that Indian mills have an appreciable advantage in being able to use unpressed cotton. I cannot discover, however, that there is any very great difference on this score, between using pressed and unpressed cotton.

To sum up then. The only serious natural advantage attending the production of cotton fabrics in India, as compared with England, lies in ready access to the raw material, and of course this applies only to those kinds of cotton which are grown in India. Now, experience has shown that the soil and climate of that country are incapable of producing profitably any but the shorter stapled cottons, from which only the coarser yarns and goods can be made. As a matter of fact, it is in the manufacture of these alone that any progress

has been made. It has, indeed, been suggested that Indian spinners should import American or other long-stapled cottons, for the purpose of manufacturing the finer and more costly fabrics, but the experiment has never yet been tried on any considerable scale. Moreover, the project can only be carried out by surrendering at least half of the one natural advantage possessed by the Indian mills. With regard to the other special facility derived from the absence of any legislative restriction upon the working hours, there can be no doubt that it has hitherto been a substantial benefit to the proprietors of the mills. It seems probable, however, from the fact that an official inquiry into the hours of labour has been ordered by the Indian Government, that some limit will be imposed, and there can be no doubt that any movement in this direction will tend to enhance the cost of production.

Coming now to the other side of the question, we have to consider what special facilities the English spinner enjoys which his Indian rival has not. The first of these is the much smaller amount of capital required for buildings and machinery. A spinning-mill, which in England could be erected at a total cost of 25s. per spindle, would cost in India about 60s. per spindle. A weaving-mill, which in England could be established for £22 per loom, requires in India an expenditure of at least £52 per loom. As a matter of fact, I cannot find that any Indian mill has yet been set to work at a more moderate cost than 62s. 6d. per spindle and £53 6s. 8d. per loom. The effect of this large outlay of fixed capital is to raise enormously the charges for depreciation and for interest upon the permanent portion of the investment. But both these charges are in another way higher in India than in England. In consequence of the longer hours of labour and the deteriorating influences of the climate during the monsoon, the wear and tear of machinery goes on at a much more rapid rate there, and persons who are practically engaged in the management of Bombay mills affirm that the allowance for depreciation ought to be at the rate of 10 per cent. per annum, as against 7½ per cent. in England; and whilst here 5 per cent. is an ample charge for interest, it cannot in India be taken at less than 8 or 9 per cent. A further advantage possessed by this country lies in its cheaper fuel. The price of engine-coal in Bombay is on an average about 50s. per ton, when English coal of similar quality is 10s. per ton. There is thus the strongest motive for the application of the most economical methods of raising steam in India, and accordingly we find that, as a rule, the steam-engines and boilers in use there are of the most approved kind. Indeed, there cannot be any doubt that, both in this respect and also in regard of machinery, the average condition of the cotton-mills in India is appreciably in advance of the average condition in England. The expenditure upon coal in an Indian mill producing 20's. yarn is estimated at ¾d. per pound. There is, of course, a possibility that, so soon as the Indian coal-fields are fully developed, there may be some reduction of expenditure upon fuel. Assuming that the fall in price will be so much as 50 per cent. —a very bold assumption indeed—it appears that the full extent of the gain which Indian spinners can hope to receive from such a change is ⅜d. per pound of yarn spun.

I have hitherto said nothing about the benefit of the protection enjoyed by the Indian producer from the effect of the import duties upon cotton fabrics. Nominally these amount to 3½ per cent. upon yarns and 5 per cent. upon goods. Owing, however, to the fact that the tariff valuations—the fixed prices upon which the duties are levied—are considerably in excess of the market prices, the duties are nearly 1 per cent. higher than the nominal rate. Now the value of the annual production from an Indian spinning and weaving mill is usually about one-tenth more than the amount of capital invested. It may therefore be concluded that the protection afforded by the present import duties amounts to about 6½ per cent. upon the investment in the mills. To this extent, therefore, the profits earned by them are traceable to the artificial benefit conferred by the duties. A year or two ago the dividends declared by the spinning and manufacturing companies were very considerable, but within the past twelve months they have sensibly declined, and are still tending downwards. The following table shows the rate per cent. per annum of the dividends published last October of ten of the leading companies in Bombay, where the profits have been much larger than those earned in the other mills in Calcutta and elsewhere:—

	Per cent.
Alexandra Spinning and Weaving Company ..	12
Alliance Spinning Company	7·25
Bombay United Spinning and Weaving Company	10
Fleming Spinning and Weaving Company ..	10
New Great Eastern Spinning and Weaving Company	11·5
Mankoejee Petit Spinning and Weaving Company	11
Mörarjee Goculdass Spinning and Weaving Company	20
Oriental Spinning and Weaving Company ..	10·88
Jewraz Baloo Spinning Company	23
Soonderdass Mooljee Spinning Company....	20

The average of these cases is 13·76 per cent. per annum, and if from this we deduct 6·5 per cent. as being due to the protection afforded by the import duties, it would appear that without it the average rate of dividends would have been only 7·26 per cent. It should be observed that the allowance for depreciation upon the fixed capital is very small in all the accounts which have come under my notice. In one instance nothing whatever was deducted on this score, and in no case was the allowance more than 3 per cent.

From the best information I have been able to gather, the respective advantages of the two countries may be stated as follows. I take 20's. yarn as the basis of comparison:—

In favour of India.	Per lb. d.
Charges of transmission of cotton to and from England	1·82
Increased production owing to longer hours of labour	·5
Import duty	.4
	2·72

In favour of England.	Per lb. d.
Cheaper coal	·6
Interest and depreciation..............	1·49
	2·09

These estimates show that the net gain to the Bombay spinner is ·64d. per lb., rather more than the amount of protection afforded by the duty. If therefore the duty were removed, there would be a very slight balance to the disadvantage of the English spinner in sending 20's. yarn into the Bombay market. I have not found it possible to make any comparison with respect to cloth, but it is not likely that the result would differ greatly from that already arrived at in the case of coarse yarn. It will be observed that these calculations, which have been arrived at quite independently, agree with the conclusions drawn from an examination of the recent dividends, in showing that without the protection afforded by the import duty the profits on cotton spinning in India would be very small indeed.

The cause of the unusual prosperity which attended the operations of the Bombay mills during 1873, and the first half of 1874, appear to have been these. The decline in the price of American cotton to a moderate level in 1871 and 1872 led to the abandonment, to a large extent, of Surat cotton in the mills of Europe. The consequence was a still more serious fall in the price of that description. Taking the seven years prior to 1861, the average price of Middling Orleans was 6·55d., and of Fair Dhollerah (Surat) 4·72d., showing a difference of 1.83d. per lb., or 27·9 per cent. But in the four years, from 1871 to 1874, there was a difference between the two of 3·13d., or 33·6 per cent. This was obviously a considerable gain to the Bombay spinners. There happened to be also, during 1872 and 1873, an excellent demand for the special descriptions of yarns and goods made in the Bombay mills, and as the demand for the moment exceeded the available supply, very high prices were obtained. Now, however, the state of things is altered; the supply is abundant and increasing, and something like a glut seems imminent.

The result of my own studies in this rather perplexing field of investigation is a conviction that the progress of the cotton industry in India is arrested, and has already ceased to be very profitable, that a period of reverse is very likely to begin so soon as the new concerns in progress and in prospect have been set to work, and that the abolition of the import duties and a curtailment of the hours of labour in India will enable English productions of the coarser and heavier kinds, which are now nearly excluded, once more to enter the country on tolerably easy terms of competition with those of the Indian mills. Apart from the duties there does not appear to be very much ultimate advantage on either side.

The rise of the jute manufacture by steam power in India has been scarcely less rapid or less remarkable than that of cotton. It is confined to the eastern side of the country, the mills being for the most part within a short distance of Calcutta. There are at present about 12 factories in operation, one half of which have commenced working since the beginning of last year. They consume altogether about 50,000 tons of jute per annum, and produce a coarse cloth used for baling produce. Of the total out-turn 25 per cent. is absorbed in India, the rest being exported to Australia, Burmah, Colombo, Madras, Bombay, and Egypt. The manufacture of jute has long been carried on in India as a handicraft, and it is probable that the introduction of steam power and machinery has largely displaced the slower process. A great impetus was given to the demand for the produce of the mills by the large quantity of bagging required for grain transport during the late famine in Bengal, and the profits of the mills were then very large. The export of jute manufactures from Calcutta during the 10 years ending March, 1873, show a steady growth from 28,122,524 pieces in 1863-4, to 32,767,930 pieces in 1872-3, an increase of fully 16 per cent. This is not a very remarkable degree of progress, and its comparative slowness is mainly due to the fact that the exports to the United States have fallen off from 7,195,409 pieces in 1863-4, to 1,914,104 pieces in 1872-3. The Americans, who formerly depended largely upon India for the gunny cloth in which their produce is packed, have within the past few years not only began to make it for themselves, but also to grow their own raw jute. At the present moment there is reason to conclude that, like the cotton industry on the western side of India, the jute manufactures of Bengal have been overdone. The production is large and increasing, and the difficulty of finding profitable outlets for the manufactured product is constantly becoming greater. The bulky nature of the raw material, and the large requirements of packing material in tropical Asia, afford strong reasons why, in the nature of things, the coarser descriptions of jute fabric should continue to be produced in Bengal, where there is the largest growth of it; but there is as yet no sign that the conversion of jute into the finer fabrics, into which it enters in this country, will take root in India. There is no need to attempt any detailed examination of the several advantages enjoyed by Bengal in respect of this particular manufacture, because the leading conclusions to which this inquiry has led, in the case of the cotton manufactures of Bombay, are even more obvious in the case of the jute fibre, of which the bulk is so great, and the value comparatively so small.

DISCUSSION.

Mr Hugh Mason said he had, in common with his friends on the directorate of the Manchester Chamber of Commerce, given a good deal of attention to this subject, and he was sorry, as a cotton manufacturer, that he could not come to the same conclusion as Mr. Helm, that the progress of the cotton manufacture in India had been arrested. He believed that the cotton industry in India, so far from being arrested, was only in its infancy, and that in the course of years there would be a vast extension of it. He did not think Mr. Helm had made sufficient allowance for the improvement which he was quite certain would take place in the manufacture of cotton yarns and textiles in India; for though it was no doubt correct that whilst in Lancashire two men and a boy would manage a large pair of mules, with a thousand spindles in each, and that eight men and a boy were required to do the same work in India, still all experience showed that as people became more practically acquainted with the management of machinery, so would the number of persons occupied upon any given machine be considerably reduced. That had been his experience in connection with the cotton industry, not only in Lancashire, but on the Continent, and in the United States of America, and it was only fair to suppose that the same thing would take place in India. Wages were

a most important element in the cost of the cotton manufacture, and Lancashire spinners had for years past been devoting their attention and ingenuity to the saving of labour; but why should not the Indian operative become as expert in the management of the mule or of any other machine as the Lancashire one? At present, no doubt, the Lancashire operative had the great advantage of his long experience of the trade, but the same thing which had happened there would take place in India. The Indian manufacturer had the best machinery, for he came to Lancashire for it; he had the same steam-engines and boilers, and in all these matters he was on a level with England except as to price. But the cost of exporting machinery was not very large, and although the Lancashire machinist had been able hitherto to obtain a higher price for his machinery in India than he could get from the Lancashire spinner, in that respect competition was on the increase, and the supply would soon be much larger. The Indian spinner, therefore, started with the same quality of machinery; he had the same cotton if not better; and he doubted if Mr. Helm had made sufficient allowance for the fact that in India the cotton was unpressed. In the course of the important experiments which Dr. Forbes Watson had been conducting in Manchester, he had come to the conclusion that there was a decided advantage in using unpressed cotton, inasmuch as he could spin several hanks finer per lb. from the same quality. Now the cotton which came here from India was pressed to an extent far beyond that coming from Egypt or America, on account of the freight. Then there was the question of the longer hours of labour, but he did not think very much of that, for he believed that the same public opinion which had tended in the course of the last 25 years to reduce the hours of labour in Lancashire factories would do the same in India. The hours now were slavish and intolerable, and capitalists there would find that by employing the workpeople to a moderate degree they would improve their quality, introduce a more intelligent class, and of course would have superior hands for the management of their machinery. He was not sorry that the hours of labour had been reduced in Lancashire, but he hoped they knew where to stop, and he certainly did not think they could go lower. The item of coal was very important in the management of a Lancashire factory, at least during the last two or three years, when coal had been double its normal price, they had suffered very considerably. He did not know much about the Indian coal fields, but he understood there was a likelihood of coal being found there, such as could be used for steam purposes, and if that were the case he hardly knew what advantage would still be wanting to the Indian spinner and manufacturer in order to enable him to compete successfully with Lancashire. During the last few years Lancashire had lost the trade with India up to at least 20's or 24's yarn; though years back she used to send all the yarns India required. There was formerly a considerable trade in these low cheap yarns and goods; but it had now entirely disappeared. In proportion as the Indian operative became more expert, he would gain upon Lancashire in the finer numbers, to which at present he was a comparative stranger. Mr. Helm had alluded to the possibility of India importing cotton from America, but he certainly did not see why she should not import it from Egypt, for the Egyptian, which was used extensively in Lancashire for the finer numbers of yarn, could be laid down in India quite as cheaply as in Manchester. But there was another point which should not be lost sight of, viz., that during the last four years there had been a substantial improvement in the quality of the Indian staple. He himself used Indian cotton, as well as American and Egyptian, and he had seen a most substantial improvement both in the quality and staple. A few years ago you could only spin Indian cotton up to numbers coarser than 30's, but at the present moment Broach cotton, or Dollerah cotton, selling in Liverpool at 7½d. per lb., was being spun into 60's yarn, a very fine number indeed. It was also used in the production of 32's twist, which was used so extensively in Blackburn for Indian shirtings. There were various causes for the improvement of the Indian staple, one being the existence in India of the Cotton Frauds Act, which, in his opinion, had done a great deal to check the deterioration of Indian cotton. The question was at the present moment before the Indian Council, who had been pressed for some years to abolish the Act, but he hoped they would not, for the consumers of Lancashire were of opinion that great advantage had been derived from it. There were no doubt other causes at work as well, and the people of India naturally saw it was to their advantage to produce a superior quality of cotton to that which they had done. On the whole, he came to the conclusion that though a check might be put for a brief period to the cotton manufacture in India, as similar checks had occurred in Lancashire, India would overcome them all, and would become a great manufacturing nation.

Mr. Elliot had noticed with interest that in the list of of names read out by Mr. Helm of firms at Bombay engaged in the cotton manufacture, the most successful were those with native names; some of them showed returns nearly double those made by European firms. A short time ago a project had been brought under his notice for setting up mills in the interior of India, in the centre of the cotton field, where labour could be obtained at least 25 per cent. cheaper than in Bombay. They would also save considerably on the carriage of the raw material. He also understood it was proposed to set up experimental farms in India, with a view of introducing improved seeds and distributing them to the people in the neighbourhood of the mills; and with all these advantages, if the profits of the mills in Bombay were already considerable, those erected in the interior promised still better returns, particularly if they were established, as they must be, in the neighbourhood of forests, where there was an abundant water supply, and in the vicinity of coal fields. He believed that the manufacturers of Manchester had better follow the example of the jute manufacturers of Dundee, some of whom were shutting up their mills and transporting their machinery to India. It might seem a doleful prospect to think of such a thing, but there were many consoling circumstances. This country was really too full of money, and for want of a proper outlet for capital many persons were induced to embark in undertakings which came to ruin, or to invest in foreign loans, which sometimes were not much better. Independently of that, it was impossible to view without some anxiety the indefinite increase of the population crowded into this narrow island, entirely dependent for their existence on a supply of foreign produce, which might at any time be interrupted. If a certain amount of English capital were removed, and profitably employed abroad, the produce coming back here, he did not think in the long run this country would be the loser. With regard to the duties, they were no doubt objectionable, but, as was said by Lord Salisbury, they could not afford to lower them at present. If they were to abolish every objectionable duty, India would become bankrupt.

The Rev. Jas. Long said that during his residence in India he had heard many complaints with regard to the bad quality of the goods they were getting from Manchester, and this made a bad impression on the native mind. When he first went to India, everything with an English stamp upon it was looked upon as good and genuine, but that was by no means the case now. Then there was a moral aspect to the question also. Two years ago he spent a winter in Moscow, and saw a great deal of the manufactures there. Speaking to some of the Russian noblemen, he asked why they went so much into manufacture, the country being eminently

agricultural, and he found that throughout Russia the manufacturing system was advocated on the ground that they needed a middle class to come between the nobles and the peasantry. He had heard the same argument used in America, and he had no doubt it also applied with great force in India.

Mr. Hale asked if it were really the fact that steam coal was five times as dear in India as in England.

Mr. Brown doubted whether the improvement in the quality of Indian cotton was attributable to the Cotton Frauds Act, as the same result had taken place in parts of India where it had not been in operation. And he was not sure that the whole of the cotton had improved in quality. Many years ago some of the cotton grown was as fine as any produced now, but it was used for spinning by the natives themselves in the interior, and that which found its way abroad was very carelessly treated. The growers were entirely in the hands of the native bankers, and did not much care what became of it. The native hand-spinning industry, which was prevalent when he went to India, had entirely fallen away of late years, but the growers having become independent of the tyrannical native bankers, a great improvement had taken place in the cultivation and production, because the proceeds went into the pockets of the cultivators themselves. The Act had not been in force in Madras, but he believed there was an equal improvement in the quality of the cotton there. He was very glad to hear that it was so general.

Major-General Marriott said his opinion on this subject might be summed up in two words, which were often used, but he feared not always considered—Free Trade. He had come there partly in the hopes of hearing an expression of the views of Manchester men on the question what was the duty of Government in the matter, but it had taken an interesting turn, viz., what were the prospects of the cotton manufacture in India. He should have been glad if Mr. Helm had stated more fully the causes of the very large difference in first cost, which Mr. Mason seemed to question. The latter gentleman, however, had hardly, he thought, made sufficient allowance for the point, very properly urged by Mr. Helm, that it was not sufficient to show that a given people could make a thing cheaper than we or anybody else, in order to prove that they were likely to supply it; it was also necessary to show that it was the article to which they could most profitably apply their labour; and one circumstance mentioned by Mr. Mason went rather to show that his expectations might not be realised, viz., the improvement of the staple and condition of the cotton. He was glad to hear that such was the case, but it raised the question whether the growth of the raw material would not be a more profitable occupation for the capital and labour of India than manufactures. There was one point in the paper which he was not sure that he clearly understood, viz., that one of the advantages possessed by the Indian manufacturer was the import duty, and he appeared to deduct from the nett average profit of 11 per cent. the entire amount of the duty, which was 5 per cent. on the value, not on the profit. This seemed to him to involve a fallacy, and perhaps he had not rightly caught Mr. Helm's meaning. With regard to the Cotton Frauds Act, though he had strongly advocated its introduction, he had subsequently not been able to obtain proof that it had been of much real benefit when in actual operation. In conclusion, he expressed his conviction that there was no real difficulty for those who had faith in free trade, though there might be practical difficulties in the way of those who had to provide the revenue.

Dr. Burn said he might perhaps be able to give some information with regard to the improvement in the quality of Indian cotton, having been engaged for some time in Bombay upon that question. He was glad to hear that the quality of cotton coming from Bombay had much improved of late, but the Government experiments with foreign seed showed that they were of little value in comparison with efforts for improving the native cotton. The real cause of the former bad condition of cotton was the mode in which it was manipulated and collected. First of all, it was left so long on the bush that it became mixed with large quantities of brown leaf, and then it was so collected as almost, if not entirely, to destroy the fibre. The object of the natives was to get it as weighty as possible, and they therefore left it out all night in the dew, which was very heavy, and in the morning it was put in pits dug in the ground, and thus by the absorption of moisture it became one-third heavier, but the elasticity of the fibre was almost destroyed. Having called the attention of the Government to this matter, he was entrusted with the drafting of a Bill to put a stop to these bad practices, which was eventually carried. He believed it was owing to the prohibition of this system, and to the almost universal introduction of American cotton gins, that the improvement in cotton was attributable. He should be very glad to think that it arose from improvements in cultivation, but he did not believe that such was the case, nor could this be looked for until there was an improvement in agriculture generally.

Mr. Pochin remarked that Mr. Helm had given the facts and figures of to-day, while Mr. Mason, not disputing the facts, thought the facts would be different in the future, and that the results would vary accordingly. This was of course to a great extent a matter of speculation. The Indian mind was capable of development, no doubt, but he did not think the people would advance with such rapidity that they would be able to supply the finer counts of cotton for a long time to come. They would get on gradually from the coarser to the finer, but it would be a long time before they would be able to supply all their own requirements, so that Manchester manufacturers must still look forward to a considerable market in India for some years to come. He was anxious to express his conviction of how impolitic it was to continue the import duties, whichever view was adopted. If Mr. Helm were right, the continuance of these duties must induce people to invest money in mills in India, depending very largely for their returns on these duties, and then by and bye, when it was thought advisable to abolish them, they would be suing in *forma pauperis* for their continuance, and the difficulty of getting rid of them would be much enhanced. It was said that the Indian revenue could not be raised without these duties, but he submitted that the people of India paid them in the price of goods, and they could equally well pay them if levied in some other form. On the other hand, if Mr. Mason was right, was it not unjust to the manufacturers of England, who had built mills for the purpose of supplying the whole world with cotton goods, to shut them out even to any extent from the Indian market by these duties. It was a simple matter of justice that they should be swept away as soon as possible. With regard to the quality of the goods sent to India, he knew something of the manufacturers of Lancashire, and he contended that they gave as good a shilling's worth for a shilling as any manufacturer in the world. They had sent bad goods to India because the people would not pay for good ones, and he did not believe that this had anything to do with stimulating Indian manufacturers. If the Indians doctored the raw cotton for the English market, they would not be above doctoring the goods for their own market. The men of Lancashire only asked for a fair field, and no injustice, and then if the trade left them they would submit with the best grace possible, not grumbling or crying, but meeting events like men, and finding some other field for the employment of their capital. They did not want anything done to keep the trade in Lancashire, but only justice and free scope for goods to be made where they could be produced cheapest and most in the interest of the people who consumed them.

Mr. Espinasse said that though he had no personal knowledge of this subject he had lately searched the Statistical Abstract for some information upon it, and he found that during the time that these manufactories had been at work in India, both the value and quantity of cotton goods sent to that country from England had increased. As regarded the abolition of the import duties, he had not heard any allusion to Lord Salisbury's argument, that as long as they were retained capital would be rather shy of throwing itself into the Indian cotton manufacture on account of the uncertainty whether they would not be taken off.

Mr. Helm did not think those who found fault with Lancashire men for producing what they called bad cloth, really understood the nature of the case. The price of cotton had risen, but good and bad cloths had always been sent out; the merchant or manufacturer shipping most of those for which he had most orders, and the goods were made week by week in accordance with the orders received. To give an instance from his own experience; he noticed some years ago that cotton dyed goods sent to the East were much impaired in brightness of colour by being dressed with starch and other materials after they were dyed, and he thought he would introduce something better. Accordingly, he sent out an experimental shipment, got up under his own superintendence, the goods being pure, and the colours bright and brilliant. The goods on their arrival were pronounced beautiful, but by the next mail he heard that they could not get along with them, and ultimately after waiting eighteen months, he received a sale note showing that he had made a loss of 10 per cent. by the transaction. Of course, he had not sent out any pure, brilliantly dyed goods since. There was a good deal of false sentiment about this matter, and some degree of ignorance. They had been sending out heavily dyed shirtings and tea cloths to the East for the last ten years especially, and orders were continually coming for them. Now by this time the natives had surely got to know how long they would last; but there were many people there as here, who would rather pay more frequently, even although the article did not last so long. It was therefore a question of the moral or mental condition of the buyer; and if he wanted to buy such goods, who should hinder him? He had listened with great interest to the remarks of his friend Mr. Mason, and if he had gone into speculations as to the future he might perhaps have agreed with him upon many of them; but he had felt that his business was to speak to facts about which there was very little information; indeed, he did not know himself until the last moment which way they would tell. No doubt the native operatives would learn by experience, but if they did more work and attended to a larger number of spindles it would only be under the pressure of higher wages. So long as labour in India was cheap, so long, he feared, it would be inefficient. The hours of labour were most important, and it had been truly said that in England we had reached the limit beyond which economical considerations would not permit us to go. His impression was that a man could do as much in ten hours as in twelve, but he did not believe he could do as much in eight as he could in ten. It was a question entirely of physical capability. He was aware of the deterioration of the staple by pressing, and had allowed 2 per cent. for it, though he was not previously aware of the results of Dr. Forbes Watson's latest experiments, in which he had taken great interest. All he meant to contend for was that such points only caused minor differences. With regard to the question raised by Major-General Marriott about the duty, it seemed to him quite clear that if the duty of 5 per cent. on the market price were removed, the price for the products of the Indian mills would fall, and the effect would be, other things remaining the same, to reduce the return on the sales to the same extent, and inasmuch as the capital was returned one and a tenth in the course of the year, the proportion of profit must be reckoned as rather more than the duty itself. With regard to experiments in the interior, he remembered about two and a half years ago a proposal being made to a friend of his to build a mill on a very fine estate in the interior, and he was invited to join in the enterprise. It looked very beautiful upon paper, and they went so far as to get estimates for the machinery, but on further investigation it looked so doubtful in many particulars that it was abandoned. No doubt large beds of coal had been discovered in India, at Warora especially, but he did not understand that the quality was anywhere equal to English, or that there was any prospect within the lifetime of anyone then present of coals being produced at half its present price, which was at least 50s. a ton, for that which in England could be got for 10s. The real economical reason which accounted for the fact that many countries with splendid resources could not utilise them, had rather escaped attention, and it was somewhat difficult to deal with; but if only raw material and labour were requisite, why did they not go and build mills in the Southern States of America, where there was abundance of coal and iron, as well as cotton. There were many more natural advantages there than in India.

Dr. Briggs said he had recently heard from the chief engineer at Warora that fresh coal had been found near the surface, and that a railway was being constructed to the works. When acting as Director-General of Gaols he made inquiries as to the cost of coal, and found that there it could be obtained at the pit's mouth for 8 rupees, or 16s. a ton. With regard to the improvement to be expected in the skill of the native workmen, he might mention that it was very common to spin cotton in the gaols by hand looms, and whereas two yards of cloth was the ordered day's work of ten hours, many men after a comparatively short time could produce six and even eight yards. His head clerk told him that since the duty, for some reason or other a good deal of the cloth used to rot, and the customers were a little dissatisfied. They only used yarn from one English mill, but nearly all the coarse cloths came from America.

The Chairman said he was informed by Mr. Helm that all these goods were made in England, although bearing an American brand. He must say he entirely agreed with Mr. Mason as to the improvement in Indian cotton, and also that great thanks were due to Manchester for it. He saw around him some of his old Bombay friends who had passed many a weary hour on the Bombay cotton green, and they would bear him out that the cotton they used to handle twenty-five years ago was far inferior to what came to market now. It was quite true that unpressed cotton was vastly superior to the pressed cotton sent to this country; it opened out much more freely, and was not caked. A handful of nice fresh cotton in India smelt like new hay, but by the time it got to England it was a very different affair. A commission had been appointed in India to inquire into the labour question, and possibly some restrictions might be imposed, but most of the members of it were mill owners, only one or two being officials. According to his information, there was a great opening out of the coal industry in India, and he had very little doubt that India would very soon be able to supply herself with coal, though the quality was certainly not to be compared with English. Some seams of a better quality had, however, been discovered, and some of the railway companies were now using native coal. From a note given him the day before he found that whereas in 1859 the average amount of cotton goods exported from this country to India was about twelve millions sterling; after the lapse of eighteen years the average exports only amounted to sixteen millions, which was not a very large increase considering the growth of the population. With regard to the duties, he had not scrupled elsewhere to say what his opinion was, viz., that they ought to be swept away, in the in-

interests both of England and India. In the latter country they were giving an artificial stimulus to manufactures, but he felt quite sure that if the duties were abolished, and they had a fair field and no favour, the manufacturers of Lancashire would never cry out because their competitors in India beat them. It could not be expected that the Indian Government could sweep away all the duties at once, as they brought in a revenue of £800,000 a year, which it would be very difficult to replace. Still he saw no reason why they should not be gradually and steadily reduced until they were finally abolished, or, at any rate, reduced to a mere registration fee. He went entirely with Major-General Marriott as to free trade, and believed that if they were only bold enough to adopt that principle in its entirety in India, they would in the course of a few years all wonder at the policy which had postponed it so long. Some time ago he had been much struck with the remarks of the French Minister for Foreign Affairs, the Duke Decazes, on that subject, at a banquet at Bordeaux, when he said that the longer he lived the more clearly he saw that in the development of free trade was to be found the surest means of attaining national wealth; and so far as he was personally concerned, he should never cease to advocate the reduction of custom duties. In conclusion, he begged to move a vote of thanks to Mr. Helm for his admirable paper.

The motion was carried unanimously, and the proceedings terminated.

TWENTIETH ORDINARY MEETING.

Wednesday, May 5th, 1875; Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Adams, Richard, 79, Addison-road, Kensington, W.
Allen, Richard, 16, Woodsome-road, Highgate-road, N.W.
Bell, David Wellesley, 20, London-wall, E.C.
Billard, F., 5, Prince's-square, Bayswater, W.
Evans, Augustus, 1, Paper-buildings, Inner Temple, E.C.
Shaw, Captain Eyre M., 68, Watling-street, E.C.
Stocker, John Palmer, 93, Oxford-terrace, Hyde-park, W.
Strauss, Adolph, 32, Woburn-square, W.C.
Swift, John, 23, Great Cumberland-place, W.
Swindlehurst, William, Eversleigh-house, Lavender-hill, S.W.
Trapp, George A., 111, Maida-vale, W.
Tomlinson, Thomas, 3, Richmond-terrace, Whitehall, S.W.
Tyssen, Francis Dashwood, 10, Whitehall-place, S.W.
Walter, Arthur F., 15, Queen's-gate-terrace, S.W.
Webb, John, 159, Euston-road, N.W., and Whitefriars, Hastings.
Whittaker, Henry, 8, Gloucester-road, South Kensington, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Carr, Mark William, C.E., 4, Woburn-place, W.C.
Fenwick, H. C., 7, The Crescent, Edmonton, N.
Fenk, Edwin Evans, 23, Cockspur-street, Charing-cross, S.W.
Ernst, Dr. Adolphi, University, Caracas, Venezuela.
Hayward, Alfred, 6, Langham-street, W.
Humbert, Charles Francis, Little Nascot, Watford, Herts.
Hunter, James, 73, Belsize-park-gardens, Hampstead, N.W.
Kynaston, William, 5, Russell-square, W.C.
Ouchterlony, James, 84, Belsize-park-gardens, N.W.
Overall, John, Shacklewell-lane, Dalston, E.
Perceval, Spencer Arthur, 11, St. George's-road, Eccleston-square, S.W.
Raymond, William T., 121, Pall-mall, S.W.
Richards, Edward Harrinson, 8, Adam-street, Adelphi, W.C.
Row, Skinner, 74, Bedford-gardens, Kensington, W.
Rowe, Robert, 40, Alfred-place West, South Kensingon, S.W.
Sanderson, Arthur, 84, Earl's-court-road, S.W., and 52, Berners-street, W.
Santley, Charles, 5, Upper Hamilton-terrace, N.W.
Townshend, Charles Thornton, India Museum, South Kensington, S.W.

The paper read was:—

HORSE-SHOES AND HORSE-SHOEING.

By George Fleming,
Veterinary Surgeon, Royal Engineers.

The subject which I have the honour of introducing to you this evening is one that I feel assured is particularly appropriate for discussion before the Society of Arts, as it is not only of a directly practical and humane character, but of great importance from an every-day utilitarian point of view; for it has reference not only to the preservation and comfort of the noblest and most useful animal ever domesticated by man, but is also related in the closest manner to the usefulness of that animal as a servant, and to the full development of its powers as a living machine.

It would take us rather beyond the limits of our subject if we attempted to point out the very important part the horse plays in the world, and in the progress of civilisation, and to what an extent mankind has to rely on him for most essential services, rendered in peace or in war; neither need we dwell on the share this creature has taken in the development of civilisation, and in the great events which have marked the history of our species. Suffice it, therefore, to state, that on no other animal has devolved, or could be imposed, the same onerous duties, and to no other creature is man indebted for so many services and benefits. These could never have been rendered but for the fact, discovered at a very early period in the history of man, that the horse was gifted with a special conformation which adapted him for the most varied uses under the most diverse circumstances, and that the chief point in this conformation was the presence of a solid foot cased in tough elastic horn.

The varied uses to which the horse has been subjected since he was taken from a wild condition, and the willing and cheerful manner with which he has undergone fatigue and performed duties which are, one would think, quite foreign to his nature, have certainly all been owing to his combined and unequalled qualities of strength, courage, speed, fidelity, and obedience, as well as docility; and though his great value has mainly depended upon a just disposition of these, yet it cannot be doubted that to the presence of a wonderfully contrived foot the horse largely owes his exalted position above all those creatures which

have submitted themselves to domestication and toil for the benefit of the human species.

The history of mankind abundantly testifies that every possible use and application of this animal, whether in war, commerce, or pleasure, seems to have been anticipated by the most ancient peoples; and those old-world nations which, long ages ago, most largely employed the horse, were the great centres of antique civilisation. Indeed, it may safely be asserted that but for the horse the human race could not have reached its present state of progress and refinement, or have been able to contend against the numerous obstacles to advancement and material happiness which surrounded it; and it has been well said, that next to the want of iron, the want of horses would have been one of the greatest physical barriers to the perfecting of the arts of civilised life. And but for the horse being endowed with a continually growing hoof, which covers the most beautiful and delicate structures, and which, being solid, and a slow conductor of heat and cold, eminently fits him for travelling in snow and ice during the winter of northern regions, and in the burning sands of tropical climates, he would scarcely have proved himself worth the trouble of domesticating. For, notwithstanding his other grand qualities, no invention or device of man could have compensated for the absence of his solid, hoof-cased foot.

Therefore it has happened that, from the earliest ages, the attention of horsemen has been largely centred on the feet of the horse; and no matter how perfect the other points of his conformation may have been, if these organs were defective all was bad, as none of his good qualities could then be made effective. And from these ages to the present time, when the uses to which the horse can be put have become so multiplied, and so much more necessary for our business or pleasure, this truth has been daily receiving further confirmation, until the aphorism, "No foot, no horse," has become a painful reality in modern days; though it is but a re-echo of what was, no doubt, enunciated centuries beyond two thousand years ago.

For the manifestation of his strength and the due development of his other good qualities, the horse must rely upon the soundness of his feet, as in them are concentrated the efforts created elsewhere, and on them depend, to a great extent, the solidity and just equilibrium of the whole animal fabric. So that it is wisely considered that the foot of the horse is one of the most, if not the most, important part of the body, and that all the splendid qualities possessed by the noble creature may be diminished in value, or hopelessly lost, if through disease or accident, natural or acquired defects, or other causes, this organ fails to perform its allotted task.

Seeing, then, the great interest and importance which attaches to this animal, in its being of all creatures most concerned with man in promoting a progressive and long-continued civilisation, and to the means and appliances which have from time to time been brought to bear in increasing the utility of this devoted servant, it cannot but be a matter of public interest to inquire into an art which, however insignificant it may generally appear, yet increases a hundred-fold the usefulness of the horse. I refer to the art of shoeing, through which, in arming that portion of the hoof which comes in contact with the ground, and sustains the whole weight and propelling power of the animal, injury is not only averted, but the power of the horse is greatly developed. An art which has indirectly exercised much influence on the destiny of mankind, and lent its aid to the restless wave of human action, surely deserves some notice; and if it be looked upon as a modest and obscure art, it nevertheless merits the attention of the humane, no less than of the utilitarian, in consequence of its being so closely related to the comfort and the preservation of this animal, whose value is every day becoming more appreciated and exaggerated.

It may be said that with the horse in a state of nature, the hoof requires no protection. The solidity and toughness of the material of which it is composed; the absence of artificial roads; nothing but the weight of the body to be supported; and the horn never being subjected to any other influences than those it is naturally adapted to resist, maintain it in health and uninjured. But in connection with climate, domestication alters more or less the conditions on which the horse depends for the horn's integrity as an efficient protection to the living and extremely sensitive parts it encloses.

In several regions of the world, which have a dry climate and a soft soil, and where the hoofs are firm in texture, shoeing is seldom, if ever, required. When the journeys are long, however, and the labour severe, some kind of artificial protection is needed, or the animal's feet become denuded of horn, and lameness results. Among the Mongols this accident is repaired by the horseman exchanging his pony for one whose hoofs are not worn; or, if he has a number, he rides another until the cripple has had time to grow a new supply for wear. In some regions, as with the North-American Indians and the Tartars, raw hide is used on such occasions, and even the horns of other creatures; and in Japan, when a traveller is about to start on a long journey, a bundle of rice-straw slippers for his steed, like the one I now exhibit, is tied to his saddle, and these he attaches to the animal's feet from time to time, as they become worn. Strange to say, the Japanese knew nothing of attaching an iron shoe to the hoof by means of nails until some of my troop farriers were sent from North China to that country in 1860, to attend to the horses purchased for the expedition to Peking. These farriers introduced the art into Japan.

But even in the most favoured countries, the usefulness of the horse can be but limited without some means of protecting the hoof from undue wear. And doubtless this fact was soon recognised by the people, who, at a very early period, trained and employed this animal, and who, no doubt, were compelled to resort to various devices to protect it from inefficiency from this cause. For, with the spread of civilisation, the demands upon the services of the horse became more urgent and heavy; and the diversities of climate to which he was carried, as well as of races which resulted would lead one to suppose that greater wear and modification in the nature and consistency of the hoof would render some kind of defence absolutely necessary. This necessity led to the bold and efficient method now in vogue, of attaching a

metal rim to the lower border of the hoof by means of nails driven through the horn,—a process which the nineteenth century cannot improve, and one which, to the individual who proposed or first practised it, must have been a feat of no ordinary magnitude; while as it has proved to be an invention scarcely inferior to that of the steam-engine in importance. But, like so many other inventions, this one is lost in the obscurity of ages; and archæologists and antiquaries have for nearly two centuries puzzled themselves in vain in trying to arrive at the period when the art of horse-shoeing was introduced; while ancient writers afford little or no assistance in enabling us to judge whether the art was practised even in their day.

Up to a recent period, horse-shoeing was traced no further back with certainty than the ninth century, though the legends, traditions, and superstitions relating to it proved that it was very old. But the great advances made in archæology now make it manifest that shoeing was known to the Romans and the ancient Gauls; and though it is persistently stated in everyday books of reference, such as Haydn's "Dictionary of Dates," that the farrier's art was introduced into Britain by William the Conqueror, it is certain that during the Roman occupation of this country horses were shod in a similar manner to what they are now-a-days.

Horse-shoes have been discovered repeatedly in the camps and graves of ancient Gaul, and even on the battle-fields of these people. They have been found in numerous instances with Roman relics, such as arms, brooches, lamps, coins, &c., in France, Switzerland, and Belgium; and in this country many have been discovered in excavations in London, in the streets of some of our towns at considerable depths, in Roman camps, roads, and villas, and in various other situations; and as a further proof that horse-shoeing was known in this country before the arrival of the Normans, we find that in the ancient laws of Wales the court-farrier was an important personage, and had certain valuable privileges conferred upon him while he shod the King's horses. But I must not trespass further upon this very interesting subject, but refer those of you who desire to study the antiquity of horse-shoeing to my work ("Horse-shoes and Horse-shoeing") published in 1869, in which the whole history of the art is carefully discussed. I may remark, however, that my researches have carried me as far back as about 300 years before our era, when a coin of Tarentum was struck, which was evidently designed to represent something in connection with the farrier's art: perhaps it was intended to commemorate the birth of the art itself.

I may also mention that there can be no doubt that a temporary protection for the hoofs was sometimes resorted to, as we find it mentioned by different Roman writers under various names. This protection was in all likelihood something of the same kind as that now used by the Japanese; but it would also appear to have been made of iron, and to be something of a sandal. Often with the ordinary Roman horse-shoe, sometimes alone, there have been found articles of different shapes, though alike in some particulars, which have been designated "hipposandals" by those who believed them to have been these temporary protections. It is questionable whether many of these could have been used for such a purpose, however; while it is not at all improbable that others may have been attached to the hoofs of horses for some other purpose than that of a sandal. One of these articles I now show. It was found with two others of a different shape at Springhead, near Gravesend—the site of an ancient British, and afterwards of a Roman station—along with a portion of a Roman horse-shoe, many Roman coins, brooches, and other articles.

A word with regard to the "Roman horse-shoe." In the preparation of my work on horse-shoeing, I had occasion to examine and to read the description of very many of the shoes which undoubtedly belonged to the Roman period, and I was surprised to find that they all bore the greatest resemblance to each other: so much so, indeed, that if they had all been laid together, anyone who did not know that they had been collected in France, Switzerland, Belgium, and England, would be likely to assert that they were made by the same artisan; and there is also a wonderful uniformity of size amongst them, which would go to prove that the horses then employed in these countries were small. The shoe is of the simplest kind, being merely a narrow strip of iron bent like the shoe now in use, the ends of the branches being rolled over to form "calks," and there are nearly always three holes on each side to receive the nails. The holes and nails form the distinctive features of the shoe, however; and have led me to consider such shoes as peculiar to the Romano-Gallic, or Romano-British period. At each nail-hole is a wide oval indentation, in the middle of which the round hole for the nail is made. This indentation was intended to, and did receive the base of a large flat-headed nail, which it supported, and prevented from being twisted out of the shoe. With the two calks, each foot in this way stood on eight distinct points, which ensured a good foothold. But in making the oval cavity for the nail-head, the narrow rim of metal was bulged out at each hole, and thus the border of the shoe presented an undulating appearance, which is exceedingly characteristic of these shoes.

The shoe I exhibit is a cast from one found at a depth of twelve feet in the High-street of Gloucester, along with another, and a Roman lamp and brooch. I also show you a shoe and nail made by my farrier-sergeant from a model, to illustrate the way in which the Roman shoer fabricated these articles.

Towards the Middle Ages, the art of shoeing acquired much importance in Western Europe. Armour of a heavy description began to be worn; horses of a large size to carry the increased weight were bred, and their hoofs had to be protected with heavier shoes. So important did the art become, that the farrier or his superintendent was often a high officer of the royal household; and kings, princes, and nobles did not disdain to be taught and to practise an art upon which so much depended in those days. Noblemen received their titles and name from their connection with the craft, as Marshall, Ferrers, Laferriere, and Ferrier; and gifts were bestowed and tenures held in connection with horse-shoes and horse-shoeing, more especially in England during the reign of William

the Conqueror. Northampton and a large tract of country was held by Simon St. Liz on condition that he provided shoes for William's horses; and it is probably in connection with this peculiar tenure that the Northamptonshire militia wear a horse-shoe on their pouches. And for superintending the shoeing of the same monarch's steeds, Henry de Ferrarus, or Ferrers, had bestowed upon him the Honour of Tutbury, in Staffordshire. In other parts of the country tenures were held on similar terms; and even in your own City of London, in 1235, during the reign of Henry III., Walter le Bruin, or Brun, a farrier, or "maréchal," as the shoer was then designated, had a piece of land granted him in the Strand, in the parish of St. Clement's Danes, whereon to erect a forge, on condition that he should render at the Exchequer, annually, for the same a quit rent of six horse-shoes, with the nails (62) thereto belonging. This curious payment was made twice during the reign of Edward I., and is continued up to the present time, the shoes and nails being paid on the 30th of September, at the swearing in of the newly-elected sheriff of London and Middlesex, to the representative of the sovereign for the said piece of ground, though it has long been City property. Noblemen and others had horse-shoes on their coats of arms and seals, and even towns sported the hoof-iron, as is seen in the old corporation seal of Gloucester, in use during the reign of Edward III.

But we need not pursue the history of the art any further, except to remark that the grooved or "fullered" shoe came into use in this country about four or five centuries ago; though shoes of this kind, of a much earlier date (5th century) have been found in graves in Burgundy, the groove having evidently been made by the same tool that cut the furrows in the formidable "scramasacs," or swords worn by the warriors, for the farrier was often also the armourer. The shoes were ponderous and clumsy, and the hoofs appear at a later period to have become subjected to serious mutilations by the farrier's "boutoir," or "butress," as the hoof-cutting implement was named.

In this country, towards the end of the last and commencement of this century, an attempt was made to place the art on a scientific basis, but, unfortunately, wild theories with regard to the functions of the horse's feet were promulgated; the hoof alone was studied, and no regard was had to the important structures it contained, and to which it was a mere shell; fantastic notions as to the expansion of the hoof at the heels, the descent of the sole, and other strange ideas, were carried into practice; and shoeing on what was, and is still, termed "improved principles"—though the improvement was an infraction of nature's laws—proved a veritable curse to horses. The hoof was reduced to the thinnest film where it should have been left strong, and was pared away until it yielded on the sole to the pressure of the thumb, or until the blood came oozing through; a knife was devised to search into the inflexions at the heels, which were so many natural bulwarks, and the elastic cushion at the back part of the hoof was recklessly sliced away; until at last the foot was so robbed of its natural covering that it required great skill and an artificial protection between it and the shoe to enable the animal to travel for a few years. The shoe was bevelled off on the upper surface, so as not to press on the tender sole, and this threw all the strain of the weight and exertion upon the margin of the foot. In short, no treatment devised to ruin horses prematurely in their feet could have been more appropriate and successful, so far as the lower surface of the hoof was concerned. With regard to the outer part, this was rasped and chiselled away to make fine work, until there was scarcely sufficient material left to drive the nails through; consequently these had to be increased in number.

The evils of horse-shoeing thus introduced have continued, and are as prevalent now as they were fifty years ago. The number of horses rendered useless by "improved" farriery is very great, and only too frequently inefficiency is brought about at an early period of the horse's career. The farriers only too frequently work by rule of thumb, and on no fixed principle; their knowledge is mainly traditional, passed from father to son, or from an elder to an apprentice, without cultivation, or without being enhanced by educated observation. This is due to the neglect into which the art has fallen for many centuries; and yet this neglect is somewhat unpardonable. Not very many years ago the farrier was the only authority on diseases of animals, and to his tender mercies were entrusted their restoration to health and soundness when they were sick or lame. Science has relieved him of this responsibility, and transferred it to the medically-trained veterinary surgeon, who, from his general and professional education, should be better fitted for such a duty. But this deprivation has still further lowered the *status* of the farrier, and, it is to be feared his art; for he has not the same incentive to maintain his social position, and to be a shoer of horses is to rank very inferior indeed; while the veterinary surgeon, with the many subjects he has to study while at college, and the far too brief period he spends there, has no time to acquire even elementary notions of the horse's foot and the best means of keeping it sound. He therefore imagines that this matter is of but little moment; and, I fear, some members of the veterinary profession think it rather degrading to pay any attention to what they consider such a humble mechanical handicraft.

This is deeply to be regretted, when we know how many horses are prematurely ruined through mismanagement of their feet; how many suffer the most horrible torture for perhaps years through bad shoeing; and how many are rendered more or less inefficient and worn out in their limbs from badly adjusted, ill-constructed, or too heavy shoes.

There is no remedy for this unfortunate state of affairs but teaching the farriers their art in a school or college presided over by competent teachers, and licensing them when they are able to carry the principles they have been taught into practice. A certificate of competency would be a guarantee that the possessor had devoted some attention to the theory of his art, and was acquainted with the anatomy and physiology of the organ with which he had to deal, that if he could not treat it as a surgeon when it was diseased, he would yet be in a position to prevent much disease in it.

It does seem strange that, in a country like our own—the home of the best and most valuable horses in the world—and among a horse-loving people such as we are, some such establishment has not been instituted. If the Society of Arts wished to confer a great service upon horse-owners and upon the noble beast itself, and through them upon the entire public, it could not do better than propound a scheme for supplying educated farriers to all parts of the country. The Society would have abundant support, and nothing would tend more to improve the minds and elevate the position of the farriers themselves.

Though the end of the horse's limb is named the "foot," yet it has no analogy to the human foot except that both rest on the ground, and are essential instruments in progression. The fore foot of the horse is, in fact, the extremity of the middle finger of man's hand, and the hind foot the analogue of the middle toe of his foot; while the nail on each represents the horse's hoof. In this way the horse's knee is the human wrist, and the hock the human ankle and heel. It is sometimes useful to bear this distinction in mind.

LOWER SURFACE OF LEFT FORE HOOF.

a a, heels of frog. *b*, cleft of frog. *c c*, branches of frog. *d d*, heels. *e e*, lateral spaces between frog and bars. *f f*, bars. *g*, body of frog. *h*, outside quarter of hoof. *i*, inside quarter. *j*, point of frog. *k*, sole. *l l*, line of junction between sole and wall. *m n*, sides of toe.

A sort of conical semilunar bone fills the anterior two-thirds of the hoof, and to it the hoof is moulded, as well as firmly attached. This is the "foot-bone"—admirably adapted for its purpose in being light, yet strong, and affording ample protection to the large bloodvessels which supply the organ in such profusion. Above this bone is the small "pastern-bone," and behind it, between the wings of the crescent, is another narrow bone—the "navicular" or "shuttle" bone, as the old farriers used to name it. Over this bone the powerful flexor tendon of the foot passes to be inserted into the lower surface of the foot-bone; and this tendon again rests upon, and is supported by, at this, its weakest part, a large mass of elastic substance which plays a very necessary part in the function of the foot. From each wing of the foot-bone spring two wide cartilaginous plates connected with the elastic cushion; and these, rising above the heels of the hoof, have a large share in promoting springiness and obviating injury to the organ. The whole of the foot within the hoof is covered by an exquisitely sensitive membrane, which secretes the horn.

The "hoof" consists of three parts—wall, sole, and frog. The wall is attached to the foot-bone by means of a very large number—over six hundred—of very sensitive and vascular leaves, which run from above to below, and are received between similar, but horny, leaves on the inner surface of the wall. This union is of the most intimate and beautiful character, and I regret that time will not allow me to show you how wonderfully adapted it is for the end in view. The "wall" itself, as indeed is the whole of the hoof, is composed of very minute cells, not unlike those which compose the skin, but differently arranged to form fibres, which pass from the top to the bottom. These fibres can

SECTION OF HORSE'S FOOT.

a a, skin of leg. *b b b*, extensor tendon of foot. *c*, its insertion into the foot-bone. *d d*, capsular ligament of joints. *d' d'*, flexor tendon of foot, inserted into sole of foot-bone (*s*). *e e*, flexor tendon of pastern, inserted at *f* into the small pastern-bone, *i*. *g*, shank or large metacarpal bone. *h*, large pastern-bone. *k*, navicular bone. *l*, foot or pedal-bone. *m*, ligaments of navicular bone. *n*, sensitive laminæ, interleaved with horny laminæ, *n'*. *o*, plantar or sole cushion. *p*, coronary cushion. *q*, horny frog. *r*, wall of hoof. *t*, sensitive membrane of frog and sole. *u*, face of navicular bone, over which the tendon plays.

be distinguished by the naked eye on a very close inspection, and to form them the cells are laid lengthways, or vertically; while the fibres themselves are united by interfibrous cells, which lie horizontally, so that we have cells laid in two directions; and this not only affords a better resistance to wear, but prevents splitting. The wall grows from the "coronet" or upper part of the foot, and this growth is incessant. The outer, or surface, fibres are very dense and smooth, but the deeper they are situated the more soft and spongy they become—a fact of much importance in shoeing. At its upper part the wall is covered by a soft elastic horn, which protects it while it is being formed. The sole is formed of fibres passing in the same direction, and constructed in the same manner as in the wall, but it differs from the latter in one important point. When it has attained a certain thickness the superficial horn becomes detached in flakes, which, even in a semi-detached state, serve a useful purpose in retaining moisture for the growing horn beneath, and acting as a springy defence against injury from loose stones. The wall, on the contrary, grows to an indefinite length, or rather depth, when it is not worn away by contact with the ground—another important fact to be remembered. The frog is also fibrous, but the horn of which it is composed is different in quality, being soft, dense, and elastic, like india-rubber. It

is an essential constituent of the elastic apparatus of the foot, and in situation and function it is analogous to the pad on the foot of the dog, cat, and other animals, and the cushion beneath man's heel. The elastic apparatus of the foot also consists of a cushion of springy material around the top of the organ, and which fits into a recess at the upper margin of the wall, so that we not only have elastic cartilages and cushions at the back part of the foot, but an excellent contrivance all round the top to break the primary shock of contact with the ground.

The fore foot when well formed is nearly circular in shape, but the hind one is oval, otherwise there is not much difference between them. The angle or slope of the wall varies, but it is generally between 50° and 52°.

This is as much of the anatomy of the foot as we now have time to notice; but I may tell you that perhaps no organ of the animal body will better repay a careful study, if only to trace the evidences of design so wonderfully displayed in every part and combination of parts. With regard to function, it may be sufficient to mention that the wall sustains the largest portion of the weight, and is the part chiefly exposed, as it is that which is mainly designed to encounter wear. The sole also shares in weight-bearing, but a wider surface participates on soft than on hard ground, owing to its concave shape. The frog has also to sustain weight to a great extent, but its most important duty is undoubtedly to support the flexor tendon of the foot through the intermediate cushion, to prevent slipping, and also to assist the animal in suddenly checking its pace when moving rapidly. The lower border of the hoof does not expand to any appreciable extent when the animal is in motion. For years this has been taught, but it is a fallacy, and many circumstances prove it to be so. The expansion takes place at its upper border, and towards the heels, where the chief elastic apparatus is situated. The function of the fore foot is chiefly to support weight, that of the hind foot is to propel the body.

Now as to shoeing. It is obvious that the horse's foot was designed to meet every natural demand, so far as the animal's weight and movements are concerned; but when a heavy load is imposed on his back or attached behind, and when he is compelled to travel, particularly over hard roads, in all kinds of weather, Nature's arrangements are over-taxed, and the wear of the hoof is greater than the repair. Consequently, art must step in to assist nature. The part of the hoof which suffers most from undue wear is that which was intended to encounter it—the wall—and when this is too much worn the sole becomes broken around its margin, and the sensitive parts within wounded and contused. Therefore all that the hoof requires in order to enable the horse to remain serviceable, is merely some kind of protection for the lower border of the wall; but this protection should not be heavy, else the muscles which were designed to move a marvellously light foot will be unduly strained, as will also tendons and ligaments, for the muscles—the moving power of the limb—are all situated at the upper part of the leg, and act upon short levers, the mechanical means being designed rather for speed than strength. This protection must be durable; it should not damage or interfere with the functions of the foot, but allow every part to perform its office unimpaired; it ought to be easily applied, and secure when attached to the foot; it should not render the animal less sure-footed, if possible, than before it was applied; and finally, it ought to be simple and cheap.

Grave charges have been brought against this method of preserving the hoof from the effects of wear, by men whose absurd theories, when carried into practice, inflicted most serious injury to the foot; but we may dismiss these and all other charges by the declaration that it is not the use, but the abuse, of the method which is to be inveighed against. The abuses are due to the farrier trying to improve, not to assist, nature, and to make the improvement costly.

The most serious abuse is a very unreasonable and barbarous mutilation of the hoof. This is often carried to an excess scarcely credible. The sole is robbed of its natural protection until it yields to the pressure of the thumb, or even until the blood is passing through it. The frog is cut away to a shred to make it look neat; the bars are carefully removed; and then a shoe is put on much too small for the hoof. This leaves a portion of the wall projecting beyond the outer margin of the metal; and to make the foot fit the shoe, the horn is removed by means of a rasp from the front of the wall, which is consequently considerably weakened at the very part of all others where it should be strong to support the nails which retain the shoe. Not only this, but the dense resisting outer fibres being removed, the soft, spongy inner horn is exposed, and this, being acted upon by external influences, cracks and splits, until there is scarcely any sound material to retain the nails, which have, consequently, to be driven higher and nearer to the sensitive parts; and this in time leads to disease and deformity. A hoof so maltreated has an unmistakably ugly and ragged appearance. In addition to this mutilation of the hoof in the vicinity of the shoe, the farrier, in order to complete a fine job, as he imagines it, rasps the outer suface of the wall as high as the hair, and in this way not only destroys the horn so rasped, but impairs the growth of that from the coronet, which becomes weak and brittle; so that at length the workman has to employ his utmost skill to fasten on the shoe without laming the horse, and has also to employ a greater number of nails, which immensely exaggerates the evil.

I now exhibit hoofs destroyed in this manner, and it will be perceived what misery the unfortunate horses must have endured for years.

Such mutilations and their consequence are quite common, and one can scarcely pass a horse in the streets of London without noticing them, and the majority of the shoes which are applied to the hoofs are no more reasonable in their construction. Great clumsy, unsightly masses of iron, the weight of which is perfectly outrageous, are attached to the feet of horses which have to travel sometimes at a rapid pace, carrying or drawing heavy loads. This weight is not only injurious to the feet, through the strain it imposes on them, but it is extremely fatiguing to the muscles; so that a large portion of the animal's power is expended in carrying about unwieldy clogs of iron. And the useless weight is not the only objection to very many of the shoes

in daily use. In order that the denuded sole may not suffer injury from the pressure of the shoe, this is bevelled away on its upper surface until there is only a narrow rim left on which the foot rests; so that in reality the whole of the weight-bearing is thrown upon the wall; and in consequence of the thickness of the shoe, neither sole nor frog ever come in contact with the ground, and sustain their fair share of the weight and strain. In this way the horse is compelled to travel as no other animal does, or was ever designed to do—on the outer margin of its feet. The space between the shoe and the sole is admirably adapted for the lodgment of stones, dirt, &c., and in heavy, stiff ground wonderfully increases suction. So much for the upper surface of the shoe; the lower, or ground surface, is not much less defective. It is usually a large, wide, smooth surface of metal, well contrived to promote sliding and slipping, furnished with a groove near its border, in which the nail-holes are punched, but which groove is a mere waste of labour and time for the farrier to make, as it is useless. Sometimes, with a view to prevent slipping, two projections, or "calks," are raised at the end of the branches of the shoe; and these, though they may to a trifling extent answer their purpose, nevertheless throw the foot and limb into a most unnatural and uncomfortable position, the pain and inconvenience of which we may realise by walking in very high-heeled boots.

SHORT CHARLIER SHOE.

These are only some, not all, of the evils of shoeing as commonly practised, and it must be confessed that they are very serious, and sooner or later lead to painful travelling for the horse, as well as impaired efficiency; and yet this art, which the farrier makes so difficult and costly, both directly and indirectly, should be neither. To shoe a horse properly, if we take observation and a study of nature's plans into consideration, is certainly not a very difficult operation, and neither need it be a very expensive one. Our object should be to protect the hoof from wear—nothing more; and in doing so we ought to maintain the integrity and soundness of the hoof, while we do not over-burden or disturb the natural direction of the foot and limb; and, as a secondary object, we should endeavour to increase the animal's foothold on the ground, if possible. The first object is attained by leaving the sole, frog, and bars in their natural condition; as I have already explained that when they have acquired a certain thickness the outer surface falls off in flakes of dead horn, so that they never become too thick. It is different with the wall, which would grow to an indefinite length, because it is not thrown off in flakes, and the shoe prevents it from being worn. This, therefore, every time the horse is shod, has to be reduced in length at its lower border to a degree corresponding to the growth which has taken place since the previous shoeing; and the manner in which this is done, as well as the extent, constitutes, in my opinion, the chief test of the farrier's skill. If the wall is too much reduced generally, injury will follow; if too much at the toe or front, the heels will be unnaturally high, and this will alter the animal's gait, particularly in the fore feet, and make its paces uncomfortable to the rider; if too much at the back part or heels, it throws the unnatural strain on the fetlocks and some other joints; and if one side is lowered more than another, it leads to twisting of the limbs and strain on the lateral ligaments of the joints. All these can be avoided by the skilful artisan; and yet, strange to say, the normal position or direction of the limb and foot are seldom taken into consideration, and we see numbers of horses of all descriptions with these more or less crooked in consequence.

SIDE VIEW OF A HOOF SHOD WITH THE SHORT CHARLIER SHOE.

The unmutilated hoof only requires as much iron as will protect the lower border of its wall, say for a month or six weeks, and ensure security of foot-hold, nothing more, and all beyond this is loss and injury; while, if possible, the sole and frog should be allowed to play their part. A shoe and method of shoeing, which admirably answer these ends, is that introduced some years ago by M. Charlier, a Parisian veterinary surgeon. A narrow rim of iron is embedded in a recess formed by removing the wall only, to a certain depth of its lower border; the iron, in fact, takes the place of the removed wall, and is retained securely by a small number of very small nails. The first, I believe, to try this method of shoeing in this country, I have continued its use, but in a modified form, up to the present time, and can affirm that it is, for many horses, the best method of shoeing known. In principle it is founded on a sound physiological basis, and in practice I can testify to its great utility. My modification consists in having only a short rim of metal passing round about two-thirds of the wall, and imbedded on a level with the sole, leaving that and the frog to reach the ground, and the heels free of iron:

in all respects, indeed, as if the foot were in an unshod state. The rim weighs about one-third of the common shoe, and is retained firmly in position by only four of the very smallest nails, and yet

GROUND SURFACE OF SHOE, SHOWING BEVEL AND CATCHES.

it wears longer than the heavy shoe which requires eight, ten, and sometimes twelve nails. This is easily accounted for by the fact that horn and iron wear together in this instance, and that the limbs are not fatigued, but move lightly and easily. Travelling is also safer on slippery roads, as there is only a very small portion of metal exposed, and the frog prevents slipping. The saving in manufacture, nails, and iron is also very great.

If this shoe cannot be employed, then we ought to resort to one in conformation the opposite of that now adopted, in so far that it should be much lighter, be concave on the ground surface and flat towards the foot, and, instead of having a groove, have merely the nail-holes punched for the reception of the nail-head. This would assure a safer footing, diminish the strain on the wall by allowing the sole to share in sustaining the weight, as it was intended it should do, and obviate the effects of suction in heavy ground, as well as picking up stones, &c. A shoe I have devised meets these ends, and is merely an imitation of the lower border of the wall, sole and bars. I have tested its utility among troop horses, and in the hunting-field for a number of years, and it has proved a good shoe for road work. The bevel on the ground surface suddenly ceasing within an inch or so of the end of the branch leaves a catch which imitates the angles of the bars, and acts like them in assisting the horse to check his pace suddenly.

The nails should be as few and as small as possible, and be driven only a short distance into the wall, which, if reduced to its proper dimensions before the shoe is put on, will not, and ought not to, receive any further rasping, especially on the face, as the shoe should be fitted full to its circumference.

A word as to fitting. To secure a perfect coaptation between the shoe and hoof is not an easy matter, and requires much time and tact; and when it has been obtained the shoe is far from being as securely attached as is desirable, particularly if the hoof is exposed to wet. The fitting is greatly simplified, and an accurate adjustment, as well as a solid surface for the shoe secured, if the latter be used in a hot state to prove the evenness of the surface on which it is to rest, as well as to fuse or char the immediate ends of the fibres, which are thereby hardened, and resist pressure and the effects of moisture to a wonderful degree. Persons ignorant of the subject imagine this injures the foot, but in all my experience I have never observed any harm to follow. Horn is a very slow conductor of heat, and provided the shoe is sufficiently hot to leave its imprint when momentarily applied, and the hoof is not mutilated to a shred of horn, no injury can or will follow.

With regard to security of foothold, and adding to the horse's power in draught, particularly with those horses which travel at a slow pace with heavy loads in our cities, there can be no doubt that "calks" are necessary, but their utility is greatly diminished, and they do harm to the limbs and joints if a toe-piece is not added. In nearly every town and city in this country, with the exception of London, the "claw-shoe," as it has been termed, is in use; and without it the horse would be much more liable to falls, and would draw much less loads with quite as much fatigue. This shoe is not worn in London, and we see horses not drawing half the loads those in these places do, and yet are scarcely able to keep their feet. Surely this is short-sighted policy. With a toe-piece, the limb foot of the horse has a powerful aid in seizing the ground securely, and its propelling muscles can be then brought into full play in moving the limb to which it is attached, instead of expending half their force in maintaining equilibrium.

Various contrivances have been from time to time proposed to give the horse a better foothold, but none have proved so successful and so cheap as the calks and toe-piece.

In connection with this subject of slipping, which is chiefly observed in the streets of our towns and cities, it must be confessed that the manner in which these are paved only too frequently does us little credit as a humane and economical people. Certainly, economy has much to do with their construction; but it is short-sighted economy, and chiefly in favour of the ratepayer—not of the community in general, nor yet of horses. Indeed, looking at the variety of pavements and their difficulties in the matter of traffic, one must feel that the horses which have to travel on them must be greatly perplexed, and if they have any reflective power they will doubtless consider their masters as very stupid and embarrassing road-makers. Some of the streets of London are infamously cruel to horses. Those paved with granite may be cheap to lay, but they are most objectionable in every respect, and the most expensive of all to horse and carriage-owners. They are at all seasons very dangerous and fatiguing for horses, in the matter of slipping; they inflict great injury to the limbs and feet from concussion; traction upon them is heavy; they are extremely noisy, and the jar and vibration they occasion to carriages wear these out more rapidly than any other kind of road. When wet and muddy, they are as dangerous to human passengers as to horses. In fact, though granite blocks make a very durable pavement, yet, on the whole, looking at such a pavement from an equestrian point of view, it is the most expensive and dangerous of any in use.

With regard to macadamised roads, there is certainly better foothold upon them, but their traction is heavy; in wet weather this is increased, and the mud is most objectionable; while in dry weather the dust is a great drawback, and watering is a nuisance and expensive. Noise is also considerable, and repair must be frequent.

The asphalte pavement is in many respects objectionable; traction is no doubt easy, but when the surface of the pavement is damp there is no foothold for horses, and the danger from serious falls is great. It is not at all a noiseless pavement; sprinkling sand over it to render it more safe increases the noise and the traction, and makes the surface disagreeably dirty. Besides, asphalte does not at all answer on hilly streets.

The best pavement perhaps ever introduced for horse traffic is that of wood, such as is laid down on Ludgate-hill. From the fact that the cubes of wood are so laid that the fibre is vertical, that the interstices are filled with pitch and gravel, and that they are laid upon diagonal planks, we have not only a very safe and comfortable pavement, so far as the horses' footing is concerned, but the nature of the material and the manner in which it is disposed render it a most humane roadway, with regard to obviating jar and concussion to the feet and legs. Traction upon it is easy. There is comparatively little noise, dirt, or dust; and, altogether, for the human and equine population of our towns and cities, perhaps no more economical, safe, and durable pavement could be devised.

The farrier must do his best to preserve and protect the horses' feet by shoeing, but we have a right to expect that the engineer will not fail to second his efforts by constructing roads which, while ensuring safety to the horses travelling upon them, will not counteract the advantages of good farriery.

The more frequent use of "breaks" for carriages, particularly omnibuses, in pulling up suddenly, and also in going down hills, would prove of great benefit to horses, in connection with shoeing and ...ing; and passing along the streets of London I am astonished to observe that this most economical and humane contrivance is not in greater request.

This matter of "roads" and "breaks" for carriages is one of great moment, but particularly the former. It is painful to witness unfortunate horses unable to keep their feet on the ...ble pavements with which the majority of ...s are laid, and brutal drivers plying their merciless whips on the poor creatures' skin for no fault whatever, but merely because a stupid and mistaken economy will persist in constructing a particular kind of road, upon which it is impossible the animals can travel with anything like safety, and at the same time exercise their powers of draught. This consideration brings me to "winter," or "frost" shoeing. In a climate so uncertain and fickle as this is, it is difficult to make anything more than a guess as to the kind of winter we may have in any year, and therefore no provision is made against the occurrence of frost. Indeed, in some winters we may have no frost at all, and the ordinary shoeing suffices for the whole season; but at other times the temperature may suddenly fall, and frost and snow appear; and then all is confusion, partial suspension of traffic, dangerous travelling, serious accidents, and such ... incidents as the past winter provided in abundance. The ordinary method of "roughing" the shoes, as it is termed, consists in taking them off the hoofs, turning up a sharpened calk, and perhaps adding a sharp toe-piece, and putting them on again. This is a slow and expensive process, and of course requires the aid of the farrier either in the stables or the forge; it is very injurious to the hoofs, takes a good deal of time, and, in consequence of the projections being only soft iron, must be repeated at short intervals. Besides, in the hurry which always exists at this time the shoes are often badly put on, and get loose or are lost, or the nails are driven into the quick.

To obviate all these disadvantages and inconveniences, various contrivances have been proposed. A very temporary one consists in inserting some large sharp-headed nails in the place of others withdrawn; these also injure the hoof. Another is the insertion of sharp studs screwed in at the heels of the shoe. These are convenient, but somewhat expensive, and are liable to break at the neck, leaving the screw portion immovably fixed in the shoe. Other more or less expensive and inefficient appliances have been proposed, but have not succeeded in meeting the requirements of those whose horses must do regular work during frost.

This winter shoeing has attracted my attention for many years. During a campaign it is sometimes of the utmost importance that horses should be able to travel on ice—indeed, the fate of an army or the success of some great movement may depend upon it. I may point to the French retreat from Moscow in November, 1812, as described by Thiers, when the terrible disasters that occurred were largely due to the absence of some contrivance for enabling the horses to travel on the slippery roads. We may also read with profit the Danish retreat from Schleswig to Sonderburg on the night of February 5th, 1865, as given in the *Times* on the 18th of that month.

I have tried every method proposed, but have found none which was economical, efficient, and speedily applicable when required, and without the necessity for taking off the shoes. Three years ago I ventured to experiment with a method which has certainly proved to be the nearest to perfection in these respects. During last winter it was very extensively used, and reports were most favourable. This method consists merely in punching a square hold at the end of each branch and, if thought

SHOE AND STUDS.

desirable, at the toe of the shoe, and inserting into it a square, slightly tapering, plug of steel, with a sharp point projecting beyond the lower surface of the shoe. The plug may be any reasonable length, from one to three inches, but it must fit the

hole somewhat accurately and tightly, and must not go quite through the shoe to the hoof. It may be tempered at the point to give it more durability, and nothing more is necessary than to insert it into the hole, give it a slight tap on the point to fix it until the horse puts its weight on it and drives it home, when it is firmly retained, every step keeping it tighter in. This stud rarely falls out if properly made; and when required to be removed, as to be re-sharpened, replaced by another, or left out altogether, a few taps on each side will generally start it, owing to the taper on that portion which fits into the shoe. This is a very inexpensive plan. An old horse-rasp, value threepence, will make eighty-two studs, and a farrier can furnish these in an hour. A set of studs will last four or five days, and the simple square hole takes but little time to punch. At the commencement of the winter—say November—all the shoes put upon my troop-horses are provided with these holes, and the farriers have their studs ready. Should the frost suddenly set in, all the horses can be made proof against slipping on sheet ice even in a few minutes, and, with a good supply of studs, may travel for weeks without going near a forge or requiring the farrier. When the frost disappears the studs can be taken out again, and they may be removed every night in the stable and inserted in the morning before going to duty.

I must now conclude what I have to say concerning horse-shoeing in general, and the principles on which it should be based. I have made no mention of the different kinds of shoes sometimes required for particular hoofs, nor what we may term "pathological horse shoeing," for the cure of disease or defects, natural or acquired, of the feet and limbs. This, though a most interesting and important section, nevertheless comes more within the domain of the scientific veterinary surgeon, and is of too extensive and perhaps technical a character to be introduced to your notice, after what has already been stated.

DISCUSSION.

Mr. Leeson asked if the French shoes, which had been described, could not be made preferably of steel, as being more durable than iron; and also at what angle the steel studs should be punched into the shoe so as to hold to the greatest advantage.

Mr. George Todd had been much pleased to hear Mr. Fleming condemn the barbarous practice of cutting and carving horses' hoofs, as if a blacksmith knew much better than the Great Architect of the universe the proper structure of a horse's foot. He had used the Goodenough shoes manufactured by Messrs. Cottam for many years, and was much pleased with them. He quite agreed that it was very often through bad shoeing that horses were lamed. Asphalte paving was very bad for horses, and ought not to be allowed. The main thing in a road was to have a good solid foundation, which was Telford's plan, following the Romans and Carthaginians, because it prevented mud working up through the stones in wet weather. The great thing required was to educate men to shoe horses properly.

Mr. J. C. Thomson, as an old veterinary surgeon, gave his testimony in favour of the Goodenough shoe. The horse he now drove was as lame as possible when he first had him, and also stood over at the knees, entirely from bad shoeing, but he had now driven him for four years with the Goodenough shoe, and he went quite well. It was not always the fault of the farrier that horses were badly shod, for he had been before now obliged to put 4½ lbs. on a horse's foot to please a customer. He once had a horse which was subject to bad bleeding sand cracks, but cured him entirely by the use of the Goodenough shoes.

Mr. Ellis A. Davidson said everyone must have been pleased to hear this subject treated, not only from a business, but from a humane point of view. Mr. Fleming's main argument was based on that which had often been advocated in that room—technical education, and if they tried to teach carpenters and builders their work, he did not see why they should not teach farriers also. He should like to see it taken up by the Royal Veterinary College, but until the College of Surgeons taught bootmakers how to make boots without distorting and injuring the human foot, he feared it would be useless to expect such a thing. He could not but think that it would be only [illegible] developing the lecturer's idea if a shoe could be devised which should be attached without the use of nails, and he did not see with the advance of mechanical science why such a thing should be looked upon as hopeless. The nails must tend more or less to injure the hoof, and as it was constantly growing, one could never be sure that they did not cause pain to the horse. Some years ago he recollected Mr. Bracy Clarke inventing a shoe, very light, which was to be fastened by thin clips coming up round the hoof, and secured by an elastic band put round them, and possibly something of that kind might yet be brought into practical work.

Mr. Colam (secretary to the Society for the Prevention of Cruelty to Animals) said it was no doubt encouraging to hear Mr. Davidson's sanguine views about the possibility of shoeing horses without the use of nails, though inventors had been constantly aiming at that result, nothing which could be called successful had been devised. The latest shoe brought under his notice was one introduced by Mr. Carr, a specimen of which was on the table, the principal object being to prevent the horses slipping. It was used for the tram-horses on the Peckham line for many months, and the report of the veterinary surgeons appointed to watch it was satisfactory; but the contract had not been renewed. He should certainly give his voice in favour of some regulation by which farriers should be prevented practising an art which they did not understand, and of which many of them were grossly ignorant. Some time ago, after giving a brief lecture, with diagrams, to an audience of working men on the structure of the horse's foot, a man came up to him and said he had been shoeing horses for thirty years, but he had no idea the horse's foot was anything like what had been described; that men like himself generally looked upon it as no better than a block of wood. He also gave his testimony in favour of the wood pavement, on which he had never heard of an accident, and against asphalte, with regard to which the society was constantly receiving complaints.

Mr. Hunting said there was no doubt that many farriers were very ignorant, but up to the present time the authorities on horse-shoeing were at variance, so that if examinations were introduced it would be a question who should examine the examiners. He could refer to at least a dozen books on horse-shoeing, no two of which agreed on some points of importance. Though he did not set up for an authority, there was one point on which he must differ from Mr. Fleming, though he agreed with him that the foot should be preserved in its natural shape as nearly as possible, that it should have a good frog and sound sole, that the bars should not be too much removed, and that there should be a proper bearing surface for the shoe. The general idea of the public was that the main thing to be attended to was the nails, and everyone had a horror of a horse being pricked, but though many [illegible]

would hardly dare acknowledge it to their masters, and the masters would certainly not own it to their employers, he did not believe there was a man who did not occasionally do so; indeed, he considered that great credit was due to them that it did not occur oftener; and it was quite a puzzle how farriers, unskilled as many of them were, managed to drive the nails without laming the horse. The whole secret, however, lay in having a properly prepared foot and well-fitting shoe, for with those conditions it was almost impossible to lame a horse with the nails. Mr. Fleming recommended the Charlier shoe as perfection, and he himself looked upon it as capable of being applied in many cases without laming the horse, but he knew of another which was equally useful, without some of its disadvantages. The Charlier shoe was the width of the wall, and the bearing surface rested entirely on it, so that unless the frog and sole came to the ground the whole weight of the horse rested on the wall of the hoof, which was contrary to the intention of nature. A shoe, to give a proper bearing surface, should be double the width of the Charlier, and should include not only the wall but the sole. It might be said that the sole did take a bearing on the ground, but he defied any one to produce a horse shod on the principle whose the sole touched the ground. M. Charlier's agent in London showed him two or three horses of his own, saying that the sole touched the ground, but on examination the sole was not within $\frac{1}{8}$ in. of the ground, and of course might as well have been an inch. As to the frog bearing on the ground, that might be as well obtained with the ordinary hunting shoe as with the Charlier, and he considered that the nearest perfection of any shoe in existence. The great advantage of the Charlier shoe was its extreme lightness, but he ventured to say that 6oz. made very little difference. The great difficulty would be arriving at a conclusion what teaching farriers should undergo, and then there was the difficulty of putting their knowledge into practice. A farrier ought to understand the foot as a whole, know what a proportionate foot was, when it was in proper relation to the leg, and apply that knowledge in each particular case. He feared it would be very difficult to educate them up to such a pitch; but there were many practical points which they might learn, and every man should have some idea of the internal structure of the foot. He would therefore give his vote for some kind of certificate being given to qualified men.

Mr. Urquhart said he had taken shoes off a horse which had been shod by M. Charlier himself in Paris, and found that the foot had been so much lowered as to have been cut right through to the blood vessels in order to bring it to the level. He had shod horses on the Charlier principle six years ago, but did not find it answer. It was not correct to say that all farriers were ignorant, for it very often happened that bad shoeing was caused by the interference of the coachman or the owner, generally the former.

The Chairman, in proposing a vote of thanks to Mr. Fleming, said it had often been his lot to ride horses without any shoes at all, at the Cape of Good Hope, for instance; and it very often happened, even then, that the sole had to be reduced, it grew so rapidly. The great disadvantage of an unshod horse was that on a hard surface, after wet weather, he found it almost impossible to retain his feet. With regard to the question of steel shoes, he believed Sir Joseph Whitworth had tried them, as would be expected of a man of such energy and enterprise connected with the steel trade, and having many valuable horses, but whether steel shoes were likely to be generally adopted he could not say. There were no doubt many farriers in London who understood their business, and if they were allowed to use their own judgment would often turn out better work than they did by following the directions given to them, but in the country they were usually very ignorant. As to the sole of a horse with a Charlier shoe not coming within $\frac{1}{8}$ inch of the ground, that of course on an asphalte or granite pavement would prevent the horse having a firm foothold, but on country roads, the hoof would sink that distance into the ground, and the action of the sole and the frog would come into play. He was quite satisfied of the bad effects of asphalte paving on horses, a friend of his owning a large number of horses having suffered very much by it. The same gentleman had tried the improved system of shoeing but had to give it up when his horses were in London, though he still practised it in the country.

The vote having been passed,

Mr. Fleming thanked the meeting for the attention with which his paper had been received, and expressed a hope that what he had said would lead to some reformation in the ordinary method of shoeing. The London farriers certainly were not so ignorant, but in travelling throughout the country they were generally found deplorably ignorant, and mutilated the horses to a most lamentable extent in consequence. He had tried steel rims for the Charlier shoe, but found them liable to break at the nail holes. These shoes should certainly not be thicker, and might even be narrower than the wall of the horse's foot; indeed, he thought the great mistake made by M. Charlier was in having the shoe too wide. He found iron wear nearly as long as steel, while it was much more easily worked, and to prevent breaking at the nail holes he used a very fine round pointed punch which did not cut the fibres of the iron. If Mr. Hunting were to see some of the horses shod at Chatham he would find that a large portion of the sole rested on the ground; the other day he saw a horse which had just been shod, and the sole projected nearly half an inch beyond the shoe. The shoes wore a long time, and the growth which took place in the interval of shoeing allowed a great portion of the wall to be removed, so that nearly all the horses shod in this way had the sole constantly in wear. With regard to the steel studs for frosty weather, the punch should be quite square, but a little tapering. He had before him a hoof which had been shod on the Charlier system, where the nail holes scarcely showed, and he did not think the use of nails was objectionable, only their abuse. Many attempts had been made to introduce shoes without nails, but all had failed. They were generally complicated and expensive, and nearly always unsatisfactory in operation. He had tried the Goodenough shoe, but found that, being machine-made, the iron was so soft that the cogs soon wore off, and then it had no advantage over an ordinary hunting shoe. The condition of the roads was a most important matter, but he certainly did not think it was fair that the ratepayers should bear all the expense of making good roads, by which owners of horses and carriages would benefit so greatly. He must repeat that the weight of the shoe was a matter of great importance, because a difference of an ounce or two at the knee was much exaggerated at the extremity of the tendons; and if you calculated the number of steps taken in an hour, it would be found that by having an unnecessarily heavy shoe you made the horse do some tons of entirely useless work during the day.

In Dr. Mann's paper on "The Protection of Buildings from Lightning," published in the last issue of the *Journal*, page 540, first column, line 10 from bottom, *for* "ropes of common wire" *read* "ropes of copper wire."

Messrs. Novello have just published a pianoforte and vocal score of the *Messa de Requiem* of Verdi, which is to be performed next week at the Albert Hall. The mass, performed for the first time a year ago on the anniversary of Manzoni's death, at Milan, has not yet been heard in London.

MISCELLANEOUS.

COLONISATION OF NEW GUINEA.

On Thursday, the 29th ult., a deputation waited upon the Earl of Carnarvon at the Colonial-office to ask the Government to cause to be annexed to the British Crown the Islands of New Guinea. Among these forming the deputation were Lord Stanley of Alderley, the Duke of Manchester, Lord Kinnaird, Mr. Hyde Clarke, Mr. R. N. Fowler, Mr. M'Arthur, M.P., the President of the Council and Fellows of the Royal Colonial Institute, &c.

Captain Young, of the Colonial Institute, read a memorial on the subject.

Mr. Hyde Clarke stated that the Council of the Society of Arts felt an earnest interest in behalf of the objects of the deputation, so far as they came within the scope of the Society for the Promotion of Arts, Manufactures, and Commerce, in which it had laboured for above a century.

Lord Carnarvon, while admitting the advantages to be gained by the shorter sea route to Australia, and the importance of such a station as the one proposed, in view of the abolition of the kidnapping trade, yet saw many grave objections in the climate, the magnitude of the operations required, the character of the people, &c. The Government had in hand a Bill for appointing Sir Arthur Gordon High Commissioner for the protection of aborigines in the Pacific, and he hoped to enclose Eastern New Guinea in the Bill. In conclusion he thought it was for Australia to make the first move, or at least to show more desire than was at present manifested for such an annexation as that proposed.

FORESTS AND TIMBER TRADE OF WURTEMBURG.

The kingdom of Wurtemburg has a superficial area of 1,950,369 hectares, or 4,819,675 English acres, and of this area 596,616 hectares, or 30·6 per cent., are forest lands. The population, according to the census of December, 1871, was 1,818,539, and therefore there are 3,281 square metres, or about four-fifths of an English acre of forest to each head of the population. Mr. Petre, the British representative at Stuttgardt, states that, to prevent waste and deterioration, and to secure the re-planting of cleared spaces, all forests in Wurtemberg are placed under the supervision of the Government forest officials, and the latter exercise their police authority and control with more or less stringency, as circumstances require. The forest lands cannot be brought into cultivation, no matter whether belonging to a private individual or corporation, without the express sanction of the authorities; and in case of unauthorised clearances, they are re-planted at the expense of the owner. In the pinewood district of the Black Forest the wood of the spruce, silver fir, and Scotch fir, from its superior qualities, external and internal, is preferred to all others for building and general purposes. The young trees of weaker growth, derived from the thinnings of the forests, are sold extensively for bean-sticks, stakes, raft-withes, props for young trees, hop and telegraph poles. The larger trees are chiefly used for building purposes, or for conversion into sawn timber, supplying materials for a very large home industry, and a highly flourishing timber trade. A considerable quantity of the pine wood is made into shingles, boxes, casks, pails, &c. Altogether about 60 per cent. of the pine wood felled is available for timber. The tops and chips are used as fuel, and are largely converted into charcoal, for consumption in the Government foundries. With regard to the hard-wood trees, the timber derived from them is applied to more various uses than th… from the firs, but as this class of wood, with the exceptio… of oak, is employed chiefly for home consumption, t… quantity used as timber is relatively small. The great… part of the hard-wood timber felled is sold for fuel.

The cultivation and preservation of the oak, on accou… of the demand for it in foreign markets, is an object… special care. The larger stems, especially the crook… ones, are much in demand for ship-building purpo… and are exported principally to Holland. They … floated down to the Rhine along with the pine rafts, … from thence to the Dutch ship-building yards. … timber is also used in considerable quantities for … in the construction of waterworks and bridges, and … mining purposes; likewise for railway sleepers, … lathwood, &c. The wood of the younger trees, ow… to its toughness, is much in request for carriage build… It is not so suitable, and is less in use for fuel. If … oak mainly supplies timber for general purposes, … beech furnishes the greater portion of the fuel cons… in the country. The ash, maple, elm, and small b… supply useful and valuable wood for carriage buil… joinery, turnery, and for instrument makers and car… The birch, even in its earlier growth, is valuable … making brooms, withes, props for casks and tubs, … for carriages and carts, &c. It is from 10 to 15 per … below beech in heating power, but as it burns with … flame, and heats more quickly, it is used in prefe… as fuel by certain manufacturers, varnishers for ins… The alder, the wood of which is chiefly used as fuel, … a similar advantage. Its heating power is about … cent. of that of the beech. Joiners, shoe-cutters, … &c., also employ this wood. When grown in wate… alder has remarkable durability. The lime-tree … a soft and light wood, and is much in use as panel… in joinery, and for packing-cases, boot-trees, … utensils, and various sorts of carving. The same … be said of the aspen, the wood of which is sold exte… at high prices, for paper manufacture and lucifer m… The heating power of the lime and aspen is about … cent. below that of the beech.

No statistical information exists showing either … proportion of the timber annually cut is exported … what value it represents. One thing, however, is … viz., that the exportation, especially of pine wood, … in its raw state, or in the form of manufactured ar… facilitated as it is by the numerous water-course… railways, is very considerable indeed; and as new … of railway are gradually opening fresh sources of … from districts hitherto inaccessible to timber traffic… export trade is likely to increase. Most of the ex… timber goes to the Rhine at Mannheim, the great … of the South German timber trade. About two-… of the larger pieces of timber go to Holland, and th… maining third to the Prussian Rhenish ports. … Rhenish provinces of Prussia are the chief cu… for the smaller pieces, the exportation of which to … land is trifling. France and Switzerland also … considerable supplies of timber from this source.

An exhibition of tin-wares, including the … materials and implements used in their manufacture, is … opened at Cassel on the 11th of September next.

In the course of last year, Belgium sent … tons of iron to China. 700 tons of Belgian iron wa… shipped to Egypt, and 750 tons to Peru. Belgium wa… however, able to find any outlets for her iron last y… Australia.

A single manufacturer of perfumery (Herm… at Cannes uses annually 140,000 lbs. of orange blos… 129,000 lbs. of acacia flowers, 140,000 lbs. of rose … 32,000 lbs. of jasmine flowers, 20,000 lbs. of violets, … lbs. of tuberoses, besides rosemary, mint, thyme, le… citrons, &c., in proportionate quantities. Nice and Ca… together consume annually over 20 tons of violets; … alone 190 tons of orange blossoms; Cannes over 150 to… acacia flowers.

CORRESPONDENCE.

FIRES AT SEA.

Sir,—I send you a slip from a paper about fires at sea, as far the Society is interested in the question; it is a most serious subject, and some safeguard ought to be insisted on. I saw an "Extincteur" used on board ship, in 1862, the *Indiana* steamer, at the Cape, putting out a large fire, which acted effectually. On board ship it is no having any things to use if they are never to be had when wanted; besides, even if they were forthcoming it would be difficult to get the carbonic gas into the bottom middle of the hold of a vessel, whereas if fastened in and fixed from the deck, I doubt much chance of getting ahead. One tap from a hammer on deck would set one or three "Extincteurs" at work the moment was perceived.—I am, &c.,

D. W.

Ceylon, March 19, 1875.

To the Editor of the Ceylon Times.

Sir,—One can scarcely imagine anything more fearfully appalling than a fire at sea. Take for instance the case of the ... The question then arises, is there no way of preventing such frequent accidents? I give one suggestion, which possibly might reduce them if compulsory measures were adopted for carrying it out. I noticed a short time ago a paragraph in the ... *News* of 22nd January, giving an account of a trial of Dick's ... fire exterminator. This is merely the old "Extincteur" with improvements, the improvements consisting in keeping the chemicals separate until required, when a slight blow drives down a pin and breaks the bottle in which the acid is kept, when the generation of the carbonic acid gas at once begins.

The power and efficacy of the "Extincteur" for putting out fire have been well established, therefore it appears to me that it is ... required to have these small and compact machines so placed on board ship as to prove effectual whenever and wherever the fire may break out in the hold or between decks.

Suppose one (or even two in large ships) "Extincteurs" with Dick's improvement were placed in a cage at the foot of each mast, with an iron rod carried along each mast to the deck, how simple a matter it would be immediately to fill the hold with gas, so that no fire could possible exist. Probably only one "Extincteur" would be necessary if used as soon as the fire was discovered. The great object to arrive at is to have such machines "untouchable and uninjurable" like enclosed safety valves for steam-engines; ... should be strong enough to resist injury from the stowage of cargo, and the iron rod might be protected by running ... pipe up the mast, and the head of the rod secured from injury when above the deck.

The "Extincteur" is a small, inexpensive machine, and a compulsory law to oblige all large coal or passenger-carrying vessels to carry these machines fixed in the manner proposed, would be no hardship imposed on shipowners, whilst it would, in my opinion, ensure a very great safety to lives and property.

Machines might also be fixed in between decks at convenient points in passenger ships, if not fixed in cases in certain places that would be sure either to be uncomeatable, or found injured when wanted in a hurry.

Messrs. Cargill and Co. imported and made successful trials of the "Extincteur" in Ceylon some years ago.

The subject to which I have hastily drawn your attention is of such importance, that I think it would be well, if you give place to my suggestions, to insert also the whole article from the ... *News* on the subject, which is interesting.

In 1842 I was in a heavy gale of wind, in a P. and O. steamer, when in the middle of the night there was a great smell and cry of fire, which proved to be the mail agent's comb burning over the lamp.

In 1871, I was in a war steamer on fire when the engineer and stoker were driven on deck from the smoke, and there was momentary expectation of being blown up by an unusually large quantity of powder on board, some outside the magazine, but fortunately, by the cool behaviour of the officers and crew, the fire was overcome just in time to save the vessel.

D. W.

PROTECTION OF TRADE, &c.

Sir,—An idea has struck me which is eminently one for our Society to forward, viz., that in lieu of the present system of "trade marks," there should be established a system of registered "trade numbers," with the same penalty for forgery or undue use of another man's number as there is now of his mark.

The effect of this would be that goods would be known all over the world by their trade numbers, just as a ship is known all over the world by her number, on referring to the ship lists. There would, of course, be published by some speculative printers, lists of the registered trade numbers and their owners, just as ship lists with their numbers are published, and every one of the public could, and would be wise to, buy one, so as to be enabled to see by the registered number (if any) on the goods whether it corresponded with the owner's or manufacturer's name in the list. The trade mark might still be used in conjunction with the number. The system would be very simple. The trader or manufacturer need only go to the proper office (say at the Board of Trade), enter his name, and thereupon he would receive a number. For this a small fee might be payable, and when the lists were published, he and his goods would be known all over the world by his number, much more effectually than by any mark, and a number could and would be more generally adopted.—I am, &c.,

H. F. NAPPER.

Horsham, May 1, 1875.

GENERAL NOTES.

Dried Fruits.—It is stated that these are prepared in America, whence a large supply is received, by means of a vacuum produced by a steam engine, in a pan warmed from about 120° to 170°, air dried by passing over chloride of calcium being admitted into the pan, the operation continuing about 20 minutes. The vegetable albumen is presumed to be thus coagulated.

Exhibition of Appliances for the Economy of Labour.—This exhibition, which is being held under the auspices of the Society for the Promotion of Scientific Industry in Manchester, will be opened, on May 14th, by the Earl of Derby, president of the society, and the opening address will be delivered by Mr. John Anderson, LL.D., late the superintendent of machinery to the War Department. The exhibition will contain a collection of engineers' tools, wood-working machinery, and other appliances. Sir Joseph Whitworth and Co.; Sharp, Stewart, and Co.; Cendall and Gent; Smith and Coventry; B. and S. Massay; and Furness, of Liverpool, are among the exhibitors. The second division is devoted to domestic contrivances. A large number of gold, silver, and bronze medals will be awarded, and Messrs. Richard Peacock, of Beyer, Peacock, and Co.; John Robinson, of Sharp and Stewart's; William Mather; Dr. Angus Smith; W. H. J. Traice, Professor Osborne Reynolds; and John Leigh, F.R.C.S., are the judges. The exhibition building is built on the same principle as the one last year, and it covers an area of over 50,000 square feet. About a dozen annexes for special purposes are attached, and not only will all the machinery be in motion, but the stoves, cooking ranges, gas making apparatus, &c., will be shown in action.

Tuscan Straw Manufactures.—The straw used for plaiting differs in character and mode of growth from ordinary straw. The grain is sown in the month of March—hence the name given to it, "marzuolo." The manufacture of hats is carried on chiefly in the provinces of Vicenza and Bologna, and in Tuscany. Although an ancient industry, it may be said to have been first developed in the eighteenth century, when Sebastian Michaelacci, of Bologna, commenced the exportation of hats to foreign countries. The reports lately collected by the commissioners deputed to inquire into the condition of Italian industries agree in representing that the trade has increased within the last ten years, but the increase has been in the inferior description of goods. This is a consequence of the caprice of fashion. Everywhere the feminine fashions are copied from those of Paris, and Parisian taste has always been unfavourable to this branch of industry. For the last twenty years past the export of split straws has ceased, as plaiting in the English and Swiss fashion has come into practice in Florence. The total declared value of the imports under the above head during the aforesaid year therefore amounted to 26,881,910 lire, or over a million sterling.

New Process for Gas-making.—On Wednesday last some experiments were made in the gardens of Sutherland-house to illustrate a new apparatus for making gas for lighting and heating purposes. Water is supplied to the bottom of a small tubular boiler surrounding a furnace. The steam thus produced is driven, together with a proportion of atmospheric air, through a second fire-box over incandescent coke and is thus decomposed. The resulting gas, consisting of carbonic oxide, nitrogen, hydrogen, and a small proportion of carbonic acid, is then conducted to the place where it is required for use for heating. When it is wanted for illuminating purposes it is passed first through a carburetter. The water supply is constant, the boiler being connected with an open cistern at a considerable height so as to give great pressure. The fuel employed was charred peat, produced by a special process.

Russian Industries.—It appears from a report recently presented to the Technical Society of St. Petersburg, by a committee charged with conducting an inquiry into the general state of trade in Russia, that a large portion of the manufacturing establishments of this country are in the hands of foreigners. In the district of St. Petersburg, for instance, foreigners possess 28 out of 32, in the province of Moscow 22 out of 47, in the district of the Vistula 6 out of 14, and in the Baltic provinces 21. The total number of works for the construction of engines in Russia, without counting the imperial establishments, is 167, three-quarters of which number make locomotives and other railway plant, while the remaining quarter construct agricultural engines and appliances, and other machines. The larger portion of these establishments is situate in Poland, next in order come the Baltic provinces, then the provinces of the centre and of the south. The 167 establishments possess 422 engines and 476 boilers, of a total force of 6,162 horse-power, employ 41,382 workmen, more than half of whom do not know how to read or write. These establishments consume yearly 133,800 tons of pig iron, 164,898 tons of wrought iron, and 127 tons of feul, of which about 100,000 tons consist of coal and coke.

Ventilation of Theatres.—As bearing on some remarks made by Mr. Hartley in a recent paper on "Air and Ventilation," the following results of experiments made at the Théatre Marie, St. Petersburg, on the night of a performance in December last, may be interesting:—"In a box on the second tier facing the stage, the temperature was found to increase perceptibly every quarter of an hour, although the ingress and egress of the occupants tended to cool the air by opening a communication with the corridors. When the curtain rose, the temperature in the box was 18° C.; at the conclusion of the first act it was 24° C., at the beginning of the second, 25° C. The humidity of the air increased more slowly. In the course of two hours it had risen to 30 per cent.; at the end of the fourth act it largely exceeded that of the outside air. Hygrometric observations in the pit showed that the air there at the commencement of the performance contained 60 per cent. of watery vapour, that of an ordinary healthy dwelling; at the conclusion, it contained 85 per cent., the proportion in an injuriously unwholesome room. The carbonic acid in the air, at the termination of the second act, amounted to 1·9 per 1,000 cubic metres, or six times the proportion in an ordinary respirable air; at the close of the evening's performance it was 4·3 per 1,000 cubic metres, a proportion amply sufficient to produce bad effects on the lungs of persons accustomed to inhale a purer air.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

MAY 12.—"River Pollution, and the Impurities of the Water Supplied to our Towns." By JABEZ HOGG, Esq., Surgeon to the Royal Westminster Ophthalmic Hospital, President of the Medical Microscopical Society, Fellow of the Royal Microscopical Society, &c.

MAY 19.—"The Agricultural Statistics of India." By CLEMENTS R. MARKHAM, Esq., C.B. On this evening ANDREW CASSELS, Esq., Member of the Indian Council, will preside.

MAY 26.—*No Meeting.*

JUNE 2.—"Toughened Glass." By PERRY F. NURSEY, Esq., C.E.

INDIAN SECTION.

Friday evenings at eight o'clock. The following arrangements have been made:—

MAY 13.—"The Russian Advance in Central Asia, its Commercial and Social aspects towards India and the East," by the Rev. JAMES LONG. On this evening the Right. Hon. Lord NAPIER and ETTRICK, K.T., will preside.

[N.B.—The date of this meeting has been transferred from Friday, May 14, to Thursday, May 13.]

CHEMICAL SECTION.

Friday Evenings, at 8 o'clock.—The following arrangements have been made:—

MAY 21.—"Explosive Compounds." By ALFRED NOBEL, Esq., the founder of the Nitro-glycerine Industry. On this evening F. A. ABEL, Esq., F.R.S., will preside.

MEETINGS FOR THE ENSUING WEEK.

MON.... Church Temperance Society (at the HOUSE OF THE SOCIETY OF ARTS), 7 p.m.
Royal Geographical Society, University of London, Burlington-gardens, W., 8½ p.m. Admiral Sir Leopold McClintock, "Arctic Sledge Travelling."
Birkbeck Scientific Society, Southampton-buildings, W.C., 8 p.m. Mr. H. Tinson, "Mineral Colours."

TUES.... Church Temperance Society (at the the HOUSE OF THE SOCIETY OF ARTS), 11 a.m., and at 3 p m.
Cymmrodorion Society (at the HOUSE OF THE SOCIETY OF ARTS), 7½ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Gladstone, "Chemical Force."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m.
Photographic, 9, Conduit-streeet, W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C.

WED. ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Jabez Hogg, "Rivers Pollution."
Geological, Burlington House, W., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 4½ p.m.
Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THURS... Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Morley, "Inner Thought of Shakspeare's Play's." [1]
Royal Institution, Albemarle-street, W., 3 p.m. Mr. James Dewar, "The Progress of Physico-Chemical Inquiry."
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

FRI....... Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Mr. J. Evans, "The Coinage of the Ancient Britons, and Natural Selection."
Astronomical, Burlington House, W., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.
Junior Philosophical Society, 6A, Victoria-street, S.W., 7.30 p.m. Mr. F. Butler, "Dwellings for the Working Classes in Large Towns."

SAT...... Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Herries Pollock, "The Drama."

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FRIDAY, MAY 14, 1875.

Communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SCHOOL DRILL.

DEPUTATION TO THE SCHOOL BOARD FOR LONDON.

On Wednesday last, a deputation from the Council and Drill Committee of the Society of Arts waited upon the School Board for London, to urge upon them the desirability of introducing systematic drill into Board Schools. The deputation consisted of the following gentlemen:—Major-General F. Eardley Wilmot, R.A., F.R.S., Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Sir Henry Cole, K.C.B., G. C. Tufnell, Captain Hon. W. Fitzwilliam, E. Chadwick, C.B., and P. Le Neve Foster, Secretary.

The deputation was introduced by Mr. J. McGregor and the Rev. Canon Cromwell.

Major-General Eardley Wilmot read the following memorial, which he handed to the Chairman:—

Memorial of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, to the School Board for London.

SHEWETH—

1. That the Society for many years has endeavoured to promote Drill in Schools as a necessary part of School training, and has caused several Reviews of Schools to be held successfully under the inspection of high military authorities and Royal Princes.

2. That military drill in schools is now recognised by the Education Department, and a small grant made for its encouragement, which, however, is quite insufficient to pay for instruction and inspection.

3. That such drill cannot be properly conducted except by competent military instructors and under *systematic military inspection*, and is too important a subject to be left as optional.

4. That such instruction could be obtained on economical terms, and would not interfere with the general teaching in schools, but rather aid it. In proof of which statements the School Board is referred to the accompanying report on drill in Christ's Hospital, which has been corroborated by his Royal Highness the Duke of Cambridge.*

5. That it is desirable that the great influence of the School Board for London should be brought to bear on the *War Department* and the *Education Department* to induce them to work together and effectively introduce drill in all schools in the country.

6. That whilst recognising to the fullest extent the admirable work which the School Board are already and have for some time past been carrying on in this direction, the Society of Arts submits that it would be a wise expenditure on the part of the Board, even in the absence of any Parliamentary aid, to carry the instruction in military drill to a higher degree of proficiency.

7. That it is desirable that the School Board should divide the metropolis into districts for the purpose of holding public reviews and inspections at least once every year, and that the Board should invite the people of each district to give prizes to the schools which had distinguished themselves.

8. That the Society of Arts expresses its willingness to provide a handsome set of colours to be competed for each year, and held for the ensuing year, by the schools pronounced by military authority to be the best of the year, and to give to such school a sum of £20 to be divided among the boys as a prize.

9. In conclusion, the Society desires to express its full confidence that the London School Board will deal with this subject, so important to health, discipline, and the highest national interests in the future, in the same wise spirit as it has shown in dealing with other subjects of national education committed to its charge, and the Society wishes the Board "God speed" in its most useful labours.

By order, P. LE NEVE FOSTER, Secretary.

11th May, 1875.

He said the Society, as mentioned in the memorial, had been for some time engaged in this work, having had reviews which had been attended on an average by about 4,000 boys, brought from different parts of the metropolitan district. The expense of this had fallen upon the Society, amounting in each case to about £400. The object of the Society, in all the work it undertook, was simply to initiate reforms, and not to carry them on beyond a certain point, and they now thought this particular work had been so far initiated, and had received such encouragement from those able to judge of its value, that it was in a condition to be handed over to a responsible Board like that which he was addressing, in order that it might be carried out in all its entirety. One great point which they considered of the first importance was that drill instruction should be good and complete. There might be a difference of opinion as to how that might be obtained, whether by obtaining the services of military men from the various depôts in the neighbourhood of the schools, or by the school instructors themselves; in the latter case, however, the Society ventured to think that it would be well if some certificate of competency were obtained from a military authority, as this would give a more complete guarantee that the system carried out was perfect in all its branches, and in accord with the general system of the service. It was very important that schools should not be left in an isolated condition to look after this matter, because such isolated work had a tendency to dwindle, and required constant supervision. The Society, therefore, ventured to suggest that the Board might assist in this direction, and by some means or other, which they did not pretend to point out, obtain from the nearest military depôt instruction by military men. He believed the feeling of the service, to which he had the honour to belong was such that there were a vast number of persons in it who would most gladly assist in carrying out this work. He would add that the Society had had considerable experience in this matter, and this they would be very glad to place, through any of their members, or through their secretary, at the disposal of the Board. Moreover, if the Board thought fit to adopt the proposition alluded to in paragraph 7, by giving their assistance in some way or other, for the holding of public reviews, the

* See *Journal*, April 30, p. 521.

Society, through its Council, would do all it could to forward those views, and to assist in carrying them out. The letter which he had handed in to the Chairman spoke very strongly of the advantage of drill in many of the Training Schools, particularly those connected with ship training. Only recently an officer in command of one told him that the introduction of this system had had such a good effect upon discipline that he was able to dispense with the assistance of two persons formerly connected with it. For himself he should be most thankful if any hopes could be held out of seeing this system of drill introduced into all the higher schools. But he was afraid the prejudices of head masters of public schools was too great, they being, unfortunately, under the impression that it implied a certain amount of inferiority for boys to be under that class of discipline; and therefore, until they were more enlightened, he had not much hope of seeing that accomplished. There were, however, schools of different classes where drill was being carried on with great effect; and what was wanted at the present time as much as anything else was the propagation of sound views on the subject in all schools that had undertaken it, so that the country might learn to understand that this was really and truly a great national movement. In conclusion he would only say if any member of the Board desired to ask any question, either he or one of the members of the deputation would be most happy to afford any further information in their power.

The Rev. G. Murphy asked if the drill intended would include manual exercise as well as marching drill, and also whether it would take place in the regular school hours or whether it would involve extra time. As they had already military certificated instructors he begged to ask whether it was desired that military men only should be employed to supersede civil instructors?

Sir Charles Reed said their rules only allowed one gentleman to speak, but any member of the deputation might answer a question.

Sir Henry Cole, K.C.B., taking the last question first, said he thought drill should be taught both by military instructors and by the schoolmasters. No doubt there were many gentlemen connected with schools who were perfectly competent to teach drilling, and he hoped that they would become more numerous, but he should like a military inspector to come round occasionally to see that the work was going on all right. This was comparatively a new subject, and they must do the best they could. With regard to the manual exercise, he had heard it said by an Inspector of Health that mere military drill was not a sufficient exercise for a boy's muscles, and therefore that gymnastics should be added. How far military drill should be carried was, of course, a question to be decided hereafter. For his own part, he should like the British boy to be as well drilled as the German or Swiss. His own individual impression was that this drill should not take place in extra hours, but should form part of the school work; for he thought a little mixture of muscular work would, so far from interfering with the intellectual, really tend to improve its character, for very often boys were kept too long at their desks.

Sir Charles Reed said one of the earliest resolutions of the Board, passed four years ago, instituted the very thing that was now recommended. They were, however, glad to have had such a strong recommendation on the system of drill from the Society of Arts, and of course it would receive their fullest consideration.

The deputation having retired,

Mr. McGregor moved, and **Canon Cromwell** seconded, a resolution, "That the memorial be referred to the Schools Management Committee to consider and report upon."

The resolution was at once agreed to.

CHEMICAL SECTION.

A meeting of this Section was held on Friday evening, May 7th, W. J. RUSSELL, Ph.D., F.R.S., in the chair.

The paper read was—

ALUM SHALE AS AN ECONOMICAL MEANS OF PURIFYING TOWN SEWAGE.

By Sidney W. Rich.

Alum shale possesses a single practical application of importance, viz., its employment for the preparation of the soluble alumina salts, alum and sulphate of alumina. The manufacture of alum is of some antiquity, that of sulphate of alumina of more recent date. In either case the sole object is to obtain the alumina in a form that may be dissolved in water in order to admit of its application to various technical purposes. These soluble salts of alumina may be readily decomposed by alkalies, lime, &c., and when so decomposed the alumina is thrown out of solution in the form of a gelatinous, hydrated precipitate. The application of the alumina salts depends on the formation of this precipitate, and on a few well-marked characters which it possesses. Of these characters may be mentioned the absorbent power which the precipitated earth exerts on many kinds of organic matter, and its practically complete insolubility in water. As illustrations I may mention the common method of dyeing with a mordant of alum, and a process of sugar refining. In the first instance the fabric is impregnated with a salt of alumina dissolved in water, and is subsequently immersed in a solution of the dye stuff. The alumina combines with the organic matter constituting the colouring principle of the dye, and an insoluble compound is formed which clings with great tenacity to the fabric. In the case of sugar refining, the gelatinous precipitated alumina removes a large proportion of the vegetable impurities contained in the aqueous solution of sugar. It must be understood that these properties are only fully developed in the hydrate of alumina which has recently been made insoluble in water by the decomposition of one of the soluble salts of alumina. Clay contains a large amount of alumina, and has a marked absorbent power, but this power is by no means proportionate to the amount of alumina contained in the clay used. If you, however, first disintegrate the clay by chemical action and make the alumina soluble, you may utilise to the full the absorbent power of the alumina. Accordingly the manufacture of the soluble salts of alumina, or at least of one of them, alum, has been of commercial importance from a very distant date.

To those who are not quite clear on the chemistry of the subject, I should like to devote a few words explanatory of the difference between alum and sulphate of alumina from a practical point of view. Sulphate of alumina is a simple salt, readily soluble in water, and not easily purified by crystallisation; if we wish to obtain solid sulphate of alumina we evaporate the aqueous solution of the salt until it is ready to set in a firm mass on cooling. It will be understood therefore that any impurities contained in the solution will accompany and remain in the salt when in the solid form. Alum, on the

other hand, is a compound salt, containing, besides sulphate of alumina, either sulphate of ammonia or sulphate of potash. This double salt is readily soluble in hot water, and far less soluble in cold water, it may therefore be readily purified by crystallisation. Accordingly, if we have an aqueous solution containing alum mixed with impurities, and we wish to obtain the alum in the solid form, we have only to evaporate the solution to a given point, when, on cooling, large crystals of alum will be formed, leaving what are termed the mother waters. It will be readily understood that these mothers will retain the greater part of the impurities which may be removed, and a pure alum secured as a product. Now for the most ancient of the practical applications of alumina, dyeing, it happens to be of the greatest importance that the salt should be free from iron, as a very small quantity of this metal would interfere with the brilliancy of the colours. Alum shale contains much iron, so that the practice has grown up of preparing the alumina in the form of crystallised alum, rather than in the form of the more simple sulphate of alumina. In point of fact, even now in commerce, the pure alum has a good name, while the often impure sulphate of alumina has a bad name. Simple sulphate of alumina may, however, be manufactured from a material, such as white china clay, containing no iron, or the iron may be removed by processes other than the crystallisation of the sulphate of alumina as alum. Again, a given weight of sulphate of alumina being a simple salt, contains more alumina than the same weight of alum, which being a compound salt, contains a large proportion of matter which for the purpose in view is inert. The second constituent of alum, although an expensive material, is therefore lost, and attempts have been made to recover it, for application to the purposes to which it is suited, but without practical success. We thus find several important reasons for using sulphate of alumina instead of alum. Nevertheless the anomalous fact remains that enormous quantities of alum are made and used simply out of mere caprice or fashion.

Whether we propose to make sulphate of alumina or alum, the treatment of alum shale or other source of alumina merely means this, that we shall combine the alumina with sulphuric acid, and thus make it soluble; in other words the first step is to convert the alumina into sulphate of alumina. The old method consists simply in calcining alum shale at a moderate heat, whereby, roughly speaking, sulphur occurring as sulphide of iron in the shale is oxidised, and, combining with a part of the alumina, forms sulphate of alumina, which may be dissolved in water. The quantity of salt formed bears a very small proportion to the aluminous material used. The second and modern method consists in the direct artificial treatment of the aluminous material, whether shale or china clay, with sulphuric acid. By this means the whole of the alumina may be converted into sulphate by the use of a proper proportion of acid.

In working the first process many circumstances conspire to enhance the costliness of the product. The very heat which accompanies the oxidation of the sulphur and other combustible parts of the shale, also, when it is not properly regulated, rises so high as to decompose any sulphate of alumina formed, or altogether prevent its formation, the acid vapours escaping into the air. Again, even if the temperature be carefully kept down, and a proper proportion of sulphur is present, the circumstances do not favour the absorption of the acid fumes. Consider, the shale is burned in heaps, and as the combustion proceeds, fresh supplies of raw shale are thrown on from above. Now raw shale is about as impervious to vapours of any kind as wet clay, and although after calcination it becomes porous and permeable, it is then removed from the reach of the fumes, which travel upwards. Accordingly a large proportion of the acid vapour escapes, and a very small proportion only of alumina is made soluble, so that by the old process many tons of alum shale are requisite for the production of one ton of alum. Nevertheless, alum shale possesses qualities which eminently adapt it for this method of working. Containing as it does a considerable proportion of alumina, sufficient coaly or bituminous substance to save the necessity of using fuel in calcination, and varying quantities of sulphur, such a mixture is peculiarly adapted to the formation of sulphate of alumina; the combustion of the bituminous portion, especially when made to take place at a smothered heat, leaves the mass porous and friable, and thus penetrable by the sulphurous fumes, air and steam. But, unfortunately, as the mass acquires these permeable qualities, it is fast losing the opportunity of absorbing the sulphurous fumes, which are rapidly given off and travel upwards, meeting with that portion of the shale which is unburnt and impermeable. Such is the crude, imperfect process which has endured for centuries, and which is carried out as follows:—The raw alum-rock is spread over a bed of brushwood, to which fire is set; as the combustion of the shale sets in, more rock is piled on from above, and this is carried on until a conical heap is formed perhaps 100 feet high. If the combustion be too active the shale is overburnt, and appears red and vitreous, and will yield little or no sulphate of alumina. On the other hand, in the absence of high winds, if the shale is not piled on too rapidly so as to induce too great a draught; if, again, all the crevices are plastered up; in fact, if every means are taken to secure a smothered combustion, the burnt rock will appear of a buff colour and be more or less friable to the touch. With every care and success, it is, however, certain that an enormous loss of sulphur must result. It has been sought to avoid this loss by raising the height of the heap to a few feet only and increasing its horizontal extension, or by burning the shale in ridges about eighteen inches high; but the circumstances I have endeavoured to explain render it impossible to avoid the loss of sulphur. The loss of the sulphur is not the only, nor by any means the principal loss which results, for there is a very small proportion of alumina made soluble, and this means a loss all round on every ton of rock treated. It will at once occur that if it were possible to convey the fumes through the lower calcined, and therefore porous part of the mass, a complete absorption would take place. A practice equivalent to this is said to be employed in Belgium, where pyrites are burned at the base of the heap, and the fumes thus made to penetrate. A prevalent idea seems to be that a larger yield of sulphate o

alumina may be obtained by mixing powdered pyrites or other material rich in sulphur, with the alum shale before calcination, and thus by increasing the amount of sulphurous fumes given off during calcination to increase the absorption and consequent production of sulphate of alumina. This proposal occurs as a feature in more than one patent. Seeing, however, that it is rather a mechanical difficulty than a chemical one which interferes with the more complete reaction, it will be clear that this plan will by no means secure the desired end; indeed, the higher temperature resulting from the presence of an increased amount of combustible matter might be expected to result in the decomposition of a part of the sulphate formed, and consequent decreased yield. Moreover, the shale would very likely be over-burnt altogether. Shales vary so much in composition that it is always advisable to mix those poor in sulphur with those rich in that element, but the yield of the mixture could not be expected to rise beyond what the mechanical difficulties have clearly set as the limit.

Some proposals have been made with the view of improving the result obtained by burning shale. Calcination in tall kilns, or upright pipes, has been practised, but of course the draught being greater the mischief has been greater. In 1860, Richardson patented a process for subjecting aluminous materials to the action of sulphurous acid in towers. The coal shale, china, or common clay, in a raw or roasted state, is enclosed in towers wherein an upward current of sulphurous acid gas meets a downward current of water, which is pumped up and used over and over again, until it acquires a certain density due to the solution of earthy matters. The solution is said to contain, principally, sulphite of alumina, yielding sulphate by evaporation with free access of air. All that could be expected of this process would simply be, that as much alumina would be extracted as would be capable of solution in cold water containing sulphurous acid. In the case of raw clay or shale the proportion would be very small, while in the case of calcined clay it is very doubtful whether the alumina would be attacked by weak sulphurous acid in the cold to a much greater extent. Spence treated the burnt shale with the waste gases in the sulphuric acid manufacture, but it does not appear that he attempted to make the process a continuous one, nor that he used the shale in a hot state. The conversion could not be very extensive, as the shale so treated was employed, instead of fresh shale, for working with sulphuric acid itself. In the conversion of alumina into sulphate of alumina, in the manner occurring during the simple calcination of alum shale at a low temperature, it is probable that the oxidation of sulphurous acid to sulphuric acid is completed by means of the oxide of iron present. At the temperature met with, the protoxide of iron greedily absorbs oxygen, and becomes converted into peroxide of iron, which is immediately decomposed by sulphurous acid gas, protoxide of iron being reproduced, and sulphuric acid being formed. The sulphuric acid is then absorbed by the alumina and other earthy bases if the temperature be not too high, but if the heat does rise [illegible] the greater part of the sulphuric acid [illegible] as vapour, together with the excess of sulphurous acid gas. Another advantage of a low temperature is, that the production of soluble alumina would not be confined to an extent proportionate to the amount of sulphuric acid formed, for it appears that the sulphurous acid gas may itself be absorbed by alumina, a sulphite resulting, which by subsequent exposure absorbs oxygen and becomes converted into sulphate. I think, however, I have said enough to show that a sufficient production of sulphate of alumina cannot be obtained by simple calcination.

The second and modern method of making alumina soluble is by the direct application of sulphuric acid to the material. With pure china clay an aluminous cake or sulphate of alumina is obtained free from iron. In dealing with alum shales, clay, or other aluminous material containing iron, it is not easy to obtain simple sulphate of alumina free from iron, but the process may be carried on for the production of crystallised alum. Several processes are, however, employed to get rid of the iron in a different way. For instance, ferrocyanide of potassium will precipitate the iron as Prussian blue, and the fluid when evaporated will yield a very fair aluminous cake. Or the iron may be in a great measure got rid of by first treating the calcined shale with weak hydrochloric acid, removing the solution, calcining afresh, and then acting on the residue with sulphuric acid. It would seem, however, that practically fine china clays are used for the manufacture of aluminous cake, while the shales are employed for the manufacture of alum. Broadly speaking, whether we simply burn the shale at a low temperature and extract all that may be soluble in water, or whether we act on the shale with sulphuric acid and then treat with water, the result is the same, that is to say, we have a solution containing in the main sulphate of alumina. By the first and old method we obtain a very small proportion of sulphate of alumina for the quantity of rock treated, by the second we may obtain the whole of the alumina present. If we simply evaporate these liquors to a solid consistence we have alum-cake or sulphate of alumina, if we treat them in an appropriate manner we may obtain alum. I will not go into the familiar details of the alum manufacture, but will simply point out that we may, as practised in the old process, simply add to the hot concentrated solution the quantity of potash or ammonia salt requisite for the formation of the double salt alum, and the solution when cold will deposit crystals of alum; or we may, as practised by Mr. Spence, at Manchester, distil ammonia vapours into the hot fluid, and the alum will likewise crystallise on cooling. In the manufacture of alum I would again remind you that the valuable potash or ammonia salt is simply used to obtain that kind of alumina salt on which fashion and custom have set their seal. An equivalent result may be obtained for nearly all purposes by using sulphate of alumina made from pure china clay.

When the question of the purification of sewage became urgent, precipitation processes were found to have many advantages. For this purpose the employment of alumina would at once suggest itself; in fact, the employment of alumina in one form or another has been made the subject of many patents. Under a well known process th[illegible]

costly alum is used with blood and clay. Now so far as sewage precipitation is concerned, the only object in using an alumina compound at all is to enable us to create a precipitate or sediment of gelatinous alumina in the body of the sewage, and thus absorb and carry down the impurities; why, therefore, use a carefully manufactured product like alum, or even sulphate of alumina, when the crudest of materials will suffice for the purpose? In the process alluded to it is not quite clear what the blood is for, considering, as Mr. Thorpe happily pointed out in a recent paper, that the quantity used was not greater than that contained in average sewage. If this addition of blood is intended to enrich the deposit it is difficult to understand why the addition should not be made subsequently to the treatment of the sewage. A blood manure so prepared might then be sold on its merits, and superficial people would not be inclined to attribute its best qualities to the sewage, which has not been their true origin. We must conclude that the inventor of this process had some misgivings as to the pecuniary results of throwing alum away by the ton, when he made the judicious addition of clay. Now whether we use an expensive, or an inexpensive aluminous precipitant, the result obtained is the same, that is to say, a gelatinous precipitate of hydrated alumina is formed in the sewage, due to the decomposition of the salt effected by the alkaline constitutents of the sewage, or if the sewage is acid, to that effected by the addition of lime. It will appear from the use of clay in conjunction with alum that the former may be made to assist in clarifying the sewage, if a proper proportion of the recently-formed gelatinous precipitate is present. We are already aware that the alum or sulphate of alumina has been prepared from shale which contains as dross or residue a large amount of material which closely resembles clay. The question therefore naturally presents itself, why separate these matters, and then add them in another form. It is clear that for sewage purposes you do not require even a partially purified salt of alumina. It is quite unnecessary to prepare an aluminous salt, taking great pains to separate dross, and then before making use of it to add similar dross in the form of clay. Indeed it is more than unnecessary, being injudicious, for can such a mixture be equally homogeneous with the original crude material? Again, where is the clay to come from, especially near towns where it is valuable for brickmaking, and more valuable in the form of land; or if plentiful, why is it found necessary to incur all the extra expense attending the digging and carriage of such a material separately, when its equivalent, in the shape of original dross, might be had at a saving? A step in the right direction consists in the employment of shale which has simply been calcined, and then converted by the addition of sulphuric acid without any subsequent treatment. If such shale is of fair quality the product will be a crude sulphate of alumina in which dross certainly does not predominate, and which will still stand dilution, so to speak. Sulphuric acid is, however, a comparatively expensive chemical, and although I may stand alone in the opinion, I feel sure that this course provides a material of too high a class for the purpose in view. The employment of sulphuric acid involves the erection of plant of an expensive kind, and entails the labour of skilled managers; and although those interested in sewage alone may leave all this to professed manufacturers, it is none the less certain that it must be paid for. The question therefore arises, how far will simple calcined alum shale, containing as it does 3 or 4 per cent. of sulphate of alumina, answer the purpose? If such a material were made into paste, and run into sewage, would there be a sufficient amount of alumina precipitated in the gelatinous form to enable the whole to do its work effectually as a clarifier of sewage? The answer must be that this can hardly be expected, so that we must seek some means of acting on the alumina to a greater extent than is possible by simple calcination. For experimental purposes—and I think I am justified in saying that in the matter of the purification of sewage, we have not yet advanced beyond the experimental stage—for such purposes the treatment by means of sulphuric acid may appear simple and cheap; indeed, many go beyond this, and advocate the employment of elaborate methods for treating the deposit, in the hope of obtaining a valuable manure. It is, however, probable that the bare cost of clarifying the sewage is likely to prove a sufficient burden, without adding the risk of loss involved in methods which entail the employment of expensive plant, whether in the preparation of the precipitating material, or in the treatment of the deposit afterwards. I am, therefore, inclined to think that in this case, as in many cases, the first loss is likely to be the least, and that it would be well therefore to select the cheapest and simplest of efficient methods, resolve to bear the expense, and not risk a greater loss in the attempt to turn great perplexity into great prosperity. Experience and time may bring the possibility of better things.

The problem then is to convert alum shale into an efficient precipitating material without undertaking expensive chemical treatment, and this will not appear so hopeless if we remember that under the most unfavourable circumstances, when the rock is calcined in the old-fashioned way that I have described, an amount of sulphurous acid gas is absorbed which causes a yield of about three or four per cent. of sulphate of alumina. Such a result would indicate the possibility of making it absorb more of the sulphurous fumes, so as to yield a larger percentage of alumina as sulphate. Several attempts have been made to put this in practice, but with an ultimate object not quite so modest as that we have now in view, the aim having hitherto been to manufacture what was alone marketable, the orthodox alum, or sulphate of alumina. In one process the aluminous material is placed in chambers which have been filled with sulphurous acid gas. Supposing the result satisfactory, I think the wear and tear of the chambers, and the expense of moving the material several times, would be adverse to the production of an article that would suit our present economical necessities. The possibility that a demand might some day arise for a material such as I have described, led to some experiments being made on rather a large scale at Guisborough, in Cleveland, Yorkshire, about three years ago. Unfortunately it was not quite so clear then, as it is fast becoming now, that cheapness would be almost the principal point; moreover, although the experiments lasted

some four or five months, they were not pushed to the point which it is now clear was their legitimate conclusion. The first object was of course to secure a larger yield of soluble sulphate of alumina, and to attain this it was clearly necessary that a larger proportion of sulphurous fumes should be absorbed. The main conditions for a successful result in this direction presented themselves as follows:—First, a proper temperature of the aluminous material, probably about 400° or 500° F.; second, an independent supply of sulphurous acid gas, which should be made to traverse the heated, calcined rock; third, a proper degree of humidity in the form of steam; and fourth, the presence of atmospheric air. It was, of course, at once found desirable to take advantage of the heat produced during the calcination of the shale, in order to induce the absorption of the sulphurous acid gas, and with this view an upright cell, or kiln, was built, about 18 feet high, 9 feet wide, and 4 feet across. Within this chamber the temperature of the calcined rock might certainly be maintained for a long period, but a very serious difficulty was at once found. The alum shale was fired within the cell, and then more was piled on until the cell was full; an attempt was then made to withdraw the calcined shale from the bottom. It was found, however, to have stuck fast, the whole mass having caked together, a result probably due to the draught within the cell inducing too energetic a combustion. The next attempt was to fill the cell with rubbish, fire the shale on the top, and then draw it down as calcination proceeded, adding fresh shale from time to time so as to maintain a heap of low elevation above the top of the cell. This was perfectly successful, and the operation was carried on for two months without intermission, calcined shale being drawn from day to day at the base, and fresh shale being thrown on above. By carefully regulating the rate at which the burnt shale was withdrawn from the bottom, all danger of overburning or choking the cell was avoided, while calcination was effected in the most perfect manner. In these experiments the heap maintained at the top of the cell was of such a diameter that about twenty cubic yards of calcined shale could be withdrawn weekly; if more were drawn there would be danger of choking the cell by the introduction of uncalcined rock, if less were drawn and the addition of fresh rock suspended there would be danger of the fire above dying out. With a cell of the size mentioned it was calculated that the diameter of the heap above might be conveniently increased until a weekly output of forty or fifty tons of calcined rock should be attained. The result afforded one step in the right direction. The arrangement described afforded a continuous supply of calcined shale, enclosed in a chamber, and maintained at a suitable temperature, and effected with the roughest of labour and the least costly of plant. On the average at the bottom the calcined shale was of such a temperature as to just hiss on the application of water; on the top, where calcination was going on, it reached a red heat, barely visible in the dark. Within the cell, and between these two points, would be found various degrees of temperature, so that at one point the conditions, so far as temperature is concerned, for the successful absorption of sulphurous acid gas would be found, and this without any trouble in adjustment. It was found that no portion of the shale was overburnt; indeed, men accustomed to the operation of calcining shale, agreed that it could not be better burnt, and the importance of this will be manifest from what we have already considered in regard to the absorption of sulphurous acid, or even sulphuric acid, under such circumstances. I think it worth while to draw attention to such particulars as these, because previous failures in this direction have been due probably to an improper condition of the material, due to overburning. We now come to the second step in the process, viz., the introduction of the sulphurous fumes. To effect this, an ordinary sulphur-burner was built facing the cell, and a flue connected the former with the base of the latter. The sulphur-burner was charged with sources of sulphur, which are rejected by the sulphuric acid manufacturer, viz., ordinary coal brasses and iron pyrites of the district, and when fired the burner was kept going and the fumes made to pass up the cell for over a month continuously, while the calcined shale was as continuously being drawn down. While the sulphur-burner was at work, the calcined rock would come down covered with a film of sulphate of alumina, while pieces that had met with moisture, trickling perhaps down the inside of the cell, were so acted upon as to be easily compressed with the finger. The one burner was found, however, quite inadequate, three or four being clearly necessary, as well as a regular supply of steam. Proper means not being at hand to secure the latter, an extemporary contrivance was resorted to, which abundantly proved its immense utility in favouring the reaction. A minor point may be mentioned, viz., that it is not essential that the complete oxidation requisite for the production of sulphate of alumina should take place. It is quite enough if the reaction ends with the absorption of the sulphurous acid gas by the shale, for a sulphite would be as likely as a sulphate to yield a hydrated, gelatinous precipitate of alumina, when treated with an alkali, in the presence of a large quantity of water, and would, therefore, be equally effectual as a clarifier of sewage. In the above experiments, the shale treated as described was subsequently made the subject of experiments with a view to secure the economical production of alum and sulphate of alumina; it was not attempted to apply it directly to the precipitation of sewage. It would be interesting to ascertain its capabilities in this direction. The simplicity of the manufacture and of the application of this material would resemble that of lime, which it might be even expected to rival in economy; and while the lime process does not permanently clarify sewage, it has been sufficiently proved that alumina will do so to a very satisfactory extent. I have said that this material might be expected to rival lime in economy, an assertion which you may consider rather vague, seeing to what an extent the price of lime varies in different localities. In order, therefore, that you may judge of the simplicity and economy of the method, I will give a brief outline of what may be expected to be the principal items of expense:—

1st. The labour of cutting out the alum rock.

2nd. Breaking it up and tipping it on to the top of the cell.

3rd. Outgoings on sulphur-burners.
4th. Wear and tear of cell.
5th. Drawing the product.
6th. Carriage to sewage-works for whhic no packing would be required.
7th. Grinding.

As regards economy, there is also another point to bear in mind. Alum shale may be obtained in enormous quantities in certain localities without mining operations, and it may, consequently, be got cheaply. In a case like the present, where carriage is a most formidable item of expense, it is a great advantage to be able to carry on operations on one spot for a great length of time. In respect to economy, it is probable that not one of the other materials proposed as precipitating agents for sewage can compete with alum shale, excepting perhaps lime. The fatal objection to the employment of lime, however, is simply that it is quite inefficacious, as it hastens a very objectionable form of decomposition, in which ammonia is given out largely, and the deposit contains even less fertilising properties than the deposit obtained with the use of alumina. I must leave it to you to judge whether the greatest economy combined with the greatest efficiency demands the employment of some such material as that obtained by the action of sulphurous acid gas on alum shale in the manner described. I may, however, say that if the argument I have put forward possesses any weight, although it may not involve the impeachment of some of the elaborate processes put forward, it will at least demonstrate the necessity of a great deal of careful consideration before we make any fatal leap in this great sewage difficulty.

DISCUSSION.

Professor Way said the paper did not bring forward the contested questions of sewage which had been a battle-field for so many years past, and he to a great extent agreed with Mr. Rich that there was no prospect of making precipitated sewage matter of any value, and all attempts in that direction had failed. Years ago the axiom was laid down that the proper thing to do was to get rid of sewage as quickly as possible regardless of the precipitate, but as a matter of course at the least expense. The efforts to make a valuable fertilising material from the matter precipitated from sewage had always failed, and he believed they always would fail, and therefore it seemed utterly absurd to put valuable materials into sewage, the greater part of which was lost in effluent water, merely for the sake of doing that which a cheap material would do. Lime had been used with perfect success, and when employed, as General Scott pointed out it ought to be, in excess, it was quite efficient. He did not hold with General Scott, that it was worth while to make cement out of the product, but still that was an ingenious suggestion, and one which might have relieved some towns of a portion of the expense if it could have been carried out practically. In many cases it was difficult to put sewage on the land, and therefore a good process for precipitation was desirable. The use of salts of alumina was very old indeed, Stoddart's process for using sulphate of alumina having been patented in 1859, and several others had since been brought forward, one for the use of sulphate of alumina produced by the action of sulphuric acid on clay. The point in Mr. Rich's suggestion, which seemed to him doubtful, was this. They knew that sulphate of alumina could be made easily and cheaply wherever clay material, free from carbonate of lime, was to be obtained, but they had not been informed what the average expense of carriage would be, and as this material contained at the most 7 or 8 per cent. of sulphate of alumina, and had to be sent from one or two localities in the kingdom, say from Yorkshire or Cornwall, 100 or 150 miles to the different towns, it appeared doubtful whether the expense would not more than balance the saving in the process now recommended. Nothing but the soluble sulphate was of any value, and it struck him that to carry 95 per cent. of worthless material, at an expense of 15d. or 20d. a ton, would be less economical than making the sulphate of alumina on the spot. Undoubtedly sulphate of alumina was the best precipitant for sewage next to chloride of iron, which had the additional advantage of absorbing the sulphuretted hydrogen. In comparing this process with the lime process, he said there was no doubt that when lime was used the water was disposed to become putrid if not quickly mixed with a large body of water, and he believed there was less fear of smell in the effluent water after sulphate of alumina had been used; still lime was the cheapest, and if properly used was quite efficient.

Mr. Leesen would have liked to hear more specific data as to the percentages of the various chemicals used for deodorising the sewage. They had not heard the percentage given either of the amount of sulphate of alumina or of lime. Then, again, a statement had been made as to the dry precipitate being found to contain only 1 per cent. of ammonia, and with regard to that it would be useful to know at what temperature the product was dried, because a temperature of 212° would be sufficient to drive off the greater portion of the ammonia, and would account for only 1 per cent. being left. The same with regard to the steam which was used at one part of the process. It might be used at a temperature of 212° or 3,000°, and it would be important to practical men to know what was the proper temperature.

Mr. Thorp had been much interested in the paper because it was impossible to have too much information on this important subject. There were, however, one or two points in which he did not quite follow Mr. Rich. That gentleman seemed to think that the sulphate of alumina need not necessarily be in solution, but that if the alum shale after calcination were mixed with the sewage that would be sufficient. Now he took it that the action of alumina was simply a surface action, and that you could not have the hydrate of alumina efficiently brought into play, unless the sulphate of alumina was really in solution. Then, speaking of sulphate of alumina as a substitute for lime, he felt rather doubtful whether that could be the case. In some sewage there was already a sufficient quantity of alkaline material to precipitate the sulphate of alumina as soon as it was added, but in the other cases that was not so, and it would then be necessary to add some lime, in order to get a precipitate, or, in other words, to get the hydrate precipitated from the sulphate. Therefore, to that extent it would appear that the sulphate of alumina was rather antagonistic to the lime, and that if the quantity of the former was increased you must also increase the quantity of the latter. As to the introduction of clay into the A B C process, he was not sure he really understood Mr. Rich, but there was no difficulty in understanding why the clay was used. It had no chemical action whatever, but purely one of surface; the clay was brought into a kind of milky condition, and thus exposed an enormous surface, and so carried down the suspended impurities of a considerable portion of those which were dissolved. That was well shown in the effluent waters from the mica pits in Cornwall, which was as thick as milk—so thick that, after standing for some time, the precipitate occupied fully three-fourths of the volume, and it was then so stiff that rods would stand upright in it. On examining the water

obtained from them, he found that the organic matter was almost entirely removed. In fact, he had examined it in cases where the water when it entered the works contained a considerable quantity of organic matter, whilst after leaving them it contained scarcely an appreciable quantity. The same thing was seen in the waste from iron and lead mines. Wherever you got a finely-divided material presenting a large surface action, it removed not only the suspended impurities, but, to a great extent, the dissolved impurities also. Mr. Rich's paper was rather directed to the production of a cheap source of alumina than directly to the solution of the sewage difficulty. The great objection to the lime process was that it did so little for the character of the effluent water, which in many cases actually contained a larger quantity of organic matter in solution than the original sewage, owing to the lime helping to dissolve some of that organic matter. The same thing must happen in most cases when alum shale was used, because if it were to be efficient the effluent must go away in an alkaline condition, which would be rather an objection with regard to the pollution of rivers. Again, the effluent water from the lime process was prone to decomposition. Other processes were also liable to the same defect; that from the A B C process decomposed pretty rapidly, and the product was of a very offensive nature. All processes for the purification of sewage by precipitation were purely of an experimental kind; but he thought some of the irrigation methods might now be said to have got beyond that stage, for the beds at Merthyr Tydvil, at Croydon, at Norwood, and at Bedford, might be said to have passed into actual practical work. These precipitating methods would be very important if you went on the hypothesis that sewage must be clarified before irrigation, but though this might be desirable in some cases, it was not essential, for there was no practical difficulty experienced in the treatment of unclarified sewage. Of course it would be advisable that grosser floating matters should be removed by straining and small deposit tanks, but beyond that he did not think any great difficulty could arise from the scum which was said to form on the surface. In the Rivers Commission laboratory they had some experimental filters working for a long period with London sewage. This was freed from the grosser matters by passing through coarse canvas before being used, but was not otherwise clarified; and although it passed continuously through various experimental media, in some cases for 12 months, there was no very serious stratum of scum left on the surface. It would be perfectly easy in filtration beds on a large scale to plough in anything of that sort which was left, and so dispose of it without inconvenience. He could not do better than repeat what had been said on a former occasion by Mr. Rawlinson, that the great difference between precipitation methods and irrigation was this, that in the former you put a very small percentage of a chemical agent into a large quantity of sewage, whereas in the latter you applied a very little sewage to an enormous quantity of the active material, namely, the earth. That perhaps was the solution of the whole difficulty. He agreed with Mr. Way as to the importance of the carriage question; for even if they could get an ingredient for nothing, and had to pay £2 or £3 per ton for carriage, it might be a very expensive material.

Mr. Shelford said he approached this question as an engineer, not as a chemist, having been employed in the construction of works for various precipitation companies, though he was not interested in any of their processes. The final blow appeared to be given to precipitation by the report of Mr. Bazalgette and Mr. Keates, the officials acting for the Metropolitan Board of Works. Those reports thoroughly condemned the experiments at Crossness; but from the attention he had given to the subject he came to the conclusion, which he had made known in a letter published in the newspapers at the time, that precipitation, if successful, must be carried out, not by putting in a cheap precipitate, but by finding one which should be valuable as manure. The experiments of the Native Guano Company and all others had proved conclusively that of the dry manure you got from sewage, the greater part consisted of the material you put in; and in an article in the *Quarterly Journal of Science*, written in favour of the Native Guano Company, reference was made to experiments at Paris, where the dry manure consisted of 10 per cent. obtained from the sewage, and 90 per cent. from the constituents that were put in. But with such methods nothing but loss could arise. Treating sewage either by the native guano method or by the sulphate of alumina process, it would be an extremely rich sewage which would enable you to obtain 40 or 50 per cent. out of it, and the remainder would consist of what you put in; you had, first of all, to buy the material, then to precipitate it, mix it, put it in, then to get it out, and finally to dry it, which was the most expensive and troublesome of all. If chemists could find a constituent which, whether expensive or not, was valuable as manure when recovered from the sewage, there would be some hope of making a manure which would pay. Two years ago he was applied to by some gentlemen who had patented a process with this object, and having obtained a concession from the Metropolitan Board, he put up some model works where it was tried, and satisfied himself that in an appropriate place the process would pay its expenses, testing the quality of the manure in the usual way, by analysis. Another process of a similar kind was now just coming into operation in a large town where he had just completed the works, and he believed it was likely to be successful unless there was a break down in a short time, which he did not think likely. It was as yet, however, too early to speak very positively, as it had only just started, and the arrangements were not yet perfect. He thought, therefore, the principles he had laid down had proved to be correct, but he would remind the meeting this was as much an engineering question as a chemical one, and in fact many companies had come to grief simply because they had ignored the engineering part; had treated dilute sewage, put up works in the wrong place, and, in fact, done almost everything that was wrong.

Mr. Newlands said he was much interested in the manufacture of sulphate of alumina, and if Mr. Rich had devised a cheap source of soluble alumina it would be a very great thing accomplished. The price of alumina in a soluble condition was very high, for if you took the sulphate of alumina as sold in London at £7 a ton, it gave by analysis theoretically 15·4 per cent. of soluble alumina, though in practice never more than 13 per cent. was found. If, therefore, you multiplied the price of £7 per ton by the percentage, it came to something like £[illegible] a ton for soluble alumina. Therefore, to propose the employment of such a costly material for precipitation of any sort required that such precipitation should be attended with considerable advantages. If, on the other hand, the alumina could be obtained cheaply, a thousand and one different things could be done with it which could not at present. The cost of soluble alumina might be compared with the cost of soluble compounds made from still more costly materials, for instance phosphatic materials. Taking china clay worth 30s. a ton in Cornwall, and containing 30 per cent. of alumina, and making it into alum-cake or sulphate of alumina, you got a material which sold at £9 a ton, but if you took phosphate of lime, which cost about £6 a ton for raw material, you could make it into a soluble phosphate, containing 25 per cent., selling at about £3 15s. per ton. The difference was enormous. If Mr. Rich could make a sulphate of alumina, which should not be absolutely pure, but should contain 1 or 2 per cent. of oxide of iron, at a reasonable cost, he would be doing a great service to various arts and industries. For the purpose of transport it was necessary to get materials in a concentrated form, and he thought, when farmers had got a little more common sense, bulky

waggons would no more be seen conveying large quantities of sand and worthless material mixed with a small percentage of phosphates, and though he would hardly go to the extent of saying that the farmer would come up to the cattle show and take home in his carpet bag sufficient manure for 100 acres, still something of that kind must be looked forward to. He had applied to the Manchester manufacturers to know if they could supply him with a concentrated solution of sulphate of alumina, offering to pay the expense they incurred for fuel in evaporating it, but he found they preferred sending it out in the solid state, and no doubt they had good reason for so doing. If Mr. Rich could produce a material containing [illegible] per cent. of soluble ammonia at any less price than [illegible] a ton, he would be conferring a great boon upon many people. He should like to have seen the figures giving the cost of producing the sulphate of ammonia, and the amount obtained of dissolved alum shale after treatment in water.

Mr. Wills remarked that, during the last four months, a large number of processes for the treatment of sewage had been brought forward in that room, and the following conclusions seemed pretty well established. First, that sewage must be purified in some way or other; next, that such treatment of sewage could never be looked upon as profitable, but must be undertaken at some expense, and that process, of course, must be selected which would involve the least amount of expenditure, and would produce the quickest results with the least annoyance. The value of the material taken out of sewage by precipitants seemed to be *nil*, or so little, that, on this ground, precipitation processes might almost be left out of consideration. This Mr. Rich seemed to agree to. Again, there was no doubt that the addition of such a matter as sulphate of alumina would increase the bulk of the precipitate, and there would be a question as to the difficulty of getting rid of it, especially as it was of no value. Mr. Thorp had questioned the necessity of precipitating sewage about to be submitted to irrigation or filtration. No doubt, if it were, it would be necessary to look for such a precipitant as sulphate of alumina, and it seemed possible that the sewage might be benefited by being clarified before being placed on the land. If this were too expensive, the question would arise whether there would not be less evil in using the sewage unprecipitated. He should like to know from Mr. Rich whether there were any other purposes to which this product might be applied, and also what was the percentage of sulphate of alumina in the finished material.

Mr. Adam Scott thought the fault on the part of most of the sewage companies had been that they considered the precipitation method as a solution of the sewage question, and in so doing had actually injured their own prospects. This opinion was confirmed by what was said by Dr. Frankland at the Royal Society recently, that these companies had been formed on the erroneous idea of supposing it was possible to precipitate organic matter in solution, which was a chemical impossibility. With regard to these precipitation processes, there was a greater question beyond that of simply purifying sewage, viz., to what extent did they succeed in so purifying it as to affect the health of towns? He thought they were palliatives only, and that they would neither affect the health of towns nor the real condition of rivers into which the effluent water flowed. The source of the diseases which were to be attributed to excremental pollution was now perhaps only beginning to be discovered, and it could scarcely be said that we knew dogmatically what were the elements in sewage which caused disease. At the present time he believed Dr. Klein was making some experiments tending to show that in the case of typhoid fever there existed in the bowels of the patient certain vegetable germs in enormous number, which not only penetrated the mucous membrane, but were also discharged from the patient. Now the question was whether any precipitation process would kill the source of disease, and so long as medical science had not ascertained what was the source of disease, it was impossible to say they had done so. He was afraid these resources were so recondite, and so far beyond the possibility of disinfection, that probably an effluent water passed as pure by an analyst would still carry with it sources of disease. On the other hand, irrigation seemed to be a method which in all probability would have the effect of absorbing or destroying these sources of disease, whatever they were. Personally he had always been an advocate of a different system of treating sewage, upon which he would not then enter.

Mr. Rich, in replying to the observations which had been made, said:—Of course the carriage question would greatly influence the cheapness of any alumina precipitate, but any material which could be carried in the crude state without packing, though much more bulky, might go much more cheaply than when it required careful transmission. He believed it would be found that in many districts in England this process would be capable of application, as it was almost as simple as lime burning. Professor Way had pointed out that in the chloride of iron process the iron caused an absorption of the sulphuretted hydrogen, and so produced a much better effluent water; but by the use of crude sulphate of alumina made in the way he had described, you might get an effluent equally good. There was a certain amount of iron present, and this iron flowed away with the clarified water in solution, and it absorbed oxygen as well as sulphuretted hydrogen, and gave up the former to a certain extent to organic matter. If that clarified water were allowed to flow for a few hundred yards, you got a deposit of oxide of iron, and on analysing the water beforehand, and then again after it had stood for some time and had deposited the oxide, it would be found there was more organic ammonia in the water which had not deposited oxide of iron than in that which had, showing that a certain amount of purification was going on, so that you had the advantage of the iron method as well as the alumina. With regard to the question of temperature, raised by Mr. Leeson, if the deposit were dried very carefully by chemical means in a desiccator it was possible to obtain a deposit of 2, or occasionally 3 per cent. of ammonia, using the smallest amount of alumina possible, which would allow the sediment to fall and leave the water clear; but if, on the other hand, the product were dried in the open air, and then completed over a water bath, you could not obtain 1 per cent. of ammonia, so that it was evident that the dry manure was not really worth anything. In treating the shale the steam need not be under any pressure, it was simply introduced in order to get a moist vapour in the cell, which caused a breaking up of the shale. His object in conducting these experiments had been to see how much sulphate of alumina, or rather alum, might be obtained from working a certain quantity of alum shale, in order to ascertain whether alum could be made more cheaply by that process than by the sulphuric acid method, and he was therefore not prepared to give exact details as to the percentage of soluble alumina. He found it was a very close question indeed whether alum could be made more cheaply in this way, and therefore the process was for the time given up. He could not agree with Mr. Thorp with regard to the necessity for using lime in sewage. If you treated shale with sulphuric acid you had a large amount of free sulphuric acid, and, therefore, wanted the lime to neutralise it, but if you treated it with sulphurous acid gas, as he had done, you had basic sulphates of alumina, which caused a deposit of oxide of iron, so that if you dissolved some of that compound you could get the hydrate of alumina without adding lime. Using the shale in this way you had in point of fact a compound which contained an excess of alumina rather than an excess of acid, so that the alkalies in the sewage would be quite sufficient to effect deposition. He found

by experience that by using neutral sulphates of alumina the suspended matter in the sewage was deposited without the addition of anything else. There was no doubt that clay had a surface action, but why should you use a separate material when you could take one homogeneous product and effect your object? He did not propose to solve the sewage question, but if sewage must be clarified it was advisable to go to work the cheapest way. It was not the fact, according to his experience, that the effluent water must go away in an alkaline condition, for he had evaporated large quantities, and found he could readily obtain it in an acid or rather neutral condition. If sewage were used unprecipitated, he did not think it would be possible to plough in the sediment as had been suggested. It accumulated, and it was just that accumulation round vegetation which was so offensive. He must differ from Mr. Shelford, who said the only hope of a precipitation process was to give a good manure; he did not think there was any hope of that being accomplished. He could not answer Mr. Newland's question with regard to the cost or percentage, for the reasons which he had already given. Soluble sulphate of alumina containing 13 per cent. ought to be manufactured by such a process, because as you drew the shale from the cell it could be put into travelling vats, and then by displacement with water you could work the lixiviation process without any difficulty at all, and get the solution down to a point at which it would crystallise and almost solidify on cooling. He therefore thought this process afforded every possibility of getting crude sulphate of alumina at a cheap rate. In reply to Mr. Wills's question, he thought the only other processes to which it would be applicable would be obtaining crude sulphate of alumina, and that would require a lixiviation process. He did not think anyone would expect a precipitation process to remove the germs of disease, and no analyst would ever pass an effluent water as being pure. He had tried every means of purifying by precipitation and also by absorption with clay, and such water, even by simple distillation for ammonia, would immediately be condemned. But if you used a very large quantity you might remove nearly the whole of the organic matter, but you could not pretend to obtain pure water by such means. The only result would be to produce a clarified water which might either be used for filtration or irrigation, or which might be run into a river without being absolutely offensive.

Mr. Thorp wished to explain what he meant with regard to the deposit of scum. At the intermittent filtration works at Merthyr Tydvil and elsewhere, where large quantities of sewage were passing on a small quantity of land, the scum might be an inconvenience; but there the crops were a secondary consideration, for there were often none at all, and ploughing in could be accomplished at any season. Otherwise it could be done when the crops were off the ground. But where sewage was used only in small quantities over a large area of land, as in irrigation proper, he did not think the scum would cause any inconvenience.

The Chairman, in proposing a vote of thanks to Mr. Rich, said, that gentleman would be the first to acknowledge that his process was far from complete, and that he had not at present all the information he would wish with regard to it. He seemed to have made some experiments, and to have got some definite idea with regard to the alumina and to making sulphate of alumina to an indefinite amount of richness, and no doubt the product might be a valuable material for precipitating sewage. At the same time there was the question which Mr. Thorp had urged, whether it was necessary to clarify sewage at all. Most people, however, seemed to agree that the precipitation process was not perfect, though under certain circumstances, and where you could not at once irrigate, or the nature of the land was such that it would not bear large quantities, a precipitation process might be useful; in other cases where you could not apply sewage to irrigation at all, they must fall back on some precipitation process. When the experiments had been carried further, it would be interesting to know whether sulphate of alumina would act so much better than the lime process as to be the one to be adopted; but even in that case the effluent water could not be called purified, and must be got rid of in a tolerably short time or it would undergo decomposition. He thought it was hardly fair for engineers to throw on chemists the onus of getting something or other, expensive or not, to precipitate with. He should say, in return, what was the use of precipitating? What did you take out by a precipitation process? Speaking roughly, what you did precipitate was a substance of no value, and what you left in the sewage was of the greatest value for fertilising purposes, and therefore, whether you put in an expensive thing or not, it hardly affected the question. If it were expensive, of course it would be of more value when it came out. The only question was, in what form would it come out. You ought to put in something which would get out the ammonia, and when that could be done a precipitation process might be carried on to advantage; but so long as ammoniacal salts were so volatile, he feared it was hopeless to expect to precipitate them, every process which had been hitherto devised for that purpose having failed.

The vote of thanks having been unanimously passed, **Mr. Rich** briefly replied, and the meeting separated.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 12th, 1875; ROBERT RAWLINSON, C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Bland, John, 40, Bedford-place, Russell-square, W.C.
Deal, George, 13, Carlyle-square, Chelsea, S.W.
Joseph, Samuel A., 44, Queensborough-terrace, W.
Rogers, J. Banting, Robertsbridge, Sussex, and 4, The Colt-street, Limehouse, E.
Schmitz, Dr. Leonhard, 26, Belsize-park-gardens, N.W.
Thynne, John Charles, Little Cloisters, Westminster, S.W.
Wanklyn, Professor James Alfred, 117, Charlotte-street, Fitzroy-square, W.
Whiston, William, Chapel Chorlton, Newcastle, Staffordshire.
Woodhouse, Henry John Cam Frederic, 14, Warwick-court, Holborn, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Bain, George, Mansfield-house, Hampstead, N.W.
Corzanego, Senor Don Antonio, University of Valencia, Spain.
Hall, Frederick, 1, Jermyn-street, S.W.
Hardy, Edward Septimus, 67, Strand, W.C.
Haynes, Edward, 5, Maida-vale, W., and 227-[illegible] Edgware-road, W.
Keith, Thomas William, 6, Pembridge-crescent, Bayswater, W.
Russell, George, 1, Sussex-place, Hyde-park, W., and Golfhill, Geelong, Victoria, Australia.
Schwabe, Alfred James, 9, New Bond-street, W., and Raleigh and Grafton Clubs.
Sim, William, 1, Danes-inn, Strand, W.C.
Simmons, William Henry, 247, Hampstead-road, N.W.
Smith, James W., 2, Warrington-crescent, W.
Tasman, William James, 7, Adam-street, Adelphi, W.C.

The paper read was:—

RIVER POLLUTION, WITH SPECIAL REFERENCE TO THE IMPURE WATER SUPPLY OF TOWNS.

By Jabez Hogg,

Surgeon to the Royal Westminster Ophthalmic Hospital, President of the Medical Microscopical Society, Fellow of the Royal Microscopical Society, &c.

River pollution is a subject which has assumed, from facts which have recently come to light, the gravest and widest importance. In a well-arranged and lucid paper, Mr. W. Thorp dwelt with considerable earnestness on the extent of the evils produced by manufacturers, trades, and mining operations, which have so much increased of late years. He also pointed out, that although the pollution of our rivers was formerly due to ignorance and carelessness, this plea would no longer prevail, since the late Royal Commissions had so well and so fully explained the various methods to be employed for impounding and collecting noxious matters, and so preventing them passing into the bed of the river. It was also clearly explained that certain portions of the refuse might not only be collected, but made marketable.

If manufacturers still refuse voluntarily to engage in a course so commendable and proper, it remains for the Legislature to enforce the valuable recommendations of the Royal Commissions of 1865 and 1868. It is hoped, and reasonably expected, that business men will perceive it to be to their interest, as well as the public good, that a remedy should be applied for evils which, throughout the length and breadth of the land, are regarded as intolerable.

There must, however, be no halting between two opinions, and masters must give stringent directions and orders to workmen not to cast rubbish and refuse into neighbouring streams, simply because it happens to be an easy and ready way of getting rid of them. Subsidence reservoirs must be established to collect all noxious matter as it passes out of the factory or mine. By simple means, and at a trifling cost, subsidence can be easily carried out, and in about six hours all the coarser matters held in suspension in water will have been deposited, and an enormous amount of the river pollution entirely prevented; but as precipitation is hindered by the slightest movement of the body of water, subsidence ponds may become failures, and the immediate results less satisfactory than was expected.

We cannot shut our eyes to the fact that many poisonous substances, culpably allowed to flow into our rivers near densely-populated towns, are of a highly dangerous character. Numerous instances have occurred of mysterious poisonings of shoals of fish, and of the almost sudden disappearance of all vegetable and animal life. In some colliery waters arsenic abounds, as at the Dowlais Iron Works, near Merthyr Tydfil. At the Devon Great Consols Copper Mines arsenic is prepared for sale, and the refuse is generally allowed to pass into the river. Arsenic, however, is largely employed, and is indeed a positive necessity in certain important branches of British industry. It is used in the manufacture of the new colouring matters obtained from coal tar, in calico printing, in dyeing, in the manufacture of glass, shot, &c.; but this, I venture to say, is a matter of no moment compared with the conservation of the public health, and one which is paramount to every other consideration. This will be perfectly clear when I state that every ounce of this virulent poison will kill a hundred strong men. It is, then, only exercising a reasonable amount of caution if we demand that every effort shall be made to prevent so poisonous a substance finding its way into our rivers. It is desirable to prohibit altogether the discharge of metalliferous liquids from tin-plate, galvanised iron works, &c., into town sewers; and while such a precaution will inflict no great amount of hardship upon manufacturers and tradesmen, it will certainly be a means of lessening danger to human beings, and also of preserving valuable property from injury, inasmuch as the cement and brickwork of the sewers are soon corroded, and leakages produced from this cause. For the same reason the discharge of all refuse from chemical, nickel, iron, steel-wire, German silver, electro-plating works, and brass foundries should be strictly prohibited. Calico printers, flax steepers, linen and jute bleachers, dyers, woollen manufacturers, tanners, starch and paper makers, paraffin oil distillers, sugar refiners, chemical manure makers, &c., all conduce to the dangerous contamination of the river, and render it totally unfit for domestic uses. Trades which were at one time thought to be innoxious, upon closer examination prove to be seriously detrimental to the health of man and beast. This cannot be more forcibly exemplified than by stating what occurred only a few years since in a stream on the banks of which a starch manufactory was situated, near Nottingham. This factory emptied all its refuse into the river, and soon the fish were found dead on its banks; and then the sheep, and lastly the cattle, were found poisoned. When attention was turned to the water, it was discovered that by no filtration or self-purification could its deadly impurities be separated. In another case, a paper manufacturer of my acquaintance noticed scores of dead fish in his mill stream, and on inquiry it was discovered that the refuse of the factory was allowed to pass into the stream. The chlorine and other poisonous matters used in the bleaching process were quite sufficient to explain the deaths in the stream, from which a good supply of fine fish was before obtained. A still more recent illustration was lately given by the Duke of Buccleuch, at a meeting held in Edinburgh on the Pollution of Rivers. The Duke stated that in a Scotch parish the sanitary authorities diverted the sewage of a village into what he well remembered as a fine stream of water, and in consequence it had become so much polluted that the tenants had been unable to use the water for domestic purposes, and even the cattle refused to drink it. The people were consequently obliged to cart every drop of water for their own use and that of their animals, and at a considerable expense. Furthermore, that "during the drought of last summer the Teviot was almost dry, and at Hawick there was scarcely any water to be seen, except what flowed along the mill-lade. In consequence, there was an immense accumulation of wool-dust and dyes in the pool immediately below the town of Hawick. It collected there for several weeks, when a heavy thunderstorm came on, and the river rose suddenly about eighteen inches, and the water came rushing down and swept away all the abominable accumulations. The result was that

fish in the river, even eels, from Hawick to Jedfoot, were killed and found lying dead in hundreds along the banks of the Teviot." The baneful effects of accumulations of filth, and the culpable neglect of sanitary authorities in suffering pollutions to arise in this way, is highly reprehensible and cannot be too strongly condemned. It was not until the visitation of the cholera in 1854 that the eyes of the inhabitants of this metropolis were opened to the fact that the rivers were liable to become disease-carriers and a means of spreading infection far and wide. It was for the first time clearly understood that the muddy Thames was receiving a deadly poison from the hundreds of sewers flowing into it, and people were not slow to comprehend that the very source of the prosperity and commercial greatness of the metropolis had become converted into a channel of cholera and fever.

It was also during the same memorable visitation of cholera palpably shown that in those localities where river-water was deficient in quantity and very bad in quality, the disease attained its greatest virulence and the death-rate was highest. Since then a great effort has been made to purify the Thames, but, owing to the rapid increase of population and greater desire to live out of town, the pollution of the river still goes on. Thames waters collected at their source in Gloucestershire are, no doubt, for a few miles pure, but when they reach the first populated town they no longer remain so, but become impregnated with sewage; and the river, as it passes through Maidenhead and on to Teddington—the in-take of the water companies—becomes a recipient of all kinds of refuse matters. A little further on, at Richmond, the incessant traffic of river steamers, barges, and small craft, all tend to keep the water in a state of perpetual commotion, and thus living and decaying organic matter is mingled and carried about with every ebb and flow of the tide; so much so, that it is no uncommon thing to find, quite high up the Thames, organisms which belong to brackish water, as well as chlorides in quantities much larger than can be acounted for by sewage contamination.

The floating population, almost constantly living on the Thames, together with the inhabitants residing on its banks, were in the last census estimated at 900,000 souls, who of course have a prescriptive right of polluting the river; it is therefore manifestly impossible to draw water free from contamination from such a source. Indeed, if Parliament were to pass an Act to compel the inhabitants of towns residing near the Thames to divert forthwith all sewage and drainage from the river, it would take at least fifty years to accomplish, and it is exceedingly doubtful whether it would be possible to stop percolation of "ground water," while the surface drainage and flood water must under any circumstances find its way to the bed of the river as the natural outlet. The in-take, storage, and filtration of water taken from a tidal and navigable river, it will be seen from the observations made, are matters of serious moment. Major Bolton's report of the condition of the Thames water in December last, and as supplied by the Chelsea Company, materially strengthens this view. He found the in-take at Seething was rapidly rising, and that water going into the filter beds of the company "was rendered thick and muddy, while that in the filter wells was opalescent and discoloured." This was accounted for by the condition of the Mole, a tributary of the Thames, which in wet weather is always turbid and very often dangerously polluted with fæcal matter; nevertheless, it is poured into the Thames, and, when an excessive rainfall occurs, sends down very large quantities of marl and clay, which cause the river at this point to become exceedingly dirty and muddy. Should it however unfortunately happen that typhoid fever were to break out in any of the numerous cottages or houses situated on the banks of the Mole, its specific poison would find its way down with the mud into the filter beds of the water companies, and thence be distributed to the metropolis. The Government inspector also found that the water of the Lambeth Water Company about the same time contained "living and moving organisms, while that of the Chelsea Company contained an abundance of such organisms with fragments of woollen and cotton fibres, clots of the mycelium of a fungus, and fibres of partly digested or decomposed meat." As a remedy for such horrible contaminations, it is simply proposed to remove the in-take a little higher up the river, and increase the size and number of the subsiding reservoirs and filter beds. It is also broadly stated by some persons, that self-purification of the river is constantly taking place; but so crude an idea has been dispelled by Professor Frankland, who emphatically declares that "there is no river in England long enough to completely oxygenate and purify contaminated water."* As to the oxygenating effect of vegetable life, this to me appears equally fallacious, for weeds certainly increase mud accumulations, afford protection to fish, and become the breeding ground of animal life of all kinds. In tropical climates we know that, from the rapidity and excessive growth of vegetable life, rivers become choked up, and malaria and death lurk about in places where we might expect to find only "streams of life." Those who believe in self-purification of rivers overlook the fact that there is an immense difference between clarification and purification. It is generally thought that if a glass of filtered water looks clear when held up to the light it is quite pure and wholesome. Some persons imagine that a moderate impregnation of earthy matter is in no way injurious to health; but, as the ova of fish and other organisms are better concealed in muddy water, it is impossible to say what danger to health may arise when a dirty mixture is taken by a thirsty man.

London, at the present time, is supplied with water by the agency of eight large companies. Most of them enjoy the privilege of drawing their water supply from contaminated sources. The Lambeth, the Southwark and Vauxhall, the Chelsea, the West Middlesex, and Grand Junction derive their water from the Thames. The East London now draws its supply from the Lea and the Thames. The New River is partly supplied by the Lea from a source

* The longest river in England, the Thames, is only 240 miles; and what is this compared with the mighty Missouri of North America, which is 4,500 miles in length.

above Ware and a variety of springs in the vicinity of Amwell and Herts, and from wells which discharge into the river; but the water-course, being open throughout the greater part of the way, admits of a good deal of contamination. A number of human beings, besides animals, are annually drowned in the New River as well as the Thames; and at some points it becomes the receptacle of garbage of every kind. Only one company offers its customers water fit to drink, namely, the Kent Company, which derives its supply wholly from deep wells sunk in the chalk.

Of the companies' waters drawn from rivers, it may be asserted that they are characterised on standing, by the formation of a deposit loaded with vegetable and animal organisms. Microscopical examination of the deposit shows that living animals, filariæ and larvæ of the most noxious kinds, abound in the cisterns of their customers, in their mains, and in the intervals between the filter-beds and the consumer, and it is therefore idle to look to engineering skill for their removal by present arrangements. It will therefore surprise no one to hear that from some of the house cisterns, in the best parts of the town of Richmond, were taken, during three months of last year, small fish, eels, and numerous noxious living animals. Experience proves, beyond a doubt, that Thames water can be made to look clearer and brighter by being taken into reservoirs and passed through beds of sand, gravel, and other materials, but only the coarser matters are arrested; while during summer and hot weather the filter beds become choked and coated on their surfaces by the accumulated remains of dead animal and vegetable matters, which the water as it passes through takes with it in solution, and thus becomes more fully charged with organic contaminations dangerous to health.

It is said that to take specimens of water from house cisterns for the purpose of reporting on its salubrity, is unfair towards the companies, but my reply is that when, notwithstanding attention to periodical cleaning, living organisms are found, it proves that they must have been brought in through the company's mains, and in no other way, and therefore should be taken as an evidence of contamination. A covered cistern, excluding as it does light and air, would certainly not be likely to assist in increasing vegetable or animal life. It is perfectly certain that the filtration of water, as carried out by the companies, merely separates or sifts out the coarser particles of organic matter, while the more subtle and dangerous organisms are held in solution or suspension. We have only to inquire into the formation of the filter bed to see this at a glance. One-third of the bulk of the most compactly-made filter bed consists of pores or holes, through which air, as well as water and the germs of animal life, easily pass. Thirty volumes of water can be poured into a vessel filled with a hundred parts of gravel and sand, without causing the vessel to overflow; indeed, substances far more compact and solid than filter beds contain numberless pores, whose combined volume forms a considerable portion of the bulk. The best and most compact sandstone used for building will absorb from five to six per cent. of its own weight of water. A brick will absorb half a pint of water; it is so porous, that without much effort on the part of the blower it can be blown through.* It is, then, a fallacy to suppose or believe that the coarse-grained materials of which filter beds are composed, will strain out minute organisms, thousands of which are contained in a single drop of water.

Another source of danger often overlooked is the percolation of the ground and surface waters into the bed of a river. At low water numbers of small streams will be seen oozing from the sides of the Thames bank, and flowing along over the mud into the stream. In this way a considerable quantity of polluted water finds a ready exit through the porous surface soil. Indeed, the more superficial stratum of earth is not so solid as it may look, consequently air, gases, and "ground-water," make their way through it to the natural source of drainage, the tidal course of the nearest river. The noxious

* To show this, it is necessary to make the four sides of the brick air-tight by coating them over with wax, leaving the two ends uncovered, and to the two small funnels (having pieces of india-rubber tubing and glass mouth-pieces attached) must be cemented (as shown in the accompanying drawing). Soap bubbles can quite easily be blown through a brick and tubing measuring six feet or more, showing the very porous nature of the material. This experiment was devised by Prof. Max von Pettenkofer, of Munich (see an excellent translation of his volume on "Cholera: how to prevent and resist it," by Dr. Hime, published by Bailliere, Tindall, and Cox, London). Nothing can be better calculated to show the security of brick-built drains, and how fallacious to suppose that percolation of sewage does not constantly take place.

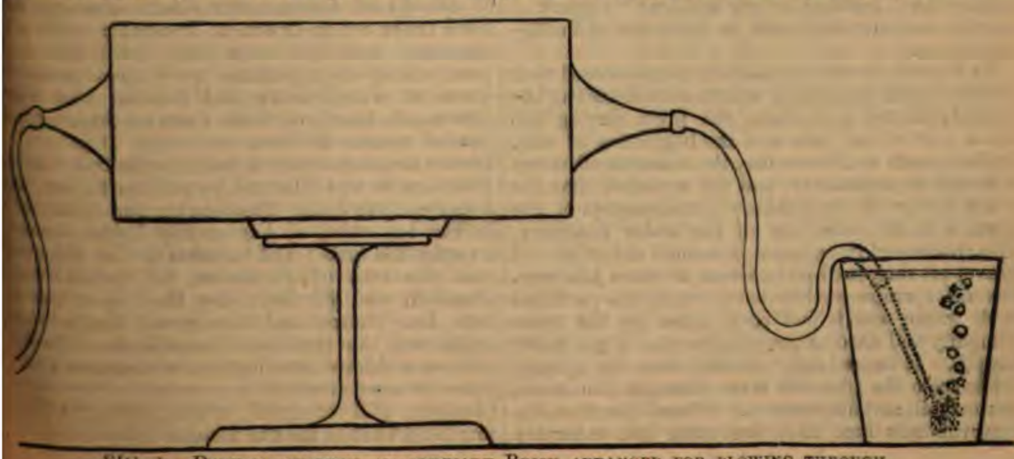


FIG. 1.—DIAGRAM SHOWING AN ORDINARY BRICK ARRANGED FOR BLOWING THROUGH.

state of the "ground-water" depends upon the sanitary surroundings of the population, the rainfall, the artificial drainage, and the higher or lower level of the district. The pressure of the atmosphere, the substratum, and its direction, also exercise no inconsiderable influence over the rate of percolation of the "ground-water." Such modes and sources of pollution are liable to be quite overlooked, and may therefore go on to a far greater extent than is generally suspected. As evidence of the peculiar insalubrity of "ground-water" percolation, a single fact will suffice. Mr. Bowie, who was examined by the committee which sat on the inquiry as to the "water supply to the metropolis," stated that his grounds were close to the River Lea, and that the water of the river supplied to his house during the prevalence of the potato disease gave out the peculiar odour of the fungus, and in a very marked manner, and that this was noticed by very many of his neighbours as well as himself. Unfortunately for the metropolis and for those who have no better water to drink, the presence of sewage poison does not necessarily give out an odour, nor does it impart a taste or colour sufficiently palpable to ordinary observers, consequently those who partake of it remain in ignorance of the danger to health. Nevertheless, it is notoriously true, as the Registrar-General has often pointed out, that "the water supply is one of the most potent of the influences in determining the health and death rate" of this and every other town of the kingdom.

Some idea of the magnitude of the evils of water pollution may be gathered from the reports of the Medical Department of the Local Government Board just published, in which it is stated that 141 towns have been visited, and inspections made into the cause of outbreaks of fever, &c., and in 104 instances the water supply was found more or less polluted; in some cases "seriously polluted; and, as at Warwick, where typhoid fever prevailed, "scandalously filthy."

In illustration of the fact stated, that typhoid fever, diarrhœa, diphtheria, &c., have their origin most frequently in poisoned and impure water, I will give a few brief particulars of some of the more recently traced outbreaks of "filth-fever," which plainly show, as the editor of the *Times* not inaptly observed, "that a cistern of impure water is often as perilous a thing in a house as a barrel of gunpowder," because at any moment "a spark of specific poison may create an explosion of malignant fever."

At Oxford, it will probably be remembered that several deaths from fever were reported among the undergraduates and about the town during the latter part of last year and the beginning of this. In the month of November, the *Lancet* sent down a special commissioner, and he reported that the worst feature in the sanitary arrangements of the town was the reservoir of the water company. This reservoir, it appears, is formed out of an old gravel pit dug out by the Great Western Railway. Several springs having been struck, the pit filled with water, and it was then taken by the water company and used as the chief source of the water supply. It turned out, however, that the springs set in from the adjacent river, through the loose, porous soil, and drift gravel. When, therefore, the reservoir was first used, the water was tolerably good, for Dr. Child, who examined it in 1866, reported of it, "so far as organic impurity is concerned, it is greatly better than that distributed in London by most of the metropolitan water companies." In 1873, however, Mr. Donkin made an analysis of the Oxford water, and stated that, "in its present state, it is at least twice as bad as the average London waters." To what, then, could this great increase of organic impurity in the water taken from this reservoir be attributed? The answer is tolerably clear—to the rapid growth and extension of the suburb of New Hincksey, and the increase of human habitations surrounding the reservoir. The suburb of Hincksey is situated on an intervening bed of drift gravel, and is utterly undrained, and the cesspools and middens with which the place abounds are placed in a direction in which the springs set. In this way organic impurities and excretory matters find their way through the loose and porous soil, and the town of Oxford is supplied with what the *Lancet* commissioner not inaptly described "as the diluted sewage of Hincksey." This foul water supply has been more lately denounced by Dr. Child and the late Professor Phillips in strong terms of reprobation. In 1870, Dr. Buchanan also visited Oxford, and reported on its sanitary condition; and then strongly urged upon the authorities to adopt some scheme that would prevent the water supplied to the town becoming contaminated at its source. The officer of health, Mr. A. Winkfield, in his report for 1873, speaks of the water supply in the following terms:—

> "I cannot but feel that it becomes a matter of even greater importance every day, that all chance of the reservoir getting fouled by the sewage of Hincksey should be removed as speedily as possible, and the question arises whether it would not be highly advantageous to have the water from this lake carefully filtered previously to its distribution throughout the district."

In January, however, of the present year, no effort was made to even filter this diluted sewage—this unutterably poisonous and repulsive Hincksey mixture. Neither do we hear of immediate steps being taken to stop the spread of "filth-fever" in the collegiate town of Oxford.

The sanitary history of Lewes affords another striking example of the diffusion of filth-fever through contaminated water. It appears by the report of Dr. Thorne, of the Medical Department of the Local Government Board, that typhoid fever broke out at Lewes in December, 1872, and continued into the early part of the following year. Sixty-four persons were then attacked, seven of whom died; and isolated cases were afterwards heard of from time to time, but no precise record of them was kept. One such is known to have occurred towards the end of May, 1874, and it was followed by another in the same house early in June. Towards the end of July and in the beginning of August the disease assumed an epidemic form; and between the 1st of August and the 14th of November, 447 persons were attacked, and 37 died. By the last-mentioned date Dr. Thorne had discovered the probable origin and the principal channels by which the fever was diffused, and had made recommendations which at once arrested its progress. A few cases, however, still occurred, which raised the total number to 486 in the five months between the 25th

of July and the 26th of December. The whole population of the place is only 10,753, and thus, in the course of the five months mentioned, no less than one person in every twenty-four of the inhabitants was stricken down. The mortality, which was one in thirteen, appeared so far to point to a copious dilution of the poison; but the report significantly says that "as yet" only thirty-seven cases had terminated fatally, obviously contemplating the possibility of an increased mortality after lingering illness. On the other hand, the diffusion was almost universal, extending to all parts of the town and affecting all classes, those who were well-to-do in a somewhat greater proportion than the poor. It was, however, clearly shown that the water supplied by the local water companies was the chief, if not the sole, channel of diffusion, and hence that it must have been infected with sewage containing typhoid excreta. When the fever was once present in several localities the source of subsequent infection was very evident, for it was found that some of the water-pipes were corroded and leaky, that others were left open over drains leading to the sewers, and the supply of water was intermittent. When the mains were empty of water, the vacant space was filled by anything which could get in, and there was abundant facility for the entrance of sewage air and absolute sewage. The cause of the commencement of the epidemic was far more difficult to determine, but this also was at last cleared up in a satisfactory manner. The water supplied by the company was obtained from three sources, two of which were beyond suspicion. The third source was the head water of a stream, called the "Cockshute," which empties itself, after a short course, into the tidal river Ouse, into which the sewers of Lewes fell. In July the water of the Ouse was very low, and then the ascending tide would roll back a considerable stream of sewage along the river bed, and also up the Cockshute. In order to protect their source of supply the water company had placed a valve across the Cockshute, to prevent the tide ascending higher than a certain point; and, as long as everything was in good working order, the protection thus given was said to be complete. It had pleased certain persons, however—presumably children playing in an adjacent meadow—to place some boulders of chalk in such a position that they prevented the tidal valve from closing, and these boulders were discovered by the medical officer of health at the end of August, when they presented appearances which left no reasonable doubt that they had been there for a considerable time. While they were so placed the tide would ascend freely, and if at any time a tide of sufficient height were flowing when water was being pumped from the river, the pumps could hardly fail to take up tidal water, or at least to take up the returning wave of sewage which the tide would drive before it. These conditions were fulfilled on the 13th of July, and there can be no doubt that on that day poisoned water was pumped into the reservoirs and sent out through all the mains of the company. Dr. Thorne reproduced the conditions experimentally during a high tide on the 11th of November, and obtained a turbid flow from the Ouse towards the head of the stream, and past the inlet of the waterworks, before the tide had reached its highest level. Such an occurrence on the 13th of July would fully account for the epidemic outbreak, and the conditions already mentioned would account as fully for its subsequent extension. In an old town like Lewes much time and much vigilance will be required in order to remove all such sources of danger; and, even with all practical care, the seeds of typhoid fever are far more readily sown than destroyed. The story of the tidal valve should teach the important lesson that no one must ever rely for the preservation of health upon construction alone. The best possible construction is liable to be deranged by accident or mischief, and systematic inspection is always necessary for safety.

The outbreak at Over Darwen is another case in point, and as it clearly conveys an accurate knowledge of the conditions under which the enteric, or filth-fever, may be produced, I venture to state the circumstances which led to the return of the fatal typhoid in October, 1874. The unwholesomeness of Over Darwen has long been notorious, and has more than once been the subject of official inquiry; and twice within the last twenty years (1861 and 1874) has filth-fever become suddenly and very fatally prevalent in the town. The history of the recent outbreak and of its source is as follows:—Over Darwen is a town lying in a valley, on a gravelly subsoil, among the Lancashire uplands, and it consisted at the last census of 4,225 houses, in which lived 21,273 persons. It draws its water supply from a rivulet two miles away from the town, and under conditions where no reason exists, except that of careless indifference, why the water should not be fairly good and pure. In reality, various impurities find (or until very lately found) their way into the water from farm-yards, cesspools, and other sources, in the township of Tockholes and elsewhere. The sewerage of the town is imperfect and insufficient (many streets are wholly undrained), and the arrangements for excrement and refuse disposal would appear to be almost unique in filthiness even among the many filthy arrangements of some northern towns. The excrement, as a rule, accumulates in cesspools, of which the possibility of their being cleansed may be estimated from the report made by Dr. Stevens of the local official arrangements for scavengers. He says:—

"My informer stated that it was the practice to empty three cesspools each night—that is, when they knew of any neighbouring farmer who would take the contents—and they carted the excrement in a semi-fluid state, and so poured it out on to the fields. Some farmers paid for the manure, and they were served first; some would only consent to take it without paying for it, and it often happened that no recipient could be found. Then no cesspool-emptying took place."

"On the 11th September, a young lady, suffering from fever, was brought to Darwen, to a house on the hill-side overlooking the town. She died there on the 12th October. It appears to have been from this one case that the great outbreak took its rise. The house is situated close to the sough by which the water for the town supply is conveyed into the service lodge. The excreta from this patient had been carried away by a water-closet, the drain from which discharged on to a meadow in front of the house, and passed in its course immediately over, and within two feet of the sough carrying the town water. The father of the deceased expressed himself as tolerably assured that no contamination of the water could have arisen by means of the drain in question, more particularly as the water company had some years since examined the drain channel here, and done what they con-

afforded necessary in order to secure the water against accidental pollution from this source.

"On examination of this drain, it was found to consist of a stone sough, leading from the front of the house to the other side of the road, whence it was continued by some earthen drain-pipes a few feet down a bank, and then onwards under a footway by means of an iron pipe, the end of which furthest from the house was left open, so that the sewage might flow out over the sloping meadow, stretching thence to the houses below. The part of this drain from the commencement of the iron terminal pipe is in relation with the public water-supply sough. On removing the earth above and around this portion of the drain, it appeared to have been fairly well laid, and between the iron pipe and the water sough some excellent puddling had been used, probably the work of the water company on the occasion of their inspection above referred to. This puddling, however, was confined to the space between the iron drain-pipe and the water sough. Further examination of the iron pipe showed it to be almost absolutely choked up, no fluid running through it except as the result of considerable pressure; and on similar examination of the earthen drain-pipes, they, too, were found to give little or no passage to sewage. This had evidently been the case for some time, and the sewage had found a way for itself outside and underneath the drain. Here the sewage had met the water sough, against which it had formed a kind of small cesspool, which was found to contain a quantity of black sewage matter. This matter, containing, be it remembered, the specifically diseased excrement of enteric fever, had, during the latter half of September, gained access to the interior of the water sough through faults in its imperfectly secured joints, and was, with the water, delivered to the houses of the town."*

Dr. Strange, Medical Officer of Health of the city of Worcester, carefully traced the outbreaks of typhoid fever in his district, to impurities, the chief among which appear to be the water. "In ninety-nine cases out of every hundred," he writes, "fever is bred of a poison generated in decomposing putrid animal matter, dissolved or suspended in water, and taken into the stomach in drinking. There, possibly, it multiplies and generates a true contagium, which, again added to drinking water, becomes, if this be already foul, a still more virulent poison, in a more active state than that which first induced the fever."

A few weeks since I received the report of the Officer of Health of the Selby Union. The town of Selby is situated in the centre of a wide alluvial plain, termed the Vale of York, and receives a constant and ample supply of pure water, obtained from artesian wells, sunk 336 feet into the new red sandstone. The yield of water, which appears to be inexhaustible, is excellent, and the health of the town population is reported as very good, but just outside the town there are groups of small houses and cottages, which although sparingly populated, are constantly infected by filth-fever. The water supply of the district is very inferior; it is drained from shallow-wells and a polluted river, and by a filthy arrangement of privies and pigsties, the earth, the air, and the water are poisoned. The result is, that fever and infectious diseases are very prevalent, and the mortality is proportionately heavy.

Dr. Parsons attributes the unhealthiness of this part of the Union chiefly to the water, which he says "is of very inferior quality, containing normally large quantities of animal and organic matters, which in some instances are derived from the alluvial or peaty soil, but more often from the percolation of filth of drains, privies, farmyards, &c.; such water has a yellowish colour and a mawkish taste; it is always very hard, for the acids produced by the oxidation or organic matters will dissolve out of the earth more lime (urate of soda), than pure water can take up. Among the samples of water from the Selby rural district analysed by me during the past year, the degree of hardness has varied from 14·5° to 52°, the solid matter in solution being respectively 32 and 160 grains per gallon. The first specimen was taken from a surface well in a sandy field at Burn. The second from a well at Bristow, with a manure heap three feet from its mouth. Two deaths, one from diarrhœa, and the other from diphtheria, occurred during the year among the poor people who used the water of this well."

When such wells are closed the inhabitants are driven to use the water from the river which flows through the district, and this is generally more or less muddy and contaminated with the sewage of the various towns situated on its banks, and in summer time abounds in living organisms.

Dr. Parsons laments the defective state of the law with regard to the water supply, for it puts very many difficulties in the way of rural sanitary authorities. At the present time, he observes, "an owner may be compelled to provide a proper supply of water to any house that is without one, if such supply can be had, 'at a rate not exceeding 2d. per week;' but the view expressed by the Local Government Board, in a correspondence which I had with them upon the subject, is, that the enactment referred to does not apply to cases where the water supply to a particular house can be obtained by digging a well." Again by the Sanitary Law Amendment Act of 1874, power is given to close polluted wells, but there is still no power to compel a landlord to cleanse, puddle and repair them, or to keep the pump in working order; so that, if he chooses to neglect his property, he may compel the occupants of his cottages to go without water, or drink that from polluted sources, rather than that he should be put to the expense of keeping the well in a sound and wholesome condition.

Typhoid, enteric, or filth-fever, however, is not the only fatal specific disease engendered by partaking of poison-polluted water. An epidemic of contagious sore throat, passing into scarlet-fever, diphtheria, and typhoid fever occurred last year at the Cripples' Home, and this was most clearly traced by Dr. Routh to the contaminated water supply. In this Home all the water drinkers were attacked, and many deaths took place, while, remarkably enough, the beer-drinkers escaped the fatal maladies. Diphtheria is a specific contagious disease, mostly produced by insanitary conditions; and, when several cases occur in close proximity to each other, may always be traced to sewer gases or contaminated water. Diphtheria, in fact, bears the same relation to these causes as does typhoid fever. However, in the Cripples' Home every care appears to have been taken to secure a pure drinking water, for "all water drunk by the inmates was received into a

* "It is noteworthy that the previous sudden outbreak of enteric fever in 1861 appears to have been brought about by some similar pollution of the public water supply. The disease was in that year traced from Withnell, a hamlet about four miles from Darwen, to Ryals Farm and the new village of Tockholes, and it was almost immediately after its appearance in Tockholes that the outbreak occurred in all parts of the town of Darwen. It has been before stated that the drainage of this very place, Tockholes, used habitually to run into the town's water."

rge funnel-shaped receptacle, kept constantly ll by a ball and tap in connection with the ater service, and the water was made to filter rough seven or eight layers (each layer about an h thick) of silver-sand and animal charcoal. Both se latter agents were made red-hot before being d, or at least put into crucibles to be purified of y retained impurities, vegetable and animal tters. The sand was also boiled in two or three antities of boiling water before being calcined. e water was made to fall from a height into a ervoir, and was then exceedingly well filtered d aerated, and to the taste appeared to be unceptionable." Nevertheless, with all this care d attention, it was ultimately discovered that faulty water-pipe admitted of a very slight wage contamination, and there was not a shadow a doubt that the filth-fever and diphtheria, ich had for months afflicted the inmates of the use, were due to the water, for the moment defective pipe was discovered, and the source contamination removed, the epidemic visitation appeared. Dr. Routh says, "I confess I was ch surprised, after all the care I had taken supply the house with good water, to learn the verse had been the result."

No peculiar, disagreeable flavour of the water s observed before the months of August and ptember, a period of the year when decomsition takes place more rapidly; but, although was more evident just at that time, it had obably existed for months before. It should be marked, however, that in this instance the most rupulous care had been taken to refilter the mpany's water; and I give this case since it rerkably bears out the opinion, before expressed, at by no process of filtration at present in general e will contaminated water be rendered much less xious or dangerously poisonous to those who ay partake of it, should it unfortunately contain ecific poison germs.

"The water-drinking disease" is well known in me parts of India, and, from a report made by r. Balfour to the Indian Government, we gather at it prevailed in the Tinnevelly and Madura tricts to an alarming extent during the hot nths of last year. Unfortunately enough, the ominent symptom was thirst, and, from the constant desire for water, the native people give the sease the name of *Tannir-hudi-Novu*. Mr. Boyle, e Head Assistant-Collector, reports sixty-seven ses of the disease; while the Collector of Madura akes mention of one hundred and twenty in the ighbourhood of Perumali on the Tinnevelly ontier; and the Zillah surgeon of Tinnevelly rnished a statement of fifty-two cases in the wn of Ettiapuram and thirteen deaths. The use of the disease was chiefly due to the scanty d bad water supply.

In the hot months of April, May, and June, a w people in other villages, who were seen by rst-class Hospital-Assistant Brown, and reported by him, *died from ordinary natural causes, to wit, fever and diarrhœa.* The drought being cessive, the tanks, wells, and channels became adually dried up, and the people, instead of ving pure water to drink, had to partake of mud d water, which, abounding in saline matter, cessarily inducing thirst, and, the thirst being ggravated by the undue consumption of new grain, a diarrhœa was the result, and very often proved fatal.

Mr. Brown stated to Mr. Lincoln that first the patients complained of a bitter taste in the mouth, then low fever came on, and necessarily thirst followed. The people wanted water to drink, but no water was to be had. Mr. Lincoln remarks: "This subject of water was of vital importance, and I beg to submit that it is one which the Local Fund Board should take up, and provide water for the poor population of the district, situated miles away," and adds, "The condition of these villages can easily be imagined when it is stated that there was no water for purposes of ablution."

On the Continent, it is almost universally admitted that the most prolific source of typhoid fever is impure potable water. Instances have greatly multiplied of late of the evils and dangers of an escape of sewer-gas into water-cisterns, and scarcely a medical man will deny that it is the great cause of the occurrence of epidemics of enteric "dirt fever" in our town population.

Typhoid fever is of comparatively modern growth amongst us; and whilst some attention has been bestowed upon drainage and improved modes of living, which doubtless have stamped out a terrible disease, known to our forefathers as plague, from sheer carelessness and indifference we have introduced the more modern and, I was about to add, more fashionable plague, properly designated "filth-disease." Upwards of a hundred thousand victims are annually offered up in England to this modern Moloch, and zymotic diseases arise out of neglected sanitary precautions; to a polluted or scanty water supply a very large proportion of such diseases as diarrhœa, dysentery, diphtheria, typhoid fever, &c., are due.

The extremely objectionable and highly dangerous nature of river pollution is, I venture to think, scarcely at all understood by the general public, or Parliament would have been moved to legislate for its prevention long ago. Indeed, its important bearing upon the health of town populations by those in charge of sanitation, whose duty it is to guard it by every means in their power, seem to be but very imperfectly recognised, otherwise we should not witness the lamentable amount of ignorance displayed, and put forth with a stamp of authority which is surprising if not remarkable. In December last a report of a professor of chemistry on the state of the Lock Katrine water, contains the following remarks:—"The water supply, although slightly yellowish and turbid, was as usual free from all traces of previous sewage, or animal contamination," and it was thereupon pronounced perfectly fit for use as a potable water. This opinion was, I have not the least doubt, arrived at without any attempt to show by the aid of the microscope whether this fine specimen of Glasgow turbid drinking water contained water-fleas or filariæ, and such a report must be utterly worthless, if intended to protect the public health. The Officer of Health of Birmingham also writes of the water supply:—"It is pretty clear"—whatever such an adjective may mean in connection with bad water, "but, again, I have to draw attention to the large amount of organic nitrogen which it contains." Why attempt to disguise the fact that Birmingham water contains an amount of impurity which

is highly dangerous. Dr. Frankland does not hesitate to call a spade a spade, and therefore unhesitatingly wrote of the Chelsea water, "It is muddy;" and of the Lambeth, "It is turbid, and contains living moving organisms, and both are unfit for dietetic purposes, and could not be used without serious risk to health." That the water supply of Birmingham is dangerous to health Dr. Balthazar Foster stated at the Sanitary Congress, in January:—"Birmingham was the worst town of all, except Liverpool and Sheffield, as regards the proportion of zymotic deaths to deaths from all causes." I specially refer to this, because these diseases are what we call, and call properly, "preventible diseases"—diseases which depend for their propagation on neglect of sanitary laws—diseases which admit of being partially (some would say very largely) stamped out." And the Medical Officer of the Privy Council in his report on the causes and prevalence of diarrhœa in Birmingham says, "The excess of mortality has been coincident with one or other of two definite local circumstances, the tainting of the atmosphere with the products of organic decomposition, and the habitual drinking of impure water." It is fairly estimated that over 140,000 people in the town of Birmingham are compelled to use water impregnated with sewage, and since they can obtain nothing better, the consequence is that the mortality among the infant population especially—children under five years of age—from diarrhœa, diphtheria, and fever, is something truly lamentable.

Of the lamentable amount of ignorance that too generally prevails on this question, I will trouble you with only a single example, taken from the columns of the *Surrey Comet* of May 8th, 1875. The learned counsel who represented the interests of the Southwark and Vauxhall Water Company, in an inquiry before the Government Commissioners, on the alleged deficient quantity and defective quality of the water supply of Richmond, said:—

"The quality of the water was a more important question than its deficiency, but what was the evidence of this? There was a fish brought, and an 'alligator' was produced; but these things did get into cisterns sometimes, and the liveliness of the animals spoke in favour of the quality of the water rather than otherwise. Whether the fishes got into the cisterns through the company's pipes, or whether little 'Jackey' put them in—(laughter)—he could not say; but at all events there was nothing serious in having a little fish in the cistern. If he found one in his he should rather be amused than otherwise, and should give it to his little grandson to play with. (Laughter.) Of course, the scientific evidence was more important. But, again, he said there was nothing in it to satisfy the Local Government Board that there was anything deleterious in the quality of the water supplied. The evidence of Dr. Frankland, Mr. Jabez Hogg, Dr. Thudichum, and others, caused him nothing but amusement. He read the evidence to his family, and the roars of laughter which followed were highly amusing. (Laughter.) He had not enjoyed such good spirits for a long time. If their statements were true, people would drink no water at all, and would have to abstain from animal food because the animals drank it * * * and then referring to the drawings of magnified animalcules that had been produced, Mr. Lloyd asked how the cyclops, the filaria, and bacteria were obtained? It was said that they were found in a drop of water, but this was not correct. They were the produce, as Dr. Letheby told them, not of a drop of water, but of 50,000 drops, from which these animals were cleverly extracted."

Now it is quite unnecessary for me to point out the mischievous folly of such talk, and if the learned counsel should see fit to crack his jokes over his own dinner table, and prefer, as he declared he would, to "drink the company's water, and stand the chance of swallowing bacteria," no one would for a moment think of interfering with the indulgence of so morbid a taste; but when he employs such nonsense as an argument for the use of polluted water, then I think we who know the danger to health have a right to protest against it.

It certainly can make no difference whatever whether I exhibit under the microscope the concentrated essence of 50,000 drops of water or of one drop, since it has been conclusively shown that if the specific poison of dirt-fever be present in the larger quantity of water which is one much below the average daily consumption of one man, woman, and child—quite enough will be swallowed to produce illness and endanger life; and, whatever Mr. Lloyd may think or say to the contrary, it certainly is no laughing matter to know that thousands of lives are annually sacrificed to drinking polluted water. The members of the profession to which I have the honour to belong engage in these inquiries from a simple desire to fulfil their duty to the public, and their only object in taking part in controversies on the public health is that they may extend their means of usefulness to mankind; and whether as regards the cure of individual cases of disease, or the larger and more important acts of preventative medicine, they feel that they better fulfil their duty to society by acting in the interests of the masses, and the most helpless of their fellow-creatures.

An overwhelming amount of evidence has been collected together, showing that water tainted with the specific poison of sewage is capable of producing a terrible amount of mortality. Two years ago certain infected cans of milk came from a farm to London; the contents of the cans were distributed in the usual way about Marylebone, and scarcely a household that partook of the milk escaped fever; this was followed by several deaths. On inquiry, it was discovered that the milk cans, before being filled and sent off, were washed out with sewage-contaminated water, and filth-fever was thus distributed far and wide among the inhabitants. The same deadly poison was for several days sold by a dairyman of Islington; but, in this instance, polluted water was used to adulterate the milk, and scatter broadcast dirt-fever. Among living organisms found largely mixed in river and sewage-contaminated water, the larvæ of entozoa and paramœcium among entomostraca, are most active agents in certain forms of disease. The latter are known to produce a remarkable feverish state, ending in death. At Dorpat, Sweden, an epidemic visitation of fever was traced to the presence of paramœcium, and numerous deaths occurred at the time. Fish, frogs, newts, and other animals have been killed by these noxious creatures, while other entomostraca, as cyclops and daphnia, multiply very rapidly, and often impart a red colour to the water. In Boston, America, the water during summer was much contaminated with water-fleas, and water-drinkers continually suffered from diarrhœa, dysentery, and other fatal disorders. The larvæ of filariæ, and fully developed filariæ, resemble the much-dreaded trichinia; and these are often conveyed into the intestinal canal by drinking water, while other forms of en-

[illegible] nematode worms find their way into the human stomach by the agency of the fish eaten. It is no uncommon thing to find some fresh-water and some salt-water fishes infested by such pests. The larvæ of some entozoa have been found in the eyes of fish, of turtle, and of the human being. Domestic poultry suffer from a destructive disease termed "the gapes," and the worm causing it kills eight-tenths of the young chickens, turkeys, &c., of poultry yards. Pheasants also suffer from the same kind of worm, which, having once got possession of the throat, clings to the loose mucous membrane, breeds rapidly, and in a few days the birds die from choking.

The embryos of trichinia are taken into the stomach of the pig, no doubt with dirty water and garbage, and those who eat of the flesh of the infested animal die a lingering death from a disease termed Trichinosis. The eggs of the trichinia are about the $\frac{1}{1250}$th of an inch in size, and a single worm will produce thousands of eggs and young worms every week. Therefore by far the most dangerous contamination to which water is liable is sewage mixed with organic matter. That Thames water is so contaminated is beyond a question. The organic impurities are both dead and living, vegetable and animal. That portion which is dissolved or suspended is the most insidious. Organic matter has a chemical condition wholly distinct from that of water, and its chief characteristic is that it contains nitrogen, and this is greater in amount in animal than in vegetable productions.

The test tube of the chemist will rightly estimate the percentage of nitrogenous matter in water; but it will not tell us anything about the vegetable and animal organisms which absorb the greater portion of the nitrogenous matter into their bodies. The microscope alone will show this, and also their intimate characteristics; without it, indeed, the significance of such bodies will be missed, or not rightly appreciated. When vegetable matter abounds in water it generally indicates a high degree of impurity; but when animal life abounds to any extent, a much higher degree of impurity will be indicated, because all animal life requires a much larger amount of nitrogenised matter to support existence.*

The absence, however, of organic productions, animal or vegetable, does not afford a certain and reliable proof of the purity of water, because there are other conditions and elements necessary for the development of organic life, as air, light, and warmth. Dissolved impurities derived from decaying or dead animal or vegetable matters may be more dangerous to health than living, and in the case of the Thames sewage impurities are frequently found in solution. A contamination of the kind cannot easily be kept out of a river which travels miles through a densely populated country, and the points of entrance of which are almost unknown, for the mouths of sewers below Teddington-lock, even at low water mark, are never uncovered, and of course above the lock their existence, from never being laid bare, must be forgotten. Suspended impurities are also derived from the surface and ground water, a considerable quantity of which is carried off the surface of roads, manured fields, &c., by rains and floods into the bed of the river. These suspended impurities quickly decay and add considerably to the general mass of dirty filthy matters. The dissolved impurities furnish the means of growth and existence to low forms of plant life, algæ and fungi, which together with a certain portion of suspended matters serve as food for organised animal bodies. I maintain, therefore, that water charged with animal organisms is dangerous, because it contains dissolved and suspended sewage matter, from which animal organisms alone derive their sustenance. It is capable of demonstration that by no power of filtration conducted on a large scale by water companies can any of the dissolved impurities I have named be removed. Of the suspended matters, only the very coarsest portions will be strained off, while the minuter vegetable and animal microscopic forms, spores, seeds, and ova will all quite easily run through most of the filters in ordinary use.

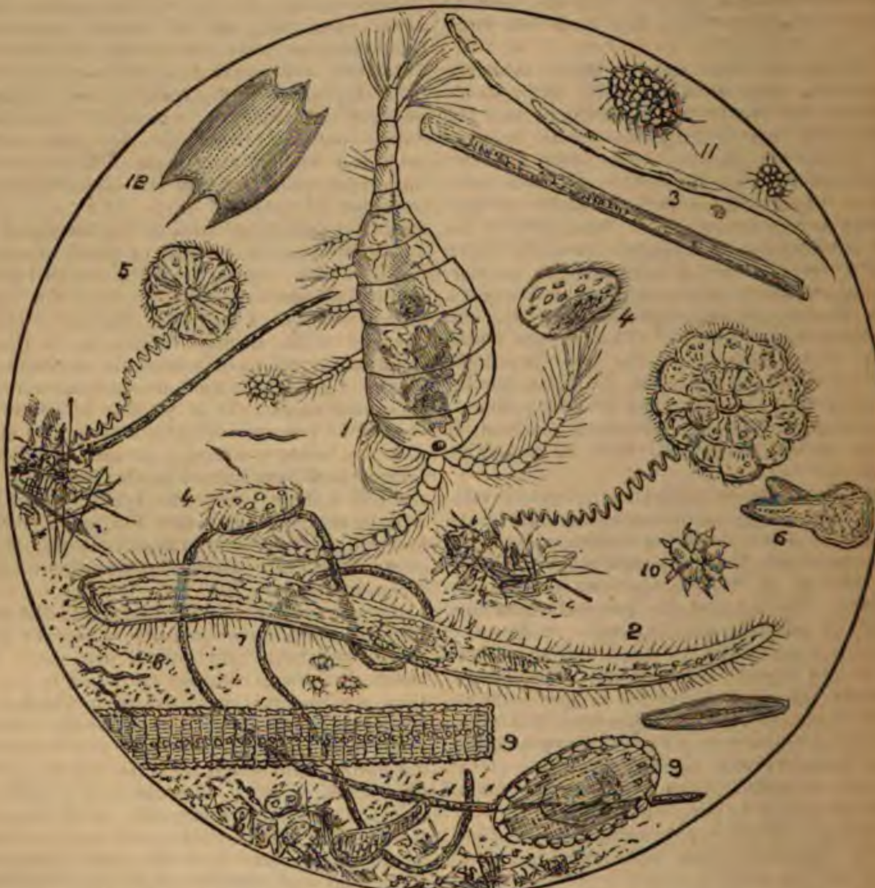
Almost every gallon of river water distributed to London contains a quantity of spores, seeds, or ova of vegetable and animal organisms, and if a bottle of water is allowed to stand by for a short time, a sediment is thrown down in which a number of creatures will be discovered by the microscope. Such water is undoubtedly unwholesome and dangerous, whether it contains the actual carriers of disease or not. If it contains the elements of disease it is doubly dangerous; if it does not contain matter which may cause disease, it is still dangerous, because it is the general experience of those who study health and disease, that the drinking of impure water predisposes drinkers to many disorders and diseases, which, although they may not be actually produced by the water, enables certain diseases to seize upon its victims, because such persons are what is termed "predisposed," that is, deteriorated in health by this impure water. For the same reason the liability to illness is increased, so that more persons become sick in a population drinking dirty water than in another population drinking clean and pure water. It is also seen that in a population drinking dirty water more persons die of one and the same sickness than in a population drinking pure water; in other words, the consumption by a population of contaminated water, such as that of the Thames, increases both its sickness and its mortality. I have more particularly dwelt upon the Thames because during three months of last year I made repeated

* I may briefly observe, with regard to starchy matters held in suspension, which form a small portion of the sediment of all river waters, that they can scarcely be rightly estimated by a chemical analysis of the water, since it becomes a part of the residual ash, and its importance as an element of contamination is liable to be overlooked. Starch enters largely into the food of all animals; and it is assumed, therefore, that the albumenised granules must have been conveyed into water with animal excreta. This is, then, a serious contamination, and one which can be more readily detected by the microscope than by the test tube. By the aid of the polarised light, starch grains are beautifully brought into view, and the curious black cross, which seems to split them up, renders these bodies remarkable objects; and I am able to show this under one of the microscopes on the table. Professors Wanklyn and Bartlett are of opinion that properly conducted household filtration will separate solids held in solution, while it exerts a chemical effect in the albuminoid ammonia in water; but although the silicated carbon or the magnetic oxide exert a chemical or oxidising, as well as a mechanical effect upon water passed through it, it by no means follows that sewage water can be can be made innocuous, for, as I have already said, the contagium of diseases, from its extreme minuteness, and from its possessing a specific gravity only very slightly differing from that of the fluid in which it is suspended, will find its way wherever water will pass. It is obvious, therefore, that a far better filtering process is required for the separation of contagium that any yet devised.

microscopical examinations of the water drawn from the mains and taken from cisterns of the Southwark and Vauxhall Water Company, and in every instance I found the specimens coloured with a considerable dirty sediment, and numbers of organisms. The latter consisted of living and decaying vegetable bodies, as amœbæ, actinophys-sol, cercomonas, rotifers, paramœcium, larvæ of filariæ, and fully-developed filariæ, resembling the much-dreaded trichiniæ, when they pierce the tissues to get into the muscles. There were also quantities of fragments of animal and vegetable tissue, starch granules, commonly brought into the river with excrementitious refuse, and myriads of the terrible *bacteria*. The latter are looked upon by Mr. Simon as the cause of filth-fever, whilst the spirileum is a fungus supposed to produce relapsing fever. Some of the bodies are shown in the accompanying drawing.

Very great importance has of late been attached

FIG. 2.



1. Cyclops quadricornis. 2. Larva of filaria. 3. Anguillula. 4. Paramœcium. 5. Colonies of vorticellæ. 6. Amœba. 7. Oscillaria. 8. Bacteria. 9 and 10. Diatomaceæ and desmidaceæ. 11. Larvæ. 12. Scale of moth.

to those very minute organisms, *bacteria;* and medical men have assigned a variety of names to them as specifically connecting them with various forms of disease, as *Micrococcus diphtheriticus*, *Micrococcus vaccinia*, *Microzymes*, &c. The form of these bodies are either ovoid or staff-shaped, and they assume under the microscope a rapid spiral or undulating motion—an axial rotation of a remarkable character. So very microscopic are they, that no power has yet been made which will show whether they possess structure. Their form only can be seen, and we know they rapidly multiply; their rate of increase appears limited only by the supply of food and the temperature of the body or organ in which they locate themselves. From observation and calculation it has been ascertained that, under favourable circumstances, a single bacterium will produce 16,777,220 individuals every twenty-four hours. The bodies of these minute living bodies are composed of a peculiar substance, a kind of vegetable cellulose which resists the action of acid and alkalies and great variations of temperature. They live in colonies protected by a kind of gelatinous covering, for union with them is strength. In certain albuminoid compounds, almost colourless, *bacteria* multiply so rapidly that in a few hours they impart an intense indigo-blue colour to them. These atoms are the active agents in putrefactive changes; and, having gained access to certain internal organs of

the human body, they proceed to leaven the whole mass of blood. A drop of putrid water, Ehrenberg calculates, will contain as many *bacteria* as there are human beings on the face of the globe! What, then, must be the size of the ova, or germs, of these organisms? and what mode of filtration can we devise to sift them out of water that contains them? Is it possible to do so? And what does the clumsy process adopted by water companies effect in this way?

I do not wish it to be understood that I have traced typhoid, or dirt fever, to the presence of these minute organisms, *bacteria*, but Mr. Simon, in his last or supplementary report states, with regard to the production of enteric, or typhoid fever, that a presumption, which has of late been growing more positive and precise, "has received an increase which may be of critical importance in a discovery which seems to give us for the first time an ocular test of the contagion of enteric fever in the discovery of microscopical forms, apparently of the lowest vegetable life, multiplying to innumerable swarms in the intestinal tissues of the sick, penetrating on the one hand from the mucous surface into the general system of the patient, and contributory, on the other hand, with whatever infective power they represent to the bowel contents which have presently to pass forth from him. This discovery of the microphyte of typhoid fever is the work of Dr. Klein. Adverting then summarily, in an administrative point of view, to the present state of medical knowledge and opinion, as to the way in which enteric fever spreads its infection in this country, I would say that it is difficult to conceive, in regard to the causation of disease in a civilised community, any physical picture more loathsome than that which is here suggested; that apparently of all the diseases which are attributable to filth this, as an administrative scandal, may be proclaimed as the very type and quintessence, that although sometimes by covert processes, which I will hereafter explain, yet far oftener in the most glaring way, it apparently has an invariable source, as that which of filth is the filthiest; that apparently its infection runs its course as with successive inoculations from man to man, by instrumentality of the molecules of excrement which man's filthiness lets mingle in his air and food and water."* I am able to show you what these bodies, *bacteria*, are like, under one of the microscopes, which Mr. Browning has been good enough to place on the table.

It is said that horses and cattle will with immunity drink river and other contaminated water, and indeed even prefer it; but more recently it has been discovered, in common with human beings, they suffer from such cause. A highly malignant and contagious disease, "splenic fever," or "milzbrand," distinguished by the extreme rapidity of its course and fatal consequences, attacks horses and other animals. The chief characteristic of the fever is the presence of immense numbers of *bacteria* in the blood, with marked peculiarities, which are regarded as specific. The disease is localised in the internal organs, the stomach, &c., and after death rod-like bodies are found in these situations, as in the human being. In the cattle plague also the blood of the animals swarm with these extremely minute bodies, and they are universally present in the textures and juices, and are therefore believed to be the *contagium* of the disease; indeed, as Mr. Simon remarks, we seem to have obtained some positive knowledge "with regard to the respective contagion and respective morbid processes of typhoid fever, diphtheria, erysipelas, relapsing fever, and the splenic fever of veterinary practice." It has also been satisfactorily shown that in the blood and vital organs of persons who die by septic poisoning, *bacteria* abound and plug up the smaller vessels; and, therefore, if actually not proved to be the cause of death, they are evidently active agents in the disease. It is my belief, however, that the germs of fevers will ultimately be proved to be far more minute than *bacteria*, and for this reason, the very smallest dose of sewage, containing liquid organisms—a homœopathic dose—may be quite sufficient to destroy life.

It will scarcely be denied that the water supply of the metropolis, compared with many other towns that derive a supply from subterranean sources, stands low in the scale of purity and wholesomeness, and it is quite certain that no remedy for existing evils will be effectual or really beneficial that stops short of providing a new source of supply. The question then arises, to whom should we look to provide a remedy? The Board of Works has already wasted thousands of pounds in trying to find one, and in the preparation of Water Bills, since consigned to the place of good intentions. The President of the Local Government Board, when appealed to in and out of the House of Commons, refused to pledge himself on the subject, and intimated that the evil day must be put off by another Royal Commission extending over years of precious time, for it is not yet forgotten that the Royal Commission of 1866 disappointed the hopes of the public. This inquiry into the means of obtaining additional supplies of unpolluted and wholesome water for the metropolis and other large towns was a miserable failure, for, after an investigation extending over a period of two and a-half years, no good came of it. Indeed, the report appears to have been made in the interest of water companies rather than that of the public. In one part of the report the Commissioners state, "That with living microscopic organisms chemistry is unable to deal, and therefore other modes of examination are needed," but they persistently refused to have recourse to "other modes of examination," and altogether ignored the aid of the microscope, which would have assisted them in coming to a right conclusion on the character and wholesomeness of the water supply of towns, consequently much of the report, founded as it is upon insufficient data, is very properly regarded as worthless, and as containing grave inaccuracies.*

* Supplementary Report to the Local Government Board on some recent inquiries under the Public Health Act, 1858. New series. No. 2, page 14.

* It is a subject of congratulation to find that since my paper was put into the printer's hands the Government has shown signs of a desire to grapple with a portion of the evils of river pollution. The Marquis of Salisbury has introduced a Bill into the House of Lords on the subject, and in doing so he said, "The grievance of the present state of our rivers is a real one, and the necessity of applying a remedy is a pressing one." He offered to the House a few instances of the alarming amount of river pollution," such as "The Clyde at Glasgow, the stench from which as you pass along produces sickness." A clergyman living near a stream which passes St. Helen's, com-

The great evils of the present water supply will not be abated by any half-measures, or by a Royal Commission. Nothing short of having recourse to subterranean stores, artesian wells sunk into the chalk or sandstone far out of the reach of sewage contamination, will, in my opinion, afford the shadow of a remedy. The large supplies of water stored up in the deepest recesses of the earth, as pointed out by Mr. Homersham in a valuable and interesting paper read in this room twenty years ago, will alone remove the evils under which we labour. Such water stores are absolutely pure and brilliant. They are entirely free from all suspended matters, from decaying organic substances, and fæcal refuse. Neither spores, seeds, fungi, ova, nor the larvæ of animalcules can possibly penetrate to the deep recesses of the earth. Deep well water contains probably the inorganic products of the thunderstorm of a century or more ago—a little lime dissolved out of the chalk as it passes through the rock, a little chloride of sodium, washed out of the sea ages gone by and deposited in the soil, but it contains no ammonia in organic combination, and no albuminoid ammonia. It contains what we prefer, since it imparts a sparkling briskness to the water, carbonic acid and air. It is, therefore, absolutely safe to drink, and it is also indisputably wholesome, and perfectly fit for all the ordinary purposes of life, both domestic and dietetic.

plains that the stench is not only offensive out of doors but penetrates to the rooms of his house, and turns the kitchen copper utensils to a blue colour. The river at Manchester is in an execrable condition, and the Mersey is as bad as the Calder, with which a manufacturer wrote a letter as legible as if he had used ink." The Calder receives the sewage of Wakefield, nevertheless the Water Company draws its supply about a mile below the point where the larger part of the sewage enters the river. It must be noticed also that the Calder, although navigable, is as narrow as a canal as it passes Wakefield, and in addition to sewage it is the receptacle of the refuse of many manufacturing works. Last year I made several examinations of the Wakefield water, and found them exceedingly bad and abounding in living organisms. The accompanying drawing shows the appearance of a few drops of Wakefield water under the microscope. That such sewage could not only be rendered innocuous, but also be made a source of wealth to the country, has, I believe, been proved, and therefore it is high time that the Legislature should preserve to all her Majesty's subjects the right of using the water of our rivers, while no one shall be permitted to foul and poison them for purposes of his own, or under any circumstances.

FIG. 3.

MICROSCOPICAL DRAWING OF THE SEDIMENT OF WAKEFIELD WATER, MAGNIFIED FROM 50 TO 250 DIAMETERS.

1. Young of Daphnia. 2. Chilodon. 3. Paramœcium. 4. Acineria incurvata. 5. Paranema globulosa. 6. Cercomonas. 7. A Cluster of Actinophrys sol. 8 and 9. Amœbæ. 10. Protococcus pluvialis. 11. Diatoms various. 12. Desmids various. 13. Confervæ. 14. Spores of fungi. 15. Fragments of vegetable tissue. 16. Amœba diffluens. 17. Cyclops quadricornis. 18. Cypris. 19. Anguillula fluviatilis.

DISCUSSION.

The Chairman said there were many points in Mr. Hogg's interesting paper in which he could not concur, though it would take too long to state his own views on the matter in detail. He would only say that if the animalcules produced such diseases as had been described, it was astonishing that the human family remained on the surface of the globe. The deep waters must be pure when they first come up, but the purer a water the more rapidly it imbibed impurity, and it could not be exposed to the atmosphere long without taking from it those spores which were always floating about in myriads, and which were taken into the lungs at every inspiration, so that life must after all be endured subject to such contingencies. With regard to contaminated waters in this country, the comparison ought to be fairly stated, and it would be found that the mortality was much higher in Glasgow, drawing its water supply from Loch Katrine, of boasted purity, than in Birmingham; and the latter town, even at the time when it was drinking the water which drained from Bilston, where the cholera was raging, did not suffer from the disease. With regard to India, he admitted that the dreadful diseases which had been described did prevail there, but it must be remembered that the water which was drunk in that country was foul to a degree utterly undreamt of in England; compared with it the Thames below London-bridge would be pure. It was taken from the foul waters of rivers and canals in which the carcases of dead bodies floated by thousands. In one province, the water supply of which was inquired into by the Army Sanitary Commission, of which he was a member, it appeared that 700 human corpses had been taken from the water courses in one year. One of the readiest modes of committing suicide in India was to jump into a tank or down a well, and from the bottom of such receptacles sometimes bushels of human bones had been taken. It was no wonder, under such circumstances, that the people suffered from Delhi sore and various entozoic forms of disease, but it was of no use setting up a bugbear to frighten people unnecessarily. With regard to soft water, Sir John Pringle, in his account of the invasion of the Highlands, stated that he found his men suffered from fluxes and similar diseases when drinking the pure water of the lakes, and he (the Chairman) had found the same water bring on spasms. The fact was that a change of water often caused inconvenience and sometimes danger to a person in delicate health.

Dr. Bartlett said Mr. Hogg had commenced by dividing his subject admirably into two heads, river pollution and the supply of water to towns, under the former taking the various sources of pollution, which were also shown on the admirable map of Dr. Frankland. With regard to the importance of chemical pollution, he must mention that he had recently analysed the refuse from a chemical works in the neighbourhood of Manchester, and found that from one to four tons of arsenious compounds per diem were flowing into the stream. Nothing could exaggerate the evil of such a state of things. The pollution of rivers was perhaps the least dangerous form in which the evils of town drainage manifested itself, because proper means might be taken to render the sewers themselves harmless; but the evil was very great in the case of ponds, canals, and receptacles of various kinds, in which there was no opportunity for the oxidising process to go on. He had had occasion to examine the water of the Regent's-canal, into which the drainage from the Zoological-gardens, a number of houses, and some stables was permitted to flow, and there, instead of there being any current of water, it was customary in dry seasons even to pump back the water through the locks so that none might be lost, and it was often very offensive indeed. Waters of this sort, even if not used for drinking purposes, became highly dangerous when the water became low, and the banks, covered with many noxious matters, were exposed to putrefaction in the open air. Turning to the question of drinking water, there was no doubt that the specific poisons referred to would set up disease in persons at all susceptible to their action, and it was no argument that they did not do so—that others not so susceptible escaped. Water in which fish had been killed by chlorine from paper mills was certainly not fit for drinking or domestic purposes, but it sometimes happened that chemical refuse, though of an offensive odour, exercised an antiseptic action on impurities previously present, as he had found in examining the Regent's-canal close to the Zoological-gardens, and at Limehouse Hole, after it had passed certain gas and other works. The danger of deep wells had hardly been taken sufficiently into account, for he had had samples which were quite unfit for use on account of the lead compounds contained in them, derived from the action of the mineral ingredients on the lead pipes. There had been several instances where people drinking such water had suffered from unmistakable lead poisoning. It might be said that gutta-percha or iron pipes might be used, but the former rapidly wore out, and the latter rusted away. In his own house at Norwood he had suffered from the badness of the water supplied, especially on one occasion when, from a defect in the pipes, there was a direct contamination from the sewer. He could not agree with what he had understood Mr. Hogg to say, that filtration would produce no great diminution in the amount of animal organic matter productive of injurious influences, because he knew of more than one filter which did oxidise and improve the water to a very great extent, and did, in fact, remove everything noxious from ordinary water, unless it were specific germs of disease which were so minute that they could not be detected either before or after filtration, and as to which, therefore, it was impossible to speak.

Mr. Adam Scott, remarking on the fact alluded to by Mr. Hogg, that during the last fifty years there had been a great increase in a certain class of diseases, said it was always well in such cases to give the exact figures. He found from the Registrar-General's returns that for the five years ending 1842 the average number of deaths per million per annum of diarrhœa, dysentery, and cholera was 298; but in the five years ending 1871 the average number per million had increased to 1,200. It might be that in the earlier years the returns were not quite so exact, but that would not account for so great a difference, and one naturally therefore was led to consider what could be the cause of such a change. Now it appeared that since the former date there had been an immense development throughout the country of the system of water flushing as a means of carrying sewage, and without going so far as to say that this was the cause, he thought it was one of the causes at least. It was found in Edinburgh that in the old portion of the town, where from the character of the houses it was not practicable to introduce modern appliances, typhoid and diphtheria were comparatively unknown, whilst in the new town, where the houses were fitted with all the conveniences of modern times, they were never absent. The question of river pollution was looked at in two aspects, by the general public, who thought principally of the beauty of the stream, and by those who thought mainly of its effect on the public health. It was impossible by any precipitation or filtration to destroy the contagious or germ matter of disease after it had got into the river, and therefore he contended that the evil should be attacked earlier, and, following the vigorous measures which had been adopted with regard to the cattle plague, he would sternly forbid any pollution of either air, soil, or water by excremental matter. In conclusion, he advised all who were interested in this question to read the reports of the medical officers to the boards of health.

Mr. Hale said he did not drink much water, but what he did he took care should be boiled first, to avoid any danger.

Professor Wanklyn agreed that deep spring water was absolutely free from organic matter, and showed no trace of any matter capable of yielding ammonia by oxidation. But these waters were pure simply because they had been filtered, and it was quite possible to imitate the same process on a small scale. He had put Thames water through a filter, and it would come out like what the West Middlesex Company supplied; by filtering it a second time, it would resemble that supplied by the Kent Company; and by repeating the process a third time, you could get water absolutely pure, and free from all nitrogenous organic matter. It was quite a mistake to suppose that the large filters used by the water companies had only a mechanical action; they had a powerful chemical action also. The organic matter adhered to the material of the filter, and, by-and-bye, the oxygen dissolved in the water oxidised it. Indeed, although it would be rather a cumbrous and tedious process, he could actually perform analyses by the use of a filter, as well as by oxidising materials in the presence of caustic potash. If, therefore, you took polluted river water, let it subside, and then filtered it, you could obtain it sufficiently pure for all practical purposes. Some years ago the late Dr. Chapman, Mr. Smith, and himself, examined the water supplies all over the country, and they found almost every description of water when fairly filtered soon obtained a high state of purity; thus the Thames water when properly filtered was as good as that of Glasgow, if not better. This was an important point to keep in view, or else the country might spend millions of money in getting water from deep wells, when it could be obtained sufficiently good from any river. Years ago he insisted on the purity of deep spring water, but it was often so impregnated with mineral matter as to be very troublesome for continual use. He had recently examined some deep spring water, which it was proposed to supply to a large town; it was beautifully pure, but it contained 25 grains of ordinary sulphate of magnesium per gallon; and he was happy to say the scheme was not sanctioned by Parliament. In his view the organic matter present in water could be dealt with more readily than the inorganic, and to the presence of the latter, therefore, attention should be more directed.

Mr. Homersham expressed his entire dissent from the view of the last speaker. The inorganic matter was dealt with daily at seven or eight different works, and there was no difficulty in getting bi-carbonate of lime out of water; but he utterly denied that you could deal with the organic matter. Natural filtration, and that practised by the water companies were two totally different things; in the former case the water percolated through the chalk for 300 to 500 feet, and took half a century in doing so, whilst every change of barometrical pressure exposed it to the oxidising action of the air. No doubt spring water often contained some mineral matter, but this could be removed by an easy process, leaving only 2½ or 4½ degrees of hardnesss. On the other hand, he did not know of any system by which these living organisms could be got rid of. The filtration process, as practised by the water companies, was one of the most horrible things to be conceived. The filter bed was formed of gravel and coarse river sand, for if the sand were too fine the water would not run through it; in passing through, the water left on the surface of the sand portions of undigested food, fæcal matter, leaves of trees, and all sorts of things, according to the season; in the summer the temperature over these shallow beds rose to 68 deg. or 78 deg., and as the water passed through a stratum of decomposing organic matter, it dissolved it, and was often worse after filtering than before; in fact, he knew some of the workmen who would rather drink the water as it came from the river than after it had passed through the filter beds. Wh[en] the sand got choked up, a layer had to be taken [off] the top, and it was then so offensive that only those ac[customed] to the work could stand it, and they we[re] allowed gin or other spirits during the operation.

Dr. Bartlett desired to corroborate the truth of Pr[o]fessor Wanklyn's statement.

The Chairman reminded Mr. Homersham that th[e] water supplied by the various companies was examin[ed] each month by two most eminent chemists, whose r[e]ports were published in the newspapers, and therefore could not escape detection if filtration had such a det[ri]mental effect upon it. He had spoken of removing [bi]carbonate of lime, but Mr. Wanklyn referred to sulph[ate] of magnesium, which, as far as he knew, could not [be] removed.

Mr. Hogg, in reply, said several of the gentlemen h[ad] answered one another, and he had not therefore m[uch] more to say. He agreed with the Chairman that th[ey] had much to fear if all were true which was stated [of] the water in the admirable reports to which he had [re]ferred. That greater evils did not result was attribut[able] to the fact that the greater portion of water which [was] drunk was in the shape of tea or coffee, or after it h[ad] been boiled, so as to destroy the various ingredients; [but] amongst the masses of the poor, who had no mean[s of] boiling it, a large quantity was drunk just as it c[ame] from the water companies, and it was amongst th[em] that the deaths occurred. The mortality of Birmin[g]ham, Glasgow, and many other large towns was m[uch] higher than London, which he attributed in part to [a] bad water supply. At the date of Sir J. Pringle's [ex]pedition, very little was known of water, but with [re]gard to India he had lately received a letter from [an] officer, stating that his troops were constantly suff[ering] from diarrhœa, dysentery, and similar diseases, whe[n on] the march, from drinking impure water, and that [the] commanding officer, who was a water drinker, had [been] several times attacked with cholera. There wa[s no] doubt that several of the filters in use had a chem[ical] action, and the silicated filter, which it was [said] would separate contaminations of lead, was a good [one], but it was too porous, and would therefore allow [the] passage of *bacteria*. He would remind his hearers, h[ow]ever, of what had been recently stated by Dr. Frankl[and], that the filtration as ordinarily practised by the wa[ter] companies was nearly valueless, and that the only pro[cess] which could be depended on was intermittent filtra[tion]. It appeared that a filter became choked in thirty ho[urs], so that unless the action was discontinued, and the [sur]face exposed to air, it was really worthless. This w[as] ordinarily practised in domestic filters, and prob[ably] accounted for their success, and it was a most import[ant] fact to be kept in mind.

The Chairman, in proposing a vote of thanks to M[r.] Hogg, said that filtration, when properly practised [by] all the water companies, was intermittent. They h[ad] been pinched for room, but they had been lately ext[end]ing their filtering areas, and most of them had n[ow a] surplus sufficient to allow of intermittent filtration, a[nd] the others soon would have.

The vote of thanks was passed unanimously, and [the] proceedings terminated.

Chloroform-vapour has been lately found b[y a] chemist at Antwerp, to act with great rapidity in exting[uish]ing the flame of the vapour of petroleum. Combust[ible] gases mixed with chloroform-vapour immediately lost th[eir] explosive properties, and even their combustibility. It [is] suggested that chloroform might be advantageously employ[ed] upon a large scale for extinguishing fires in petroleum stor[es] and on board ship.

The quantity of sandal-wood sold in the pro[vinces] of Mysore and Curg during the year 1872-73 was [...] tons, valued at £27,896.

MISCELLANEOUS.

GOVERNMENT AND LOCAL ART MUSEUMS.

PUTATION TO HIS GRACE THE DUKE OF RICHMOND.

The Council thought it right, considering the at and enduring interest which the Society in the establishment of local museums of nce and art, to take measures for obtaining a l report of what occurred at the deputation ch met to advocate the claims of the Midland nties Museum, to be established on the ruins Nottingham Castle, which was burnt in the form riots in 1831.

A deputation, consisting of the following gentle-n, waited upon his Grace the Duke of Richmond, the Council-office, Whitehall, on Tuesday last, the subject of Government and Local Art Mu-ms:—Mr. J. E. Denison, M.P. (Nottingham); Samuel Isaac, M.P. (Nottingham); Mr. C. Smith, M.P. (North Notts); Major Cust, P. (Grantham); Colonel Chaplin, M.P. (Lin-n); Mr. Earp, M.P. (Newark); Mr. Fol-mbe, M.P.; Mr. Hildyard, M.P.; Mr. Bass, P.; Mr. Storr, M.P.; Mr. S. Morley, M.P.; W. Lambert (Mayor of Nottingham), Alder-n Ward, Alderman Stacey, and Mr. O. Far-thm.

Mr. J. E. Denison, M.P., in introducing the deputation, he desired to point out that the subject upon which deputation had come was one of interest, not only to town and county of Nottingham, but also to the ining towns and districts. The Art School and eum in Nottingham were in a very flourishing con-tion. So much was this the case that they were no ger able to meet the demands made upon them, and y now had an opportunity of making an Art Museum a site admirably adapted for the purpose if they ld obtain a little assistance. Money had already n most liberally subscribed by themselves, and with assistance they asked, they felt that they could make institution of very great value. He would beg to l upon Mr. Lambert, the Mayor of Nottingham, and Mr. Ward, gentlemen who had always taken a very at interest in all art, science, and education measures, d who would fully state their views.

Mr. Lambert (Mayor of Nottingham) said although y came with a small deputation, they represented a ge number of the inhabitants of the town; indeed, might say almost the total population of Nottingham, o were extremely desirous that the present museum, ch was exceedingly limited, might become a per-ment and better institution than they now had. They d an admirable opportunity for securing the Castle at ttingham, which was situate on the western side of town, and photographs of which were lying upon table. On the previous day they were told that a ommendation would be made that a lease be granted the inhabitants of the town, for something like 500 years, and those who were masters of the subject said t the site was admirably suited for the purpose. The town of Nottingham had subscribed £10,000 towards converting it into a museum, and they had come with the hope that such institutions, admirable as they were, and calculated to raise the people of England generally, would meet with the sympathy of the Government, and they were encouraged to believe that his Grace, who held a distinguished position at the South Kensington Museum, would certainly not fail to extend to them his sympathy. Everything was now ripe for it. More money could be raised in the town if it was needed; but he thought that for institutions of that kind the Government might fairly be solicited.

Mr. Alderman Ward said he might, on behalf of the town of Nottingham, express thankfulness to the Government for what had been done in aid of art in time past. He was quite sure that its position as a commercial town would have been very much impaired if it had not been for the efforts which had been made in that direction. He believed that local efforts would have thoroughly failed to do what was necessary unaided by the Government. The Department of Art, which had rendered signal service, had assumed various shapes from time to time, and had been developed by taking new ground, and that had all been done in consequence of the development which was little foreseen a short time ago, but which was now very apparent, namely, the development in the shape of the establishment of local museums. South Kensington had very nobly assisted in establishing loan museums from time to time of a temporary character, and they had been extremely valued wherever they had been founded. Nottingham was the first that had assumed a permanent character. It was established something like three years ago, and the principles involved in the establishment of such a museum had been thoroughly tested. It had been found that they could supply, with the assistance of South Kensington, all the objects that were necessary. They had had during that time six changes of objects, and they found the local nobility and gentry were very willing to aid them in providing things for exhibition in quite sufficient numbers to keep up the interest. The public also took great interest in the institution. He need only say that in a town comparatively small as Nottingham was compared with places like London, they had during the three years the following number of visitors:—In the first year, 131,995; in the second year, 139,963; and in the year which had just closed, 140,009—each year an increase, and the numbers being very large. It must be borne in mind that those attendances had not been free. They were advised, in establishing the museum, to make a small charge of one penny, and he could testify most fully to the fact that that penny kept no one away who would benefit by going. It provided a very important income, sufficient to defray all the expense of cleaning, and attendants, and so forth. It was a practical thing in a financial point of view, and they did not at all fear the cost of maintenance in carrying on an institution of that character, especially when they got better premises, under more favourable circumstances, as they hoped shortly to do. He need not enter into the history of what led South Kensington to make the offer to them of the establishment of a permanent art museum, because that was well-known to the department of which his Grace was the head. The success of their school had been very marked; he thought it was taking the first rank in the kingdom, and it was owing to that they were honoured by being chosen for the establishment of the first art museum. Of course, in the establishment of an institution of that kind, and in loaning objects of great national value, it was necessary to have some one responsible, and th department made it a condition that the Town Council and municipality should take the responsibility of the management. It was a matter of serious consideration as to whether they would undertake that, in the first instance, but they did ultimately by an almost unanimous vote decide to do so, and the success was so marked, that more recently they

had appointed a committee to consider the question of getting better premises. That committee reported in favour of the Castle project, where they would obtain a most suitable property upon advantageous terms. They could get the shell of the old castle, which was burnt in 1831, at the time of the Reform riot, a building of considerable dimensions, this they could restore for something like £20,000, and it would then be worth what they could not get otherwise for £100,000. In fact, it would have more wall space, and as many good rooms for exhibition of pictures as Burlington-house, and be quite suitable in all other respects. This they could obtain, together with 1,700 yards of ground surrounding it, at a rent of £200 a-year. The Corporation had undertaken the responsibility of negotiating the lease, and undertook to pay that rent, and in addition, to find £6,000 of the public money of the town, provided £9,000 could be found from other sources. It was thought that a minimum sum of £15,000 would be required. They were desirous of getting as much more as they could, because they wished to do the thing well, seeing that its success would materially depend upon the manner in which it was carried out. He was glad to say that although it was expected in the first instance that even £9,000 would with difficulty be raised by appeal to the Government and public donations; they had already overtopped that amount in public donations. They had £6,000 promised by the town; they had £9,700 already promised by local gentry and inhabitants of the town; and their appeal that morning was in the hope that they would be able to do the thing much better by getting another £6,000, making a total of £24,000, which could be extremely well spent. They could do with less, but they thought that sum could be spent with great advantage. They asked that the Government would give them besides the £12,200 to be found by the inhabitants and £6,000 from the town, another £6,000 to make up the £24,000. They were aware that applications for money were constantly being made to the Chancellor of the Exchequer, and they knew what had been done in the past in such matters. There was one instance of what he thought might be considered a museum not only aided, but, he believed, entirely built from the taxation of the country, namely, the Bethnal-green Museum. He believed that was maintained also out of public funds, and all that was done by the public in that instance was to subscribe something like £2,000 for the site. He considered that was a very noble thing to do in such a district as Bethnal-green. But he must urge the claims of the provinces, because they all contributed to the taxation of the country, and they believed that at all events they had some claim. It was not absent from their minds that institutions of the kind could not possibly be established in all large towns, but they considered they had a special case. They represented a site which might be regarded as the centre for a very large district, and in its adaptability to the purpose could not be matched anywhere. Taking all things into consideration, the nature of the site and its surroundings, he believed the project was popular not only in the town of Nottingham, but in the neighbourhood, and if they wanted any evidence of that, the presence of so many members of Parliament representing neighbouring boroughs would afford it. He might say it was necessary for them to obtain an Act of Parliament to enable them to proceed as they had done, because corporations were not empowered to spend money for such purposes, and he would quote two clauses referring to that particular matter:—"The corporation may accept from the trustees for the time being under the will of Henry Pelham, late Duke of Newcastle, and those trustees may grant to the corporation a lease of the Castle of Nottingham and the grounds thereof, and approaches thereto or any part thereof, for any term of years not exceeding 500 years, at such rent or for such other consideration, and on such terms and conditions as the corporation and those trustees agree on. If and when a lease of the castle of Nottingham and of the grounds thereof is granted to the corporation under this Act, the corporation may lay out, maintain, and use the same as a park, place of recreation, museum, or other place of exhibition, and may charge such sum for admission thereto as they from time to time think fit, and the lands and buildings comprised in the lease shall be by virtue of this Act part of the borough." He was very glad to find her Majesty's Ministers in sympathy with Fine Arts, as was evidenced by the closing paragraph in Mr. Disraeli's speech last week at the banquet of the Royal Academy:—"I hail it not as a mere ceremony, but as a public recognition, that there are relations which ought to be cherished between the Fine Arts and the Government of the day. I hail it because, on the part of the Ministry, it gives them an opportunity of expressing, as the responsible advisers of the Crown, their sympathy with those arts which add lustre to life and soften and elevate the condition of man." It remained therefore simply a question of financial arrangement. With reference to the financial part of the matter, he might say, as he believed the Chancellor of the Exchequer was rather poor just now, that they would not require the money this year. All they wanted at the present time was a promise that they should have the money.

His Grace the Duke of Richmond said he was very sorry that the Chancellor of the Exchequer was not able to be present. He knew that he had intended to be there, but there being a morning sitting in the House of Commons, he was unavoidably absent. The Chancellor of the Exchequer, however, wished him (his Grace) to make his apologies to the deputation, and to add that there was nothing he took so great an interest in as the museums of the country. With regard to the money part, of course that remained with the Chancellor of the Exchequer, but he would put before the Chancellor of the Exchequer the very able statement which had been made as to the great beauty of the site and the eligibility of the castle for containing such a musuem. He understood Mr. Ward to urge that all he wanted from the funds of the Government was a grant of £6,000.

Mr. Ward said that was so.

His Grace said he understood Mr. Ward to say he was quite aware that Nottingham was an exceptional place, and that it could not be urged upon the Government from other towns that they also might require something of the same kind.

Mr. Ward said he did not go that length. He fully expected that from some large centres similar applications would be made. He might mention that of the 140,000 people who visited the museum at Nottingham, not more than 40 would have come to South Kensington.

Mr. Denison, M.P., desired to say that Nottingham was a sort of centre for the Midland Counties. It would not be an institution for one town only, but the centre of a large district.

Mr. Bass, M.P., said he had no authority to speak on behalf of the borough he represented, but he was quite sure that when it came to be explained to them they would be very well pleased with the scheme, and no doubt would do their part.

His Grace inquired whether Mr. Bass was sure they would not start a museum of their own.

Mr. Bass, M.P., did not think they would. In the first place, they could not get so beautiful a site. He might add that he was perfectly well acquainted with the place; he had walked about it scores of times when he was a boy, and he did not think a better position could be found in the kingdom. If he might presume to make a remark upon the sketch which had been exhibited, he might say he thought it would be better without the tower.

Mr. Ward said the second plan showed the building without the tower.

His Grace observed that they need not go into the details of the building. His duty merely was to tell the Chancellor of the Exchequer the facts which had been brought before him, and the application which was made for assistance. But he could not shut his eyes, and he was sure the deputation did not, to the fact that the application opened a very large question. Subsidising a museum in Nottingham opened the question whether such things might not also be required in Glasgow, Aberdeen, &c., in the North, and throughout England. Therefore, they could not look at it merely as applying to Nottingham or one or two other places. They must face the question of subsidising other places which might think they had equal claims. He was not expressing an opinion one way or the other, but merely stating it as a fact not to be lost sight of.

Mr. Morley, M.P., ventured to suggest that there could not by any possibility be a better appropriation, within reasonable limits, of the public moneys than just as much as would stimulate the creation of museums everywhere.

His Grace said that was a point for the Government to consider.

Mr. Alderman Ward thought that a museum of the kind suggested to be of any value, and at all attractive, must be large, because the objects they exhibited came from a very large neighbourhood, and must provide for the wants of a large population. He thought it would be particularly hard upon a town if, because having taken the initiative in founding an institution for a district, say of fifty miles, the entire burden fell upon that town. He considered it was not at all an unfair thing to ask that some help should come out of the public taxation of the country for such an object. If a town like Nottingham, in providing institutions for the benefit of a large surrounding district, took upon itself the burden, maintenance, and responsibility of management, it had a claim, he considered, at all events to some small assistance. He simply suggested this because it might be an argument which did not occur to the mind at the time, and which he thought was of very great weight; indeed, he thought it was an argument which could only be fairly met by granting the money.

The deputation then withdrew.

CHANNEL PASSAGE.

On Saturday last the first practical trial for the improvement of this service, in which this Society has taken much interest, was made. The *Bessemer* steamship, the particulars of which have for some months been before the public, made her first formal voyage across the Channel. Thanks to the liberality of the directors of the ship, the Chatham and Dover Railway, and the Northern Railway of France, a united invitation to visit Paris and return on the Monday, brought together, on board the *Bessemer*, a numerous party of scientific men, engineers, sailors, members of the Legislature, and others to witness the great experiment. The weather was unfortunately, both on the occasion of going and returning, of too calm a character to bring into play the special qualities of the ship, even if the machinery of the swinging saloon had been in a sufficiently perfect condition for trying its efficiency in the prevention of sea-sickness. The voyage, however, if not made with all the speed that had been hoped for, was at least made in excellent time, and with an amount of comfort to the passengers which showed a marked superiority over anything ever yet attained on any public boat service, not even excepting the Irish mail boats, which certainly stand at the head of their class. That an accident occurred at the Calais pier is true, but when it is considered that the whole proceedings were an entire novelty, and that the size of the ship presented difficulties of no ordinary nature in entering the narrow harbour of Calais, however competent the captain might be—and there is no desire to disparage his attainments—it is not surprising that something unexpected should occur. Experience will doubtless remedy all this. The following letter in the *Times*, from Admiral Sir Spencer Robinson, who was on board, gives a fair and reasonable explanation of what took place, and coming from one so experienced as a sailor and a builder of ships, may be relied on:—

Sir Spencer Robinson says:—"I think that all those who crossed over from Dover to Calais in the *Bessemer* on Saturday last (of whom I was one) will not wish to see the success of a most important effort to promote the comfort of the travelling public put in jeopardy through any misapprehension of facts. The limited experience of the *Bessemer's* qualities which it has been possible up to this time to acquire, seems to prove that the ship steers with ease, answers her helm well and quickly, and possesses the power of moving, by her engines, either ahead or astern, under an unusual and remarkable degree of control. Perhaps a non-technical description of what the *Bessemer* had to do in going into harbour on Saturday may explain to the public the state of the case as far as it can be known without further inquiry. Calais Harbour is formed by two projecting piers, whose distance apart is 50ft. less than the length of the *Bessemer*. On the left of the spectator, looking inshore, is the pier alongside of which the *Bessemer* has to find her berth, between 500 and 600 yards from the pier-head. As both these piers are for a considerable distance from their extremities constructed of open-work resting upon piles, the tide passes through the openings freely, and at the time of the *Bessemer's* approach was running strongly from the right-hand pier to the left. The ship approached the entrance according to custom, obliquely, keeping as close to the right-hand pier as possible (the tide setting strongly to the left), put her helm a-port as soon as the pier-head was passed, and turned quickly and perfectly into the fair-way between the piers. It seemed as if a ship which had made so sharp a turn so satisfactorily would not have found it difficult to keep in the fair-way, or as much on either side of it as those in charge of her should think desirable; but, whether the ship's helm was not put over to starboard soon enough, or from some other cause, the ship's head never paused in turning towards the right-hand pier, and as far as I could see, though the rate of turning slackened before the collision, which occurred about 250 yards from the pier-head on the right, the turning movement to the left—that is, away from the pier—had not begun when the accident happened. The bow and foremost sponsoning struck the pier obliquely, destroyed many feet of remarkably rotten wood, and as soon as the ship was clear of the wreck she steamed slowly over to her berth on the opposite side unharmed. I have no doubt that the tide which I have described as setting strongly from the right-hand pier to the left operated with very unequal strength at the outer end (or stern of the ship) from what it did at the inner end or bow of the ship, and would naturally render the steering of any ship so placed a matter of considerable difficulty. No ship will steer unless she has way on her, and way enough to counteract the accidental movement of the water across the line of her path. Whether the ship had sufficient way, or whether the helm was put over to starboard at the right moment, I cannot say; I was not in a position to see or know what passed with reference to these points. I ought to have mentioned earlier that the wind, moderate in strength, was blowing obliquely from the right-hand pier to the left, and was acting, therefore, so far as it had any effect, to turn the outer end or stern of the ship towards the left-hand pier. I have not sufficient local knowledge for my opinion to be absolutely conclusive, but, notwithstanding what ha

happened, it is my conviction that whenever there is water enough the *Bessemer* can be taken into Calais Harbour without an accident. No professional man would deny that every ship has some particular points and qualities differing from those of other ships, and which when known and discovered by practice render their handling perfectly secure and certain; and none who know the accomplished seaman who has lately taken charge of the *Bessemer* will doubt his ability to obtain a complete mastery of her qualities in a very short time. I sincerely hope that the difficulties which beset the efforts to improve our Channel communication, and from which no one connected with the enterprise is exempt, will not rashly be considered insurmountable, and that our efforts may be crowned with full and complete success—a success as much to be desired by the public as it will be agreeable to ourselves."

Pioneers in the path of improvement proverbially have always had to struggle with difficulties, and Mr. Bessemer is no exception to the general rule; but all honour is due to him, and the public are deeply indebted to him for the enterprising and enlightened spirit which he has thrown into this work, and the untired energy with which he has devoted himself to the task. Let him but persevere in his undertaking, and, in spite of adverse checks, there is nothing which has taken place which need cause him to despair of ultimate complete success.

Since the above was written, Captain Pittock, who commands the *Bessemer*, has addressed a letter to the *Times*, in which he says:—

"With regard to the letter signed by Sir Spencer Robinson in the *Times* of this morning, referring to the voyage of the *Bessemer* to Calais on Saturday, and describing the accident which occurred on her entering the harbour there, I shall feel favoured if you would permit me to correct several important errors into which the gallant Admiral has fallen.

"He asserts that the ship put her head a-port as soon as the pier-head was passed. This was not the case. The helm was not put a-port, but, on the contrary, was starboarded before the vessel entered the piers, and remained so until she struck, because it was known that the tide, acting on the ship's stern when her bow was inside, would have a tendency to throw her head towards the west pier, and the starboard helm was to prevent it.

"Sir Spencer also observes that 'he cannot say whether the ship had sufficient way on her, or whether the helm was put over to starboard at the right moment'—or, I would presume, soon enough. In reply to this I may state the speed on entering the harbour was about 12½ or 13 knots an hour, which was thought to be the best speed to have the vessel properly under command of her helm. Further, if the helm had been starboarded sooner she would in all probability have struck the east pier instead of the west one.

"I need only add that Mr. William Hume, my chief officer, who has been for many years in command of steamers entering small ports, and who was stationed at the engine telegraphs giving orders to the engine-room at the time, and also William Cook, the quartermaster, who was at the helm, fully corroborate all I have above stated."

GENERAL NOTES.

The Manufacture of Watches in Europe and America.—A French paper gives some particulars respecting the manufacture of watches in Europe and America. It appears that, in 1870, the whole number of watches made was 2,200,000, of which number Switzerland alone furnished 1,600,000; France, 300,000; England, 200,000; and the United States 100,000. The Canton of Bern furnishes the greater part of the cheap watches made in Switzerland, the annual production exceeding 500,000 in number. The best classes of watches are made in the Canton of Geneva, which supplies about 150,000 every year. The Canton of Vaud supplies chiefly the works and not finished watches, the number made chiefly in this canton being about 150,000. The Canton of Neufchatel is the most productive, both as regards the quantity and quality, and supplies nearly one-half in value of the whole production of Switzerland. The Observatory of Neufchatel has contributed to a great extent to the perfection that watch-making has attained in this canton. The watches sent there to be regulated in 1862, showed a variation of 1·51 seconds on the average in 24 hours; and in 1868 the average variation did not exceed 0·57. With regard to chronometers, out of 99 sent to the observatory in 1868, 50 varied less than half a second in 24 hours, and only eight showed a variation of more than a second.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made:—

May 19.—"The Agricultural Statistics of India." By Clements R. Markham, Esq., C.B. On this evening Andrew Cassels, Esq., Member of the Indian Council, will preside.

May 26.—*No Meeting.*

June 2.—"Toughened Glass." By Perry F. Nur[illegible], Esq., C.E.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Royal United Service Institution, Whitehall-yard, 8½ p.m. Major E. Maitland, "Fog Signalling by Explosives."

Tues.... Royal Institution, Albemarle-street, W., 3 p.m. Prof. Gladstone, "Chemical Force."
Statistical, Somerset House-terrace, W.C., 7¾ p.m. Mr. Stephen Bourne, "The Progress of our Foreign Trade, Imports and Exports during the past 20 years."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Clements R. Markham, "The Agricultural Statistics of India."
Meteorological, 25, Great George-street, S.W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 11 a.m. Annual Meeting.

Thurs ..London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Morley, "Inner Thoughts of Shakspeare's Plays (I.)"
Chemical, Burlington House, W., 8 p.m. 1. Mr. A. [illegible] Smee, jun., "Notes on Milk in Health and Disease." 2. Mr. G. J. J. Coleman, "The Effects of Pressure and Cold on the Gaseous Products of Distillation of Carboniferous Shales." 3. Prof. How, "Some Nova Scotian Triassic Trap Minerals." 4. Mr. W. H. Deering, "Some Points in the Examination of Waters by the Ammonia Method." 5. Dr. Campbell Brown, "The Agricultural Chemistry of the Tea Plantations of India." 6. Mr. J. A. Phillips, "The Structure and Composition of Certain Pseudomorphous Crystals, having the form of Orthoclase." 7. Mr. M. M. Pattison Muir, "Nitrogen Bromide and Sulphur Bromide."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "The Progress of Physico-Chemical Inquiry."
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Fri.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. Noble, "Explosive Compounds."
Royal United Service Institution, Whitehall-yard, 3 p.m. Colonel Lumley Graham, "The Company as a Military Body; its Establishment; and the Best Number of Companies in the Battalion."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Mr. J. Baillie Hamilton, "The Application of Wind to Stringed Instruments."
Civil and Mechanical Engineers' Society, 7, Westminster-chambers, S.W. Mr. H. E. Hill, "Self-acting Machine Tools."
Philological, University College, W.C., 8 p.m. Annual Meeting.
Society of Engineers, 11½ a.m. Visit of the Members and Associates of the Society to the Western Pumping Station of the Metropolitan Main Drainage Works at Pimlico.

Sat......Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. H. Pollock, "The Drama."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

OURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, MAY 21, 1875.

...munications for the Society should be addressed to the Secretary ...John-street, Adelphi, London, W.C.

ROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

...e Society's Conversazione will be held on ...ay, June 25th, at South Kensington Museum, ...rmission of the Lords of the Council on ...ation. Cards will be issued in due course.

INDIAN SECTION.

...e report of the last meeting, at which Mr. ...'s paper on "The Russian Advance in Central ..." was read, will appear in the next issue of ...*Journal*. It has been deferred to admit of the ...ration of a map, showing the country.

TWENTY-SECOND ORDINARY MEETING.

...dnesday, May 19th, 1875; ANDREW CASSELS, ...ber of the India Council, in the chair.

...e following candidates were proposed for ...ion as members of the Society:—

...ham, Sam Stenton, F.R.I.B.A., 32, King William-...eet, E.C.
...ll, Robert, F.R.G.S., 103, Abingdon-road, Ken-...gton, W.
... John Charles Addyes, J.P., 3, Ormonde-terrace, ...ent's-park, N.W.
..., Alexander, 10, Maida-vale, W.
...r, George, 5, Stanley-gardens, Belsize-park, N.W.

...e following candidates were balloted for and ...elected members of the Society:—

..., Richard, 79, Addison-road, Kensington, W.
... Richard, 16, Woodsome-road, Highgate-road, N.W.
... David Wellesley, 20, London-wall, E.C.
..., F., 5, Prince's-square, Bayswater, W.
..., Augustus, 1, Paper-buildings, Inner Temple, E.C.
..., Captain Eyre M., 68, Watling-street, E.C.
..., John Palmer, 93, Oxford-terrace, Hyde-park, W.
..., Adolph, 32, Woburn-square, W.C.
..., John, 23, Great Cumberland-place, W.
...hurst, William, Eversleigh-house, Lavender-...S.W.
..., George A., 111, Maida-vale, W.
..., Thomas, 3, Richmond-terrace, Whitehall, S.W.
..., Francis Dashwood, 10, Whitehall-place, S.W.
..., Arthur F., 15, Queen's-gate-terrace, S.W.
Webb, John, 159, Euston-road, N.W., and Whitefriars, Hastings.
Whittaker, Henry, 8, Gloucester-road, South Kensington, S.W.

The paper read was:—

THE AGRICULTURAL STATISTICS OF INDIA.

By Clements R. Markham, C.B.

Agriculture is the main resource on which India relies for the supply of her wants, and the branch of administration dealing with it is the most important that can occupy official attention. Through it statesmen may be furnished with knowledge which will enable them to improve the condition of the people, to increase their means of subsistence, to avert famines, to add to the wealth of the country, and to adjust taxation. And it is because this knowledge is not marshalled and classified with sufficient accuracy, and brought to bear upon current questions, that disasters and mistakes have occurred, and that the progress of the country, in moral and material prosperity, is checked and retarded. It is the want of accurate knowledge of facts, and most assuredly not the want of capacity to deal with them when known, that is the evil to be grappled with. Expenditures of millions to avert famines, barrenness from *reh* efflorescence, water-logged villages, and all other evils connected with the British adminstration of India are due to want of knowledge; and the consideration of the ways and means through which accurate knowledge may be brought to bear on the consideration of administrative questions is the first step to the adoption of a sounder system of record, and to the eventual introduction of efficient measures for securing the desired results.

It is, however, essential to a right understanding of the matter, that we should bear in mind the habits and polity of the agricultural communities in India, and consider, as the basis of all future measures, the machinery for the collection of agricultural statistics which has existed among them from time immemorial, in a more or less efficient form. Systems which may be adapted for one country and one state of society are often not suited for others. Information that is needed by one Government may be useless to another; and any *doctrinaire* attempts at uniformity are strongly to be deprecated. The first and leading rule should be to use the machinery which is adapted to the habits of the people, and to improve existing methods, rather than to attempt the enforcement of uniformity or the introduction of theoretical improvements.

The record of agricultural statistics is coeval with civilised government, and assuredly such excellence as has ever been attained in administration for the good of a people has been due to the action of rulers founded on more or less accurate knowledge. In Peru, under the Incas, the happiness and material comfort of the people were more completely secured than in any other country the history of which is recorded; and in Peru agricultural statistics formed the basis of all the measures of the Government. So exactly were the resources of every district known, and so complete were the arrangements for supplying one district with the superfluities of others, that not only were

famines rendered impossible, but the regular system of exchanges secured a degree of comfort for the people throughout the empire such as is unknown in these days. A knowledge of the crops, and of all other products, was obtained by means of a village system entailing exact measurement. It was almost effaced in later times, but the attention of Peruvian statesmen is now aroused to the perfection of the Incarial system, and to the necessity for exact statistical records as a means of good government. The statistical volumes that are in preparation in Peru, one of which is actually published, are based on correct principles of record and classification, and are very far superior to anything of the kind that has yet appeared in India.

I have alluded to the facts relating to a country almost at the antipodes of India, because it seems desirable to point out that the importance of agricultural statistics is not confined to any region, and that results have been secured by them in former days such as are certainly not equalled in our time. Yet the machinery was analogous, and we may, therefore, conclude that like results must be sought through that machinery, and not by substituting any other.

In the East, although the demand for agricultural knowledge has been more entirely due to fiscal considerations than in Peru, the necessity for it has, from time immemorial, been as strongly felt, and its acquisition has been sought by similar means. Unhappily, the records of the past are lost or incomplete; still, in distant ages, we can discern the fact that agricultural statistics were the basis of good government. When they were neglected, mistakes, arbitrary exactions, and consequent poverty and misery were the consequences. Attention to them was synonymous with an age of prosperity and happiness. In Persia, the king whose memory is most revered, and whose reign is ever referred to as the happiest and best, was Noursheivan; and it was Noursheivan who, carrying out the intention of his predecessor Kobad, first established a revenue survey, and a system of measuring and classing the lands. In India all prosperity and happiness is ascribed to the reign of Akbar; and the work of the great king's favourite minister proves that a very elaborate system of recording statistics was in force. The "Ayén Akbori" explains the rules for measuring the fields, for classing the soils, and for ascertaining the weight and value of the crops.

The institutions in India, such as the village communities, which grew out of the necessities of the people, and have existed from time immemorial, and others involving special tenures of land, which have been introduced by former governments, are now an integral part of British rule; and it is through the machinery supplied by native institutions that our knowledge of the condition and wants of the cultivators must be obtained. The welfare, and even the existence of the people depend on the correctness of this knowledge, and on the way it is used; so that the importance of agricultural statistics cannot be over-estimated. When we find the cultivators well off in one district, depressed by poverty and want in another, or on the verge of starvation in a third, we may feel sure that these differences are, to a great extent, due to want of exact knowledge on the part of the rulers. The inequalities are roughly shown by comparing the average amount of land revenu per head of the population, which varies in different parts of India. In Bombay it is 3s. 4d.; in the North-West Provinces, 2s. 5d.; in th Punjab, 2s.; in Madras, 2s. 6d.; and in Bengal and Assam, 1s. 1½d. If we select a village in any part of India, and examine carefully into its interior economy, the wants of its inhabitants, i immemorial institutions, the system of agricultu that prevails, and the machinery for collecting information relating to it for fiscal and other pu poses, we shall have a rough, but a sufficientl good notion of the material from which the ite of information must be brought together and co pared, so as to form a serviceable body of sou knowledge. For such a village is one unit in o calculations, and its combination with other u enables us to supply the facts which administra tors need.

In the Bombay Presidency, the means exist such an examination in perhaps a more comple and certainly in a more accessible form than other parts of India. For in the Mahratta count the village system, which during centuries of rule was the only centre of stability and the o repository of civil rights, is still maintained, each village has more than once been the object minute statistical inquiry. Fifty years ago, typical village in the Deccan was selected by Coats for examination,* and the particulars rela to it are applicable to other Mahratta villa Twenty years afterwards the settlement nece tated a similar investigation of every village, w Mr. Gooddive reported upon the village commu ties;† and there has been a third such investig tion, connected with the new settlement, recently. Here, then, we have the bases for tistical inquiries, in a knowledge of the condi of agriculture and of the agricultural populati at three distinct periods. It is, unhappily, necessary to insist that the object of statistic not to fill ruled tables with figures, but to se the well-being of an aggregate of units, by obta ing an accurate and scientific knowledge of t wants of each, and of the means for supplying wants. The unit is the village cultivator; and we would really understand the use of Ind agricultural statistics, we must begin with acquaintance with the agriculturist.

In the Bombay Presidency we recognise him a lean man, with prominent muscles, and hands and feet, with eyes full and black, ch bones high, and teeth stained with betel, clo in a *longoti* or rag between his legs, and anot round his head, with a black woollen cloth, *cumli*, in cold weather. He is frugal, and not provident; better informed than most Europ labourers, and devoted to his children, but cun and false. He forms one in a population of ab 600 to 1,000, which cultivates some 4,000 ac and lives in a village surrounded by a mud wal with two gates. The 150 to 200 houses are of su dried bricks, with terraced roofs, and there open porticoes along their fronts, but the few sm dark interior rooms have no windows. The

* Transactions of the Bombay Literary Society (18 p. 172.

† Report on the Village Communities of the Decca, by Gooddive (1852).

the same temples will be of hewn stone. The furniture of a cultivator's house consists of a copper boiler and a few other copper vessels, about 20 earthen pots, to hold stores of grain and other food, a large wooden dish for kneading dough, a grind stone and rolling-pin for powdering spices, two iron lamps, and two beds laced with rope. The whole will not cost much more than forty shillings. But his agricultural implements and bullocks are his most valuable possessions. The plough, consisting of beam-head and handle, but having no share, and leaving a mere scratch, is made of babool wood (*Acacia Arabica*), and only costs a few pence. The cart is a rude frame on two solid wooden wheels, and there are also a harrow with wooden teeth, and a drill plough. A pair of good oxen is indispensable, and the well-to-do have two pairs. All these matters are of moment in calculating the cost of cultivation.

The arable land consists of *jirayat*, the crops on which depend on rains, irrigated land, and *bagayat* or garden lands, where fruit trees and vegetables are carefully cultivated, and often surrounded by a hedge of the blistering milk bush (*Euphorbia Tioncalli.*) The *kunbi*, or cultivator, has two crops to attend to during the year; the *kharif*, which he sows in June and July, and reaps in October and November; and the *rabi*, which he sows in the latter months, and reaps in January or February. For the *kharif* he sows *bajori*, or red millet, the chief food of the people, in rows, with a drill-plough, mixed with *toor* and *muthie*, two pulses. *Jawari*, or great millet, *rabi*, and the other smaller millet, are also *kharif* crops. The *rabi* crops are wheat and grain; and a variety of seeds are often mixed in the same field, which is an obstacle to correct statistics.

The land is only ploughed once in two years, and the depth of a span is considered sufficient, the cultivator working from six in the morning until eleven, and again from three until sunset. The land, whether ploughed or not, is subjected to a drag hoe, first lengthways and then across, which loosens the surface and destroys weeds. This operation is repeated three or four times at intervals of eight days. When harvest begins, a level spot is chosen for a threshing-floor, and made dry and hard. A pole five feet high is stuck in the middle, the grains are stacked round the floor, and the women break off the ears and throw them on it. Six or eight bullocks are then tied to each other, and to the post, and driven round to tread out the grain; and the winnowing is done by a man standing on a high stool, and submitting the grain and chaff to the wind from a basket.

The cultivator requires but little food. It consists of cakes made of millet flour, with water and salt, baked on a plate of iron; greens, pods, and fruits cut in pieces, boiled and mixed with salt, pepper, or turmeric, and then fried in oil; and porridge of coarsely-ground *jawori* and salt. His wife brings him his dinner at noon, and the two other meals are taken on setting out and returning to and from the fields.

The working-day toils are interspersed with pilgrimages to temples, and holidays, such as the Holi, or full moon in April, which lasts five days, when many games are played; the *Dashara* in October, the *Devali* twenty days afterwards, and the feast in honour of the bullocks in October, when the poor beasts are painted, dressed up, and fed with sugar, and their masters prostrate and worship them.

The office bearers of the village, including all the artificers, form an institution which has undergone no alteration from time immemorial, and they also enter into calculations connected with the statistics of an agricultural village. The *patel*, or head of the village, has freehold land or special rights, and the *kulkarni*, or accountant, also receives remuneration in various ways. These two officers supply the machinery in every village for collecting statistical details. The *Barra Balloota* consists of twelve hereditary office-bearers, including the *patel* and *kulkarni*, who receive certain fees or remuneration from the village in exchange for professional services. Thus the *sutar*, or carpenter, the *lohar*, or smith, the *chamhar*, or shoemaker, are paid by each villager, and they mend all implements for agricultural purposes, the owners finding the materials. Some of the office-bearers have a right to a certain number of rows in the crops, and all the fees form items in the statistical calculations.

Such are the circumstances which surround our cultivator in the Deccan, and for the most part throughout India—he who forms a unit in the vast aggregate of similar units which are the source of the wealth and the revenue of British India, and whose welfare is the ultimate object of agricultural statistics. The proper statistical unit is, therefore, the extent of land which one of these living units can plough with two bullocks; and this area, in the Bombay Presidency, is called a "number." It is the smallest extent of land that can be ploughed and tilled by the cultivator or bread-winner, so as to serve for the support of his family.

If an accurate record can be kept of each of these "numbers," as regards the nature of the soil and other circumstances, the crop and its yield, and the items which compose the cost of cultivation, the aggregate of these particulars for all the "numbers" forming a village, and all the villages forming a district, will furnish the materials required by the statistician.

The three essential bases of statistics are—space, which is the abstract of all relations of co-existence; number, which is the abstract of all relations of comparison; and time, which is the abstract of all relations of sequence. Now, the first basis, namely, area or space, is supplied by the survey for fiscal purposes. Number is derived from the periodical census, and is the relation between the bread-winner and his crop, or between the aggregate of bread-winners and the aggregate of crops. Time, the third basis, is obtained through the periodical surveys; and the comparison between prices of all articles and services which form the items of the cost of cultivation supply, and the means of examining the relations of sequence.

In the Bombay survey, the "numbers," or fields of a village, varying in size from what a pair of bullocks can plough to double that quantity, are carefully measured, with the necessary checks to insure accuracy, lands held on different tenures being measured separately, and different kinds of culture, such as wet, dry, and garden, being treated as separate "numbers." The checks are taken by

a European assistant, and the errors of native measures are not allowed to exceed 2 per cent. All the original records are kept in the vernacular language.

After the "numbers" or fields composing a village are measured, there is a process of classification for purposes of assessment, which also supplies essential information in the preparation of agricultural statistics. The fields are classified, according to the productive capability of the soil, in three distinct orders, black, brown or yellow, and gravelly. These are again gauged according to their depth, on which depends their ability to imbibe and retain moisture. Then the presence of deteriorating ingredients, technically called "faults"—*choonkud*, a mixture of nodules of limestone; *walsa*, a mixture of sand; *potuowat*, sloping surface; *keswut*, want of cohesion among particles of soil; *kanul*, a mixture more or less impervious to water; *doopun*, liability to be swept over by running water; *populwat*, excess of moisture from surface springs; *gochur*, mixture of large nodules of limestone—is taken into consideration, as well as the means of irrigation and distance from markets.

Thus the statistical units are measured and classified, and a return for them is made for each village, with the population, number of live stock, carts, ploughs, wells, and other agricultural details. These returns are only prepared at intervals of some years. But every year statements are sent in of the number of acres in each village under 28 of the principal crops, with the number left fallow and temporarily out of cultivation, the prices and the rate of wages, and village population. The village accounts are combined, so as to give the results for each *taluk*; the *taluk* accounts are united into accounts for collectorates and divisions, and these again furnish agricultural statistics for the whole Presidency.

I have selected the system prevailing in the Bombay Presidency for more detailed description, because, to the best of my judgment, it appears to be best adapted for the record of statistics making some approach to accuracy. The same system has been introduced into Mysore, and eventually, not at present, statistics will be available from that State in the same form as those which can now be supplied from Bombay.

But there is analogous machinery, differing in details, in several other parts of India. In the Madras Presidency the statistical records collected between 1810 and 1825 are most full and complete in every respect, more especially those for Tinnevelly. At present the measuring portion of the survey is effected with greater scientific accuracy than in Bombay, and the classing of soils is done on similar principles. Annual returns are furnished of the acreage of cultivable and cultivated land in each village, and of irrigated and dry crops, as well as of three principal crops, sugar, cotton, and indigo, and of prices and rates of wages. But the acreage under various millets and pulses, and other dry crops, is not given separately, as in Bombay, the Punjab, Oudh, &c. There is also, in Madras, a quinquennial agricultural census, containing those details of population, live stock, implements, &c., which are furnished in Bombay at each settlement. In Malabar, however, which is one of the most interesting districts in the Madras Presidency, owing to the prevalence of pecul private rights, it is more difficult to obtain stati tics. In Madras, as in Bombay, the village retur are combined into those of *taluks*, and are published showing the general results for collectorate.

In the North-West Provinces the different tlements, and especially the most recent one, ha furnished a series of records and maps which useful with reference to the time they were ma But hitherto these records have not been kept to date. There is, in this part of Ind only one section of the agricultural statistics whi are recorded in Bombay and Madras, nam those given in the periodical settleme Details can only be supplied referring to cer periods, and not annually. The extent of information that has been periodically recor can be judged from the report recently made Mr. Halsey on the district of Cawnpore. He enabled to show the estimated cost of cultiva of the six principal crops, as deduced from sta tics collected at three different periods by Robert Montgomery, Mr. Hume, and hi The details include the quanity of seed requir sow an acre, the cost of ploughing, sow manure, weeding, watering, bird-scaring, rea threshing, the total expenses, rent, prices quantity and value of each crop per acre; prices of grain and pulses each year for fifty y and a comparative statement of produce whe irrigated, and when under irrigation by wel canals.

But annual returns were also needed in North-West Provinces, and the suggestion of Buck, the secretary to the Board of Revenue, a special officer should be employed for the su vision of the records, has recently been adopted Sir John Strachey, the present Lieutenant-Go nor. This officer will supervise the colle agency, see to its efficient instruction, and pro an annual series of agricultural statistics. subordinate staff will test the accuracy of maps and records, and he will himself concentr and arrange the materials on a uniform plan.

In the Punjab, where the village system pre the measurements were executed by the *Pat* or accountants, who were specially trained, who prepared the field maps and registers, un careful series of checks. The Punjab settle reports are perfect mines of statistical informa Among others, that of Mr. Barnes on the Ka district may be mentioned as most interest while that by Mr. E. A. Prinsep, on the Seal district, is remarkable for the amount of valu suggestive matter it contains, and for its admir series of maps, which show the immense import of that method of statistical illustration. acreage, first of culturable and unculturable and then of irrigated, moist, and dry cultiva are given, the classification of soils and the di bution according to products as well as the sys of rotation of crops, also the number of ploug carts, cattle, population, prices and rates of wa This information, with many other interesti details, is contained in all settlement reports, the adoption of a measure similar to that appro by Sir John Strachey in the North-West Provin will place the Punjab on the same footing.

In the Lower Provinces of Bengal, the perman

settlement has caused the effacement of that machinery for the record of agricultural statistics which is supplied in other parts of India by village and district officials. They cannot be collected without a separate staff, which would entail great expense, but Sir George Campbell has introduced a plan of selecting certain districts for statistical treatment, which will at least be useful so far as those special districts are concerned. But it will be long before satisfactory results will be received from this rich and important province.

There are monographs on some of the special products of India, such as tea, silk, cotton, tobacco, fibres, and especially jute; and others are needed on opium, indigo, coffee, and sugar. These form admirable bases, and should be given for each year in the annual returns.

Closely allied to agriculture, and forming inalienable portions of the subject, the statistics of irrigation should be collected and displayed side by side with the facts referring to the area and yield of crops and the cost of cultivation. The present returns give the area of land under irrigation, and the classification of soils, as well as the rainfall. To these details should be added the sources of water-supply, and the depth of water in wells. The disturbing influence which irrigation, when supplied to a region hitherto mainly under dry cultivation, has upon agriculture is very striking. In a district of Rohilcund the area under well-irrigation increased from 4,991 acres at the period of the settlement of 1835 to 202,505 acres at the last settlement. But Mr. Buck points out that, at present, our ideas on the results of irrigation (he is speaking especially of canal irrigation) are founded on mere conjecture, which a series of reliable statistics would enable us to replace by knowledge based on certain and accurate facts. It is by no means certain that the introduction of canals would be beneficial to a district—frequently the reverse would be the case—and accurate knowledge may as often avert administrative errors as promote the construction of useful public works. In some parts of India the whole history of agriculture and population depends upon irrigation. In the open country of Mysore, for instance, population has little or no existence except in connection with works of irrigation, and nearly 60 per cent. of the whole area of that State has, by the patient industry of its inhabitants, been brought under the influence of tanks. The total number, as given by Major Sankey, is 26,450, or one per square mile. It is sufficiently clear, from such facts as these, that details of irrigation must form an integral part of efficient agricultural statistics.

The question of timber and fuel supply is also most important, in connection with the operations of agriculture, yet until the last thirty years it was wholly neglected. Forest conservancy was commenced in India not a single day too soon, and not before agriculture had begun to suffer very severely from its neglect in many parts of the country. In the Ceded Districts timber is so scarce that the very cart-wheels are made of stone, and in other districts all timber is so difficult to get that the operations of the farmer are sensibly crippled. The destruction of forests, and consequent absence of trees, has also so curtailed the means of manuring the land, in many parts of India, that it is permanently in a poor and exhausted condition. Leaf manure cannot be procured, the area for feeding cattle is reduced, and yet the people are obliged to use such small supplies of manure as they still have for fuel. Thus, from an agricultural point of view, the measures for forest conservancy have become most important; and the amount of forest, with its comparative value, and the extent to which its produce is available for agricultural purposes in the different districts, is another integral part of agricultural statistics. But it is a part which is not yet attainable. Its first basis, a survey of reserved and communal forests has only just been sanctioned in the north of India, and has not yet been permitted in Madras. Knowledge respecting this branch of the subject can only at present be had in a very general and mutilated shape.

A third, and not the least important collateral consideration, is that of communications, proximity to markets, and facilities for transporting produce. It is certain that every year, including famine years, the crops raised throughout India are sufficient to feed the whole population of India. The question of food supply, the most momentous that can come under the consideration of the Government, consequently resolves itself into one of distribution. It is not enough to know the quantity of grain in each district; the means of transport, and the distances from good roads and railroads must also be considered, and these particulars ought to be included in the commentary on agricultural tabular statements, with market prices. In Northern India we are assured by Mr. Halsey that the average prices of grain and other staples are such as to preclude their paying even the cheapest forms of transit for long distances. But the traffic in grain is a proof that this is not generally the case, and a correct view of the facts bearing on cost and means of transfer in the different districts of India, is one of the most essential items in the preparation of really useful agricultural statistics.

I have now given a general view of the character and extent of the information which is collected. In all parts of India where there has been a revenue settlement we have one or more reports on the agricultural condition of each district, containing many details which are needful in calculating the cost of cultivation. In Bombay there are annual returns of cultivable and cultivated land, (distinguishing wet, dry, and garden), with the acreage under 28 principal crops, prices, rate of wages, and population. They are based on village accounts, which are in the vernacular. These are condensed into tabular returns, whence the published returns for each collectorate are compiled. In Madras (exclusive of Malabar) the same information is available, except that instead of the 28 principal crops, only the wet and dry cultivation is given, and three other special crops, sugar, cotton, and indigo. But in Madras much additional information is furnished in the quinquennial returns, which in other parts is only found in the settlement reports. In Mysore, information of the same character as is supplied to the Bombay Government, will be eventually attainable as soon as the survey is completed, and also in the Central Provinces. In the North-West Provinces statistical information has hitherto been mainly

derivable from settlement reports, but a system of annual returns has now been inaugurated; and in the Punjab a similar system can be introduced. But in Bengal there will long be difficulties in obtaining any but very general views respecting the state of agriculture, owing to the effacement of native institutions through the permanent settlement. There is, however, over the greater part of British India, exclusive of the native states, machinery for collecting agricultural statistics, which is based on ancient local institutions, and best suited to the customs of the people, and the returns that are made serve many of the purposes for which they are required. It is to their improvement with the use of the same agency, not to the enforcement of uniformity, and the demand for figures to fill up cut-and-dried tabular statements, that we must look in our effort to make more perfect the methods of collecting and recording statistical facts.

Although the machinery is there and at work, yet there is undoubtedly a great want of accuracy and reliableness in the returns. The facts are not brought together so as to furnish the knowledge which is so much needed. The most efficacious remedy for this state of things lies in the step taken by Sir John Strachey, and this ought to be imitated in all parts of India. For securing accuracy, which is, after all, the main point, the standard of intelligence among the actual measurers and collectors of statistics for the village records must be raised, and the checks on their work must be rendered more effective. This can only be done by a special officer, with a small staff, whose duties would be to supervise the efficient instruction of the subordinates, to apply checks for securing accuracy, and to prepare the statistical returns and memoirs. The small cost entailed by such an appointment would be amply repaid by the value of the work. In preparing the returns, a commentary should accompany the tabular statements; and statistics of irrigation, forests, and communications should form an integral part of the agricultural reports. Another indispensable change is the supply of more detailed information. At present all the returns are lumped into statements for whole collectorates. But these divisions are much too large for any useful purpose. They often include every kind of soil and climate, mountain and valley, plateau and swampy plain, and, of course, every description of product. When information which only concerns a portion of a collectorate is given as if it vaguely affected the whole, it is not possible to make any graphic and effective use of it. It is, therefore, essential that the returns for each *taluk*, or division of a collectorate should be available; because the *taluks*, as a rule, include one class of cultivation, and will, therefore, serve as units for purposes of illustration.

Why not take the village at once? It is the actual unit. The *taluk* returns are only the totals of the villages contained in the *taluk*. The local government could not operate on a *taluk* return. Upon any question arising the Government would have to recur to the village returns. The adoption of the village would place the registration on the same footing as the English and other European systems.

The *taluk* returns are made up in the vernacular, but abstracts of them would not involve much additional labour, while the advantage of obtaining them would be very great.

I now come to the second part of my subject, in which I propose to submit the uses to which agricultural statistics should be put, and to a certain extent are now put, first in India for administrative purposes, and next in this country for the supply of information.

Statistical inquiries are primarily instituted for the purpose of ascertaining the gross receipts from agricultural operations, in order that a portion of the profits may be deducted as the land tax.

An important object of agricultural statistics must be to ensure the provision of accurate and complete knowledge in fixing the assessment. Too often there has been action without complete knowledge. The assessment has occasionally been too light, but more often it has been so heavy as to absorb all the profits, and in some cases even to encroach upon the sum which should be set apart for expenses of cultivation. The consequences of such mistakes are very serious. One out of many instances may be selected from the reports in the district of Cawnpore, by Mr. Rose in 1871, and Mr. Halsey in 1872. Mr. Rose tells us that no district has ever suffered so much from bad administration as Cawnpore, owing to excessive revenue rates; and Mr. Halsey draws a still sadder picture in 1872. The abject poverty of the average cultivator is beyond the belief of anyone who has not seen it. The demand actually encroaches upon the sum that should cover the cost of cultivation, and the land could not be cultivated with hired labour, so as to leave a margin of profit. The cultivators are slaves to the usurers and Government, and live just on the very verge of starvation. This state of things, wherever it exists, and it exists in many parts of India, is due to a want of accurate knowledge on the part of revenue officers, so that the importance of agricultural statistics, and of a thoroughly efficient system of recording them, can scarcely be over-stated. To ruin and starve the cultivators is to destroy the wealth of the country.

A second use to which agricultural statistics should be put is to secure the selection of judicious lines for irrigation canals. In choosing a country through which such a canal should pass, there are other considerations besides the head of water, the rainfall, and the levels, of equal importance, which are all connected with agricultural statistics. One is the nature of the soil. In some soils, unless there is good and expensive drainage, as well as irrigation, there will be a salt efflorescence, which will convert fertile land into a barren waste. In others, although the rainfall may be deficient, irrigation is unnecessary, because the richness of the soil renders dry cultivation profitable. Mr. Minchin* has well pointed out that, under such circumstances, it is idle to expect a complete revolution in the agriculture of the country because it has pleased the Government to construct a huge work of irrigation. Another serious mistake has sometimes been made by taking a canal through a region already irrigated by wells. It is a well-known fact that well water is more productive than canal water, and canal-irrigated land is apt to become water-logged.

* *Academy* (February 27th, 1875), page 208.

for want of concurrent drainage. The real use of canals is to bring fresh and poor lands under the plough, not to bring out *reh* efflorescence, and to create water-logged villages; and a close attention to the lessons taught by accurately recorded agricultural statistics would prevent future mistakes in the preparation of large irrigation schemes. Another subject of inquiry, especially in the densely-peopled Lower Provinces of Bengal, relates to the preservation of the land from periodical inundations, whereby it is probable that large tracts of fertile land could be rendered available for food crops and human occupation.

The improvement of agriculture is in reality, as will eventually be recognised and acknowledged, the most pressing of all Indian questions; and reliable statistics are the chief instruments for its solution, for it is not by introducing European appliances and ideas that Indian agriculture can be advanced. The first step must be an exact knowledge of Indian facts, and the second a careful study of Indian methods. Although agriculture is sadly behindhand, this does not wholly or even mainly arise from ignorance, but from want of means. For instance, manure is not sufficiently used, yet this is not owing to want of appreciation of its value, but to the absence of available means for obtaining it. The yield per acre of nearly every description of staple is less than in other countries, although the population is over vast tracts more densely packed. Yet the soil and climate of India will yield cereals as heavy and as good as the English climate, if manure and liberal improved agriculture could be applied.

The condition of the people depends upon the state of agriculture, and questions of social science are ruled by facts recorded in agricultural statistics. It is well known to readers of police reports that increase of crime coincides with increase of the market price of food grains. Such principles as that industrious and hard-working classes* should pay more rent than those which are idle and improvident would scarcely be allowed to prevail if the facts were understood and appreciated, and more attention would be given to agriculture if its close connection with all social and sanitary questions was better understood. The prevalence alike of crime and disease is partly due to the fact that the people are insufficiently fed; and their misery is mainly the consequence of ignorance of facts, which should be collected and classified before action is taken which ought to be influenced by them.

Thus in India agricultural statistics are required to decide questions relating to the assessment of taxes, the averting of famines, the construction of public works, the improvement of agriculture and the condition of the people, and as the connection of India with this country is one which makes it a necessity that all the details of administration should be thoroughly understood, and that all information that is recorded should be available here as well as there, it is evident that the details needed in India are also needed in England. The only difference should be that while in India these details are primarily wanted to decide upon direct administrative action, and for guidance in settling pressing questions, in this country they should be marshalled and classified for the illustration and clear setting forth of the information they convey, so as to furnish effective assistance in the consideration of lines of policy, and reliable guidance in the formation of sound opinions.

*Kuornis and Kachis.

There can be no reason why Indian agricultural statistics should not be as well and as completely displayed and illustrated as those of any other country. To no country is agriculture more important, and in none does the existence of the people so absolutely depend upon its well being. In the formation of an efficient scheme we may obtain ideas from the reports that are prepared in other countries. For this object the returns published for Great Britain and Ireland are of no use. They consist of three tabular statements without commentaries, the first giving the number of occupiers of land, and owners of live stock, with the average size of each holding; the second having columns for population, area, area under corn and green crops, grass, fallow, permanent pasture, orchards, woods, and number of live stock; and the third, showing acreage under ten different crops, and percentage of corn crops, and live stock to total acreage. There is no other illustration, although rough attempts have occasionally been made to produce agricultural maps, showing the areas of prevailing crops.

In the United States there is a nearer approach to what the Indian returns ought to be. There are reports for each State, including the details for every county, divisions which correspond with the *taluks* in India, and these are combined in the annual report of the Commissioner of Agriculture at Washington. The tables for each State show the amount of the different crops, the average yield per acre, the number of acres under each crop, the price, and the total value; the number, average price, and value of live stock, and the acreage of forests and woods. The reports are illustrated in various ways. One very suggestive diagram shows the proportion of forest area of farm lands in the several States, with reference to timber and fuel supply. The diagram consists of square blocks, divided into white and shaded portions, showing the farm area in acres, and the proportion of that area under forest. The report is not a mere series of repulsive tabular statements, but consists of interesting chapters, illustrated by tables and diagrams.

In France the agricultural returns are most voluminous, and they furnish complete materials for their illustration by means of maps and diagrams. The agricultural map, recently prepared from these returns, by M. Delesse, is very suggestive.* It comprises the whole of France on a scale in 500,000, yet it shows the divisison of cantons (equivalent to Indian *taluks*) the arable land, pastures, woods, and vineyards, and the courses of equal revenue indicated by graduated shades. The whole forms a most suggestive and graphic illustration of one aspect of French agriculture.

In Holland, especially with reference to the development of the resources of Java, much attention has been bestowed upon the illustration of agricultural statistics, and monographs have been prepared on special products. In one of these

* "Bulletin de la Société de Géographie," October (1874), "Carte Agricole de la France," par M. Delesse, p. 337.

works there is a series of maps and diagrams, showing the results of rice cultivation in Java.* It strikingly illustrates the use that may be made of those items of information which show the cost of production, including the quantity of seed required to sow an acre. By this method the facts are presented with far more clearness and precision than if they were huddled into tabular statements. The map and diagram for each year, occupying a page, show at a glance the profit or loss on rice cultivation in every district of Java.

The maps and diagrams which have occasionally been prepared in India itself, are also suggestive, and some of them should certainly be adopted for continuation in a series. The maps of the earlier surveys in the Nizam's territory are very beautiful specimens of cartographic illustration, and show, besides physical features, the irrigation system, and the fields under wet and dry cultivation, as well as waste land. The series of maps prepared by Mr. E. A. Prinsep are also full of useful suggestions. One of these shows the productive power of a district as influenced by rain or aided by irrigation, with lines of rainfall, lines showing depth of water in wells, and other particulars. Others give areas under different kinds of produce, prices quoted in different markets, with a diagram, areas of various classes of soils, and physical features, with zones of fertility. Diagrams are also most useful aids to the comprehension of statistics, and often show at one glance what it would take some time to gather from columns filled with figures. In Bombay the extent of Government land annually in cultivation in each *taluk*, with the assessment on it during a series of years, is always shown by a diagram, and this is also the best method of showing the fluctuations of market prices. One large map of a collectorate, that of Sholapore, has recently been completed under the orders of the Bombay Government, which shows the division into *taluks* and villages, the river system, and the various tenures. Even on a smaller scale many other particulars could be shown, which are best exhibited by cartographic illustration, such as the distribution of soils, the wet and dry cultivation, the area of special crops, and the lines of rainfall.

Both from other countries and from India, many valuable suggestions are available for the illustration of statistics, so that in the commencement of a series of annual returns in this country, with the agricultural memoirs as a basis, there is excellent guidance. I should propose, in the first instance, to select one special agricultural region for illustration, as a type or pattern upon which other maps should be prepared on smaller scales and covering a larger area. This plan, which is suggested by the excellent tentative measures of Sir George Campbell, is, as it seem to me, almost a necessary preliminary to useful work. I have selected for typical illustration the most southerly district of British India, that of Tinnevelly, for several reasons, the chief of which is that the necessary details are likely to be accessible at present, and experienced advice is at hand. Tinnevelly also presents a great variety of features. It has an interesting system of irrigation, various soils, wet and dry cultivation, districts covered with Palmyra palms, special crops, such as cotton and senna, forests and coffee plantations; and it also includes within its limits, the two products which form the subjects of papers I have previously read before the Society of Arts, namely, chinchona cultivation and the pearl fishery.

Maps, with the same elaboration, could not be prepared on the same scale for all the districts of India. But the Tinnevelly map, besides its intrinsic value, will be very useful in showing the materials out of which smaller scale maps covering large areas are produced. Eventually, agricultural maps might be prepared for the Madras and the Bombay Presidency, for Mysore and the Central Provinces, and for other divisions of the Bengal Presidency, forming a series of most valuable cartographic illustrations of Indian agricultural statistics.

* "Bijdrager tot de taal-land en Volkenkund van Nederlandsch-Indie." (S. Gravenhage, 1874.)

DISCUSSION.

The **Chairman** thought it would be generally conceded that Mr. Markham had shown himself to be thoroughly master of the subject. With regard to the very great inequalities of the land revenue in Bombay and Bengal, the population of the Bombay Presidency had, it was said, been considerably understated, the difference being no less, according to some authorities, than three millions, which would cause the amount per head to be reduced. In Bengal the small return was part of the heritage of woe bequeathed to us by Lord Cornwallis, nearly [illegible] years ago. Holding as he (the Chairman) did, that the rent or revenue derived from the land was the wisest and most equitable way of raising a large portion of the revenue of India, he could only think of that measure of Lord Cornwallis with something like bitterness of spirit. When he thought of the millions of money lost to the country by that measure, and that it did in no way benefit the lower classes in India, but rather tended to impoverish them, he could not but look upon it as one of the greatest errors ever committed by a statesman. He was aware others held a different view, but that was his. The extinction of native institutions caused by that measure had also deprived Government of the means of getting correct information, and it would be a very long time before they could obtain returns again which would approach anything like accuracy. Mr. Markham had remarked that the improvement of agriculture would eventually be recognised as the most pressing of all questions; he fully recognised its importance at once. It was fearfully behind the mark. In a minute of the late Lord Mayo it had been said—

> "Of all branches of Indian industry, agriculture, which constitutes the occupation of the great mass of the people, is by far the most important. We believe it to be susceptible of almost indefinite improvement. It is not necessary to dwell upon the obvious and the necessity of increasing, in every practicable way, the supply of food available for the people of India. How this consideration affects the prospects of the permanent material advancement of the country has, of late years, been painfully and repeatedly shown by the famines which have taken place, and to the recurrence of which we shall ever be liable until the production of cereals is rendered more certain, and the facilities of conveyance immensely developed. For many generations to come, the progress of India in wealth and civilisation must be directly dependent on her progress in agriculture. In India agricultural and commercial progress go together. Agricultural products must long continue to constitute the most important part of our exports; and the future development of Indian commerce will mainly depend on the improvement in the quantity and quality of existing agricultural staples, or on the introduction of new products which shall serve as materials for manufacture, and for use in the industrial arts.
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> "The efforts of the Government of India and of English enterprise in such a direction have, doubtless, been very beneficial in their results. Thus, important progress has been made in regard to [illegible]. Large sums of money were spent in former years in attempts to improve its cultivation, but with little useful result, owing to the mistaken system under which they were made. Renewed attention has been more recently given to this subject with much better effect, and the extreme importance of doing all that is possible to improve

and develop the cultivation of this great staple is fully recognised by the Government. Jute, which not long ago was hardly used, has become an article of first-rate commercial interest. The partial success of our tea, coffee, and cinchona plantations shows what has been and may be done in introducing into India new and valuable products; the world derives from India nearly the whole of its supply of indigo. Other illustrations might be given to the same effect, but speaking generally, it cannot be denied that Indian agriculture is in a primitive and backward condition, and we think that it must be admitted that the Government has not done for its improvement all that it might have done.

"To state exactly what measures the Government ought to have taken in the past, or what course it should follow in the future, is undoubtedly not easy. It is hardly too much to say that scientific knowledge of agriculture in India has at present no existence. The common belief has been that the natives of this country can, in respect to the processes of agriculture, derive little or no benefit from any instruction which European science can give them. Such a belief rests, perhaps, upon observation of the obvious progress which has been made in many of the elementary requirements of agriculture in regard to tillage, rotation of crops, and so forth. But it has often been lost sight of that this sort of knowledge is only rudimentary and empirical, and that recent experience in all parts of the civilised world show conclusively that there is no branch of industry in which the effects produced by the intelligent application of science are more certain or more remarkable. We cannot doubt that when the light of science has been properly brought to bear upon Indian agricultural experience, the results will be as great as they have been in Europe.

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"In their well-known despatch of the 19th July, 1854, on the subject of education in India, the Court of Directors referred with approval to proposals that had been made for teaching practical agriculture. Quoting the words of Dr. Mouat, they said that there was no single advantage that could be afforded to the vast rural population of India that would equal the introduction of an improved system of agriculture."

That was an extract from Lord Mayo's minute, in which he probably said more evil of the Indian Government than Manchester had ever ventured to say, for he said the matter had been very much neglected. He (the Chairman) was happy to think that efforts were now being made to obtain reliable statistics to throw light on the agricultural questions which were so deeply interesting to all, and also to improve the knowledge and condition of the agricultural classes in India generally.

Mr. W. Taylor said that the subject of agriculture was most important in connection with the welfare of India. With regard to the statistics which had been so ably and elaborately set forth, he would merely say that, when derived from official quarters, they were received with some little hesitation by the outside world, but he was sure that, as far as they could follow Mr. Markham, they must gratefully accept the facts which he had brought forward. But what would be the practical result of these suggestions? For years he had himself been occupied with statistics of the most voluminous and elaborate character, and he was never able to find any practical result from what had been called the paper Government. In 1856, when he was Commissioner of Patna, he had to make serious objections to the education that was then going on. What the country wanted was industrial education; what the land wanted was improvement; what the people wanted to learn was not how to read Shakespeare, or write idiotic essays, but how to improve their own means of subsistence, and to perform their duty in that state to which God had called them. He had never ceased to feel that in spite of all our administrative excellence we had failed signally in that one most important part of our duty, the improvement of agriculture; for it was an undoubted fact, that some three-fourths of the population depended for their subsistence on the produce of the land. Whatever might be the improvements in other departments of administration, until the people were secured abundant food, and until the rotation of crops was secured, we failed in performing that duty which Providence had placed in our hands. We had proposals of all kinds for educating our future rulers; there were colleges at Oxford, there were schools of engineering, and other educational institutions, but there was no school for agriculture. What was the use of all this unless there was some instruction for the mass of the people? How were they to be profited unless we gave them practical instruction? He would say—let them have schools of instruction and museums where practical experiments could be carried on in the presence of the people, and until that was done he did not believe they would improve them. Then again, if agricultural statistics were important in themselves, still more important were they in connection with the most wonderful and most interesting subject of irrigation. He regretted to find that during the last few years the extension of irrigation had received a check. It was very true that saline efflorescence here and there might be injurious. It was very true also that in some districts drainage must accompany irrigation; but Providence had supplied the country with water, and they ought to utilise it, and thus spread the blessings of universal plenty throughout the land. He sincerely trusted that the elaborate statistics which had been gathered, would be utilised for the comfort and material prosperity of that great country, and that a new system would be inaugurated, in which agriculture would take its place among the arts and sciences they were introducing; yes, even above judicial administration or legislative enactments, or any of those more advanced symbols of civilisation which England prides herself in introducing, and that ere long there would be seen a people happy in themselves, and secure in their crops from the fearful effects of periodical famine.

The Rev. J. Long remarked, that when the International Statistical Congress sent to the Turkish Government to get some statistics, the answer returned was that they had none, and the same remark would apply to India on that point. The people did not understand what they were wanted for. They had a suspicion if any inquiry were made, that it was done with the object of increasing their taxes. The same difficulty he had experienced when making inquiries into their social condition. He knew of men who would not tell you the names of their wives, because they thought you wanted to interfere with their private affairs. To get information precise questions must be put. Half the battle lay in putting a proper question. If you simply said to a man, "Tell me all you know about such and such a thing," you got nothing. The late census report taught them very solemn lessons of the necessity for accurate statistics in India, and the gross mistakes into which they had fallen about the population. First it was 120 millions, then 150 millions, then 180 millions, then 200 millions, and now it was thought to be 250 millions, and probably even more than that. As regards even Calcutta itself, there had been a difference in the estimate of some two or three hundred thousand people. He was glad to find that the village system was to be an integral part of British rule; for until lately, wherever they had gone, they had introduced the feudal system, and had disintegrated the people. He was surprised to find at Washington the immense amount of statistics which had been collected there, and he would be glad to see a similar collection here.

Mr. Elliott thought that the difficulty of obtaining correct statistics would apply to any country, and did not show the evasive character of the people. With regard to saline efflorescence, he had heard of an instance of it in Tasmania, which showed how very insidious it was, and how very careful they ought to be in examining the soil thoroughly before committing themselves to large irrigation works. The land in Tasmania which was irrigated had borne excellent crops for 15 years, and was the surprise of the whole country; but after that time it turned utterly barren, and he had no doubt it was simply owing to saline efflorescence. Salt existed in quantities in the neighbourhood, and this rose to the surface. As regarded the agricultural statistics, he thought the point of beginning should be to ascertain the qualit and the quantity of the culture of the land. That know

ledge was of all knowledge the most important. It was not alone sufficient to ascertain what was cultivable, but they must know how much must be set aside for cattle and for sheep grazing, and this they only could know by accurate statistical information.

Mr. Bremner said it would be very valuable if some definite good could be extracted from the valuable paper to which they had listened. It would also be of very great importance if some definite information could be obtained as to what were the real difficulties which stood in the way of irrigation. In Manchester they had been favoured with the visit of Lord Salisbury, who referred to the effect of saline efflorescence, and of the unwillingness of the population to use the water, as reasons against the extension of the system. Then there was Sir Bartle Frere, who described all this as moonshine. Then there was Sir Arthur Cotton, who believed irrigation was the only remedy for drought. It was of vast importance to know to what extent this saline efflorescence was an objection, and whether the people were really unwilling to use the water. If ever they were to derive that benefit from India which they ought to, they must develop the agricultural resources of the country, and this they could only do by obtaining reliable statistics.

Mr. Trelawny Saunders believed that hitherto statistics had been obtained by Indian officials, not so much in the interests of the people as in the interests of the Government revenue. The object of the collector of the statistics had really hitherto been to extract as large a revenue as possible for the Government, and not for the purpose of informing the people what the land would produce, or the nature of the soil, and so forth. So oppressive had this sometimes been that it had led to the ruin of the cultivator in too many instances, and to the reduction of the sources of living over large areas. At least this was so in the north-western provinces, where in some parts the habitual condition of the population was one of semi-starvation. If statistics were to have any benefit, they must be sought with a different view to that. It had often been said by Indian officials that minute statistical researches in India were subjects that could only be interesting locally, but that was not so, for one of the results of these inquiries was that you brought to bear upon the information obtained the intelligence of the world, and were able to make a comparison between the statistics of one country and another, and so bring the most valuable aid to the solution of the various problems. It would be to minimise the advantage to be gained, if the knowledge of these statistics was to continue to be confined to the lowest classes by the details being preserved only in the vernacular. In India there were greater facilities than here for the collection of them. There was a distinct account of the villages and hamlets giving details of the various instruments employed in the cultivation, the nature of the soil, the character of the inhabitants, their dwellings, &c. We owe our present statistics regarding births, deaths, and marriages to the system of registration districts. But each of our registration districts was a large parish, or contained a large number of villages and hamlets, and the registrar was a person who had to watch over a large space; but in India the statistics upon which the revenue was calculated were obtained from an official possessing his office by hereditary descent, and who possessed facilities which enabled us to obtain complete returns. But by the substitution of the zemindary system for the ryotwarry system (which was for a very useful purpose, viz., the setting up of a class of great landowners who should owe their possessions to ourselves, and therefore be interested in maintaining our power), this was altered. Sooner or later statesmen would have to return to that system, or substitute some other means of placing the collection of statistics in all parts of India on an equally advantageous footing. When that was done he believed it would only rest with the Government to publish the returns.

Mr. Botly thought Mr. Markham had scarcely allowed due value to the important information published by the Statistical Society, and to the agricultural statistics of England, published in the *Agricultural Journal*, and observed that formerly the same difficulty was experienced here as in India of collecting statistics.

Mr. C. Meenacshaya desired to make a few remarks in consequence of what had fallen from the Chairman. He thought it was rather hard to condemn a measure because it was introduced in a manner altogether incorrect and irregular. A comparison had been made between the state of Madras and Bengal in an agricultural point of view, but with all its defects and drawbacks the permanent settlement had worked with greater advantage than the ryotwarry system. The first principle of ryotwarry settlement was that a maximum rent was charged upon every field, payable upon good crops, and then there was an annual settlement for the purpose of settling the accounts, at which the ryot was able to state his grievances, such as a failure of crops, and so forth, urging these as reasons for lowering the rent. This led to great demoralisation, for an unpleasant struggle was continually going on between the collector and the ryot, the one trying to extract too much rent, and the other entering into all sorts of combinations and machinations, and tampering with the officers of the Government, in order to get rents reduced.

Mr. Markham, in reply, said that wherever there was a cadastral survey, there were returns of all the land cultivable and uncultivable within the area, but beyond that in some parts of India there were lands which were called forest, and also land for grazing of which there were no means now of ascertaining the area.

Mr. Elliott asked whether there were any returns of uncultivated cultivable lands.

Mr. Markham said yes, wherever there was a cadastral survey. The most important point connected with the matter was the survey of the forest lands, and that had not been commenced yet. The question whether irrigation should not be undertaken on account of efflorescence, or because people did not want the water, could also be ascertained by carefully collected statistics, which would also prevent canals being made in the wrong places. He was certain that irrigation was most important, but engineers should not merely introduce canals, but go to the question of agriculture, and ascertain whether the people wanted them or not.

The Chairman, in proposing a vote of thanks to Mr. Markham, said that to his mind the question of irrigation seemed to resolve itself into a simple question of statistics. Let them only know the truth, and they would soon find a remedy for every evil.

It has been decided to postpone the opening of the Exhibition of Scientific Apparatus at the South Kensington Museum until March, 1876.

Near Papakura, an ancient Kauri forest was buried at some remote period. Much of the timber has recently been dug up in perfectly sound condition, and it has been used for sleepers on the Auckland and Waikato Railway.

With regard to the proposed staff of examiners under the new Patent Bill, it may be worth noting that the examining staff at the American Patent-office numbers [illegible], the total salaries paid to them amounting to £37,840. This is independent of the other official staff, and refers only to examiners and sub-examiners. The total charge for salaries in the United States Patent-office was last year £96,411.

MISCELLANEOUS.

ELEMENTARY, PHYSICAL, AND MENTAL TRAINING.—THE TUFNELL TESTIMONIAL.

A numerously attended meeting of head masters of elementary schools, chiefly of the district institutions for rearing orphan and destitute children in the metropolis, was held at the rooms of the Society of Arts, on Saturday, the 15th inst., for the presentation of a service of plate to Mr. Edward Carleton Tufnell, as a testimonial of regard and esteem, on his retirement from the public service as one of Her Majesty's Inspectors of those schools. Mr. Edwin Chadwick, C.B., presided, and gave the following address:—

MY EARLY COLLEAGUE AND DEAR FRIEND,—I have the honour to be charged by a committee comprising the head teachers of the foremost elementary half-time schools and of others, in number upwards of 170 persons, who as head masters or pupils have served or have been reared in the educational institutions under your inspection, to present to you the handsome testimonial of plate before you as a mark of their appreciation of your self-denying labours for upwards of 40 years to improve the education of the poor. If the testimonial were, as it might well be, simply one of acknowledgment of your kindness and sympathy, and of benefit derived from your efficiency in the maintenance of educational institutions on old, long established, and settled principles, my task might be very shortly and easily performed; but your service from the first to the last has been one of peculiar and rare difficulty, in dealing with conditions of lamentable disorder,—of dire suffering amongst the most depressed classes of the population, and, with widespread public evil requiring the execution of new and untried administrative principles and legislative measures to cope with them. To those measures, in justice to you and to them, it is requisite that I should advert, and I do so from experience and observation in the position of Commissioner of Royal Commissions of Inquiry, and particularly as the last surviving member of the central boards of two Royal Commissions of Inquiry under which you served as an assistant commissioner with us forty years ago. Your service involves large historical facts as to the progress of legislation and administration for elementary education not so readily got from books, and so I may fittingly relate somewhat of the deplorable condition of large masses of children of the wage classes which we had your aid in examining and in devising means of relief for. And, first, under the commission of inquiry into the condition of children and young persons employed in factories, in the greatest number in the cotton factories. We found there the widely-spreading practice to employ children, often of the tenderest years, to work during the same long hours as adults, with the result of crippling many for life and weakening and stunting that class of the population bodily, and at the same time stunting them mentally by excluding them, by the long hours of manual labour, from the benefits and the rights of education. As against the one evil of the overworking of the children and young persons, what was called the ten hours' bill was proposed to reduce the labour of all engaged in factories, adults as well as children, to one level of ten hours' daily work. But we set aside the measure as being founded on no sufficient definite legislative principle, as having no sufficient executive machinery of inspection, and as being, as it was, practically unworkable. Ten hours of daily manual labour, we declared, was too long and injurious for little children, and we pronounced that for them six hours of daily manual labour fully sufficed, and that where their labour was needed it should be applied in double sets. As a security for education, and also as an important and requisite security against overwork, by collusive employment in double sets, in different manufactories, on the same day, my colleagues agreed with me in proposing that, as a condition to qualify them for employment, they should every Monday each produce the certificate of some approved fitting teaching in a fitting school, certifying that the child had each day during the week preceding been three hours in that school. My colleagues also agreed with me then, and it has been very much proved by your exertions since, that three hours of daily direct teaching, or that amount of time on alternate days, exhausts the profitable mental receptivity of children of the usual elementary school ages. Hence arose the "half school-time system," which is in the course of extension in this country, on the Continent, and in America. Now I know no one who has had so clear a perception of the principle of that measure, who has had so firm a hold of it, who has done so much to prevent it falling through, and for its extension to wide fields of service, naval and military, as well as civil, general, and industrial, as you have had. I know no one who has shown himself so strongly impressed with the need of the careful combination of bodily, with mental, for the elementary training of the young. You have been one of the foremost to perceive that we want physical training for sanitary purposes to keep up physical force;—that we specially need it for economical purposes to maintain industrial force; and that we need it, moreover, for political purposes to maintain military force. Primarily, in the economical and industrial aspect for industrial force the physical training has been promoted by our Society of Arts, and displayed at their successive school drill reviews of the children trained in the institutions where these exercises have been most advanced under your inspection. As respects the first factories regulation measure, out of which this "half school-time" principle arose, I may state that I was charged with the preparation of the Bill founded on our report, and that, as we got it passed through the House of Commons, it contained provisions of rating powers for securing fitting schools where none existed, and also powers to secure fitting teachers. But these provisions were thrown out in the House of Lords expressly on the ground that they would lead to that, which is now at length determined upon, namely, a national system of elementary education, as, indeed, I believe they would, but in better ways and in better principles, as increasing experience is showing, than those at present adopted. By subsequent agitation, the limitation of the labour of adults to ten hours was obtained; but their case was not within the reference to us, and the special limitation of the hours of labour for children and young persons, and of half-time teaching, with inspection, as provided by our measure, has continued to be the basis of subsequent legislation for the regulation of factory labour, abroad as well as at home. Your next services in the advancement of elementary education were with our Board as an assistant commissioner of poor-law inquiry. We there saw that we might take as a national rule the great old Hebrew maxim that "He who does not teach his son a trade, teaches him to become a thief." In these poorhouses the children were not taught trades; and we found that only a minority gained self-supporting employment, and that the career of the majority was corroborative of that maxim. Of those who did not return as paupers the greater proportions were found in the streets as mendicants, or in the prisons as delinquents. The teachers in these schools were of the cheapest and lowest sort, often drunkards who, as paupers, were paid miserable pittances for teaching the children the three "R's" and their catechisms. The general teaching was then low and coarse, and the general outcome, in the manner and behaviour of the children, was coarse and repulsive. We found, moreover, that the association of orphan children under the same roof with adult and confirmed paupers

exercised a baneful influence, which the best trained teaching could do little to mitigate. Our principle of amendment, as Poor-law Commissioners of Inquiry, was separation,—the economical principle of "aggregation for segregation," of segregate or class treatment to the extent of separate institutions for the deaf and dumb and the blind. Our examples of success, as stated in our report, were of separate training institutions. I confine myself to the statement of the fact that the treatment of small numbers of orphan children in union houses is in contravention of these principles, and has been a grievous failure, which you were of the foremost of our assistant commissioners in endeavouring to get retrieved. There fell early to the direct control of our Board a large separate establishment at Norwood, comprising nearly a thousand children, under a contractor (Mr. Aubin), for the treatment of the children of a number of the smaller parishes. Though it was a separate establishment, the results from cheap and comparatively inferior teachers was unsatisfactory. You, with Dr. Kay, another of our assistant commissioners (now Sir James Kay Shuttleworth), were entrusted with the task of amending the administration, by an improved classification, and showing what might be done by the application of better teaching and training power on the half-time principle. The first difficulty experienced was in finding fitting school teachers, and you had to send and get them from Scotland. The industrial training of the elder boys—shoemaking, tailoring, and carpentering—were supplemented by a naval and military drill, for all the boys above six years of age. The results, as I may show in their national bearings, you wrought by the application of the principle were highly important. One economical result displayed was that the cost of this segregation and treatment by a staff of school teachers and trainers, instead of being much greater, was much less per head than that of the single school teacher. You had peculiar experience in the work there—that the immediate obstacle to the extension of the system was to obtain fitting teachers; that the elevation of the condition of the school teacher was vital to the advancement of education. My own observation had deeply impressed me with the maxim, "As is the teacher, so is the school." On looking at the teacher or the teachers and the children, I could soon, as a commissioner of inquiry, anticipate very much of what I should find to be the general outcome of the school. You, in your earnestness in this as a primary objective point for improvement, succeeded in inducing Dr. Kay and one of our commissioners, Mr. Nicholls, to visit Holland, Germany, and Switzerland, and observe the better organisation and trained school teaching there. On your return, Dr. Kay and yourself, by your joint individual efforts, got up the first training college in this country, that at Battersea, to the establishment of which we know you gave more than three years of your salary. It is too long to trace the issue of the lead of that joint effort, in the foundation of 40 training colleges now established in this country, and comprising more than 20,000 pupil teachers. Of the teachers trained in that first college some have become leaders in education, who join in the memorial of acknowledgment now to be presented to you. You were of the foremost assistant commissioners in the obtainment of amended powers for the general establishment of industrial institutions for the reception of orphan and destitute children, in districts of unions, on the principles successfully applied at Norwood. Fortunately, the lead in the subsequent organisation of the chief district schools of the metropolis fell to you, as our inspector, with the experience you had obtained at Norwood and at Battersea, and with the supply of trained teachers, and gained there available for the service. On an examination of the working of the earliest previous separate training institutions to which I have referred, my colleagues of the Poor-law Commission of Inquiry were led to state in the conclusion of our report, recommending a general system of elementary education as the primary means of prevention:—"We believe that if the funds now destined to the purposes of education, many of which are applied in a manner unsuited to the present wants of society, were wisely and economically applied, they would be sufficient to give all the assistance which can be prudently afforded by the State." Now this conclusion your service mainly has verified, to an extent beyond what we could then have confidently anticipated, and has afforded a basis of experience applicable to the improvement of the national elementary training and education of the country, and to a gain in time, in money, and result, which, without your service, in all probability we should not now have possessed. And, first, as to the gain of time by the division of labour in education, as against the present common condition of school teaching by single trained teachers,—with a mistress and one or two pupil-teachers. I will endeavour to exemplify the principle, for the advantage of those here who have not had an opportunity of considering it. The mother of a large family who has to teach her own children—as many mothers in remote districts have to do—will have as many grades to teach as there are children. She will have her infant school on her lap; then her primary school, for the three R's; her secondary school; and even her superior school, with the biggest boy. She can only give direct instruction to one at a time,—to one, spelling lessons; to another, writing lessons; to the bigger boy, his grammar lessons, and so on in succession. A maiden lady, who had to act, as aunts often have, as assistant teacher to her married sister's children, observed what a convenient thing it would have been for teaching children if all came at once in one litter, so that they might all receive simultaneous class teaching. The single village school teacher has as many distinct classes of distinct ages and conditions to deal with as in the large family. As a rule, he has at least six distinct classes, and he can only give direct instruction—the only effective instruction—to one class at a time; and whilst he is teaching the one class he is subjected to a wearisome conflict with the outbursts of irritability from the pupils, and from the impatience of waiting unoccupied. He may get mitigation and relief by the aid of one or two pupil teachers, but the general educational organisation throughout the country is of some schools averaging a hundred pupils under single masters, with one or two pupil teachers in six class schools, who can and who only do get them through the six classes in seven years. As a rule they are all seven years schools throughout the country. As a rule they all require (and it was the requirement of the Newcastle Commission) compulsory attendance at school up to the thirteenth year. But the children of the wage classes begin to earn money—now more than ever—between their tenth and their eleventh year. The present scheme of compulsory attendance to the end of the thirteenth year amounts to a forced sacrifice of two years and a half, or three years of wages, often averaging four shillings a week. Against this sacrifice there has been almost a rebellion, as it was foretold there would be, and children are taken away half taught. Out of a million and a half children last in the national schools, only sixteen thousand were got up to the required standard. And, at what cost is this? at £2 per head per annum, or a total of £14 for the seven years of completed results when attained. There are yet 4,000,000 of children to be got into State aided schools on this scheme. The demand of time to the thirteenth year for primary education, moreover—as we complain at the Society of Arts—excludes the greater part of the children of the lower and middle class from secondary art and science education, as their exclusion from employment cannot be afforded beyond that time by that class. Now, by the division of educational labour in these special schools, for each of these, say normal six separate classes, a trained teacher is provided, who

keeps every pupil of that class occupied without intermission,—it may be from the first minute to the last that he remains in the school, in his one class, under constant direct teaching. The "half-timer," who goes into the common single mastered schools can only receive by special accommodation one-sixth, or one hour of direct teaching; but in what would have followed our original intentions as a fitting school under fitting teachers, with a proper division of educational labour, he would have received his full three hours of direct teaching, or as much as is compatible with the powers of mental receptivity of children of the primary school stages. Now, in the graded schools, fostered chiefly under your superintendence, more is imparted by the tenth or before the eleventh year to the children, by the time their productive services are required, than can be given under the existing plans. For by the thirteenth year, including the infant school, the instruction and training is imparted in four and a half years (instead of seven), with military drill, free-hand drawing, and vocal music. Moreover, the outcome is of more docile, and better mannered children, as well as more apt for service. With the combined bodily as well as mental training, the efficiency of three is imparted to two for future service. To do this, in the place of the single master, with his one or two assistants, costing £160, or £2 per head per annum for teaching for seven years by the division of educational labour, the teaching power of a head master at some £200, or £250 per annum, a second master at £150, and a third master at £100, with a staff, it may be of six or eight pupil teachers at a cost of £1 per annum, for that largely teaching power, for four and a half years. In other words, on this economical principle, you bring to bear upon each child in its turn, a teaching power costing five or six hundred pounds, that is to say, three or four times more than in the common school, but with a more than double economical result. It is to be observed too, as respects the school-teaching profession, that the common single-mastered schools throughout the country present even to the trained teacher only one dreary dead level of condition, from which he has no prospect of rising so long as he remains within the profession, whilst the principles most successfully developed under your superintendence present gradations of remuneration, of social condition, and distinction, which must needs be augmented for the attainment of higher economical results to the community. The classes of children dealt with in these orphan district schools are, it is to be borne in mind, of the lowest types of humanity, most difficult to treat even when they are received in infancy, whilst many are received there who have been reared for years in habits of bodily and moral depravity, in conditions almost hopeless of cure if they remained a sufficient length of time for reformation, but many of them remain only a short time, and are taken back, girls especially, into the worst associations in the most depraved abodes. Such exceptional cases have been unjustly held out as the general rule of result of the institutions in question. But those who know the actual conditions dealt with, know that the general results have been of the highest order of success of any elementary educational training whatsoever. Whilst, as I have stated at the outset of your service, not above one out of three of the orphans reared from infancy in the poor-houses of the metropolis attained conditions of self-supporting industry; now the failures to do so of those reared in infancy form a smaller percentage than amongst children of the comparatively well-to-do classes, or not more than some 4 per cent. Then, as I have stated, whilst destitute orphans reared in parish poor-houses formed a large proportion of the prison population, and the most difficult to be dealt with, now they are less frequently met with there than those reared in independent conditions of self-support. This success of fitting training and teaching by fitting teachers is largely aided by the ministrations of the Chaplains in insuring to the pupils fitting places. The early success of these children in places of productive industry is only traceable for a year or so, after which a large proportion are lost amidst the general population. We positively know, however, how rarely they are found in the streets or in degradation. Mainly by a teacher from your training college of Battersea, as a head-master, the mixed industrial system of training has been applied for the training of the class of former castaways as camp followers, the orphan sons of soldiers, who now volunteer for the army, and there the outcome is traced accurately as of pre-eminent success, including a large proportion of attainment of the position of non-commissioned, and even of commissioned officers of the army; and we have examples of the like results of the success in civil life of the orphans reared in the separate district institutions. For the information of the Newcastle Commission of Inquiry on Elementary Education, I had occasion to put the following questions to you, to which I add your answers, as a summary of the bearing of your service upon the future of national elementary education. "Does your administrative experience enable you to state that with full power as to the means you would ensure, with confidence, the like general results of the half-time industrial district schools with the drill, in insuring fitness and general permanence in productive employment of the children of the vagrant pauper class as well as of others?—Yes; if I am given charge of such children I can, with positive moral certainty, ensure of the class that, as a class, they shall never be vagrants or paupers again. This I can undertake positively." Now, if I were to appeal to the officers and head teachers of the great teaching and training schools here present, under whose ministrations many thousand such children have passed, I know that the confident response will be, "Yes; that may be done, for it has been done, and we have done it, and are doing it." I then, as an economist, put to you the next queston, "At what expense?" To which you answered, "At the like expense to that incurred in the chief instances. For example, in the Stepney school the expenditure has been four and eight-pence per week," of which you give the details. The expense of teaching power, including the moral and military drill, being fourpence halfpenny per week, or about a pound per head per annum, the total time of imparting the elementary school instruction, including the infant school, being there four years and a-half. The next great questions and answers follow:—"That is to say, the experience is such as to enable you to ensure so far moral as well as intellectual results?—Yes." "And this conclusion you deem warranted by experience as applicable by appropriate administrative means and organisation to the whole of the children of the poorer classes of the country?—Yes." Foreign commissioners, engaged practically in education, who have visited the institutions under your particular inspection would agree that the sum of experience now gained with them justify this great conclusion. Our one leading conclusion at the Poor Law Commission of Inquiry was that, whilst the first action in dealing with the evils of pauperism must needs be repressive, we must look for effectual prevention to an improved system of elementary education and early training. I cannot help feeling how much it would have gratified our great colleagues—our chairman, Bishop Blomfield; Bishop Sumner, afterwards Archbishop of Canterbury; Mr. Senior, the professor of political economy at Oxford; and others—if they could have been spared to hear the confirmation of their solemn convictions on that topic, on such testimony as that which I have recited. From the opening to the close of your official service you have given yourself, with a truly Christian spirit of self-sacrifice, to the relief of suffering children and the elevation of the most depressed population. In that service you have ever acted in the least degree with the force of peremptory authority, and in the highest degree with the

force of friendly and aiding sympathy with the teachers. And now that your official career has ended, I may express, on their parts, their hopes that rest may restore your health, and enable you to continue your visits, if not as a superior officer, as a friend, animating their labours by your sympathy and advice, and that you may be enabled to act with the greater freedom in vindication of the principles you have so pre-eminently promoted. Hundreds of thousands of orphan and deserted children will have already benefited by them. Millions of children of the general population may hereafter benefit by your labours, by relief from barbarous and unnecessary long school time compulsion, and by a better preparation of body as well as mind for the work of the world before them.

Mr. Tufnell expressed his thanks to the subscribers for the spledid testimonial they had awarded him, and continued — From the commencement of my official career, it struck me that the chief obstacle to the general improvement of the people was their defective education. I continually had in mind the words of Shakespeare, that "Ignorance is the curse of God, knowledge the wing wherewith we fly to Heaven." And in fact I do not understand how it can be doubted that many of the evils that afflict humanity might be counteracted by improving the intellectual condition of the people. Is it not clear that most diseases owe their existence to the deficiency of sanitary knowledge; that ignorance of the laws of health causes the large death-roll that weekly appears in the papers, and continually remind us of the words of the prophet, that "The people are destroyed for lack of knowledge?" Is it not obvious that much of the vice and immorality that prevail would succumb to a greater extension of religious knowledge? And in this building, belonging to a Society for the Promotion of Arts, Manufactures, and Commerce, it is appropriate to remark that no better means could be devised for that promotion, and meeting the competition to which our manufactures are exposed abroad, than the increase of scientific knowledge. And shall I be saying something unsuited to this meeting, if I hint that those who rule the destinies of this and other nations might sometimes perform their duties more efficiently, if they were better acquainted with the science of political economy. In truth, it seems to me almost a truism to assert that of all the miseries and evils that depress our prosperity, many might be mitigated, and not a few entirely removed, by increasing the intelligence of the population. The Chairman has alluded to a point on which I have always taken the greatest interest, the conducting of schools on the half-time principle. All the schools that have been under my inspection have been managed on this principle, *i.e.*, one half of the day has been devoted to intellectual learning, the other half to industry, and I believe that in the institution of half-time schools is to be found the real solution of the difficulty of enforcing education compulsorily on the poorer classes, which is now puzzling many of the School Boards. But the point of my past career which I look upon with the greatest pride and satisfaction, is the part I took in the foundation of the first training college in England, at Battersea. Having found the difficulty of procuring efficient teachers, I determined to see what was done in foreign countries; I accordingly travelled over France, Germany, Holland, and Switzerland for the purpose of discovering how this matter was managed in those countries. The effect was to make me ashamed of my own country, and on my return, in conjunction with Lord Auckland and Sir J. Shuttleworth, we founded the Battersea Normal School, the first institution for the training of teachers in England. We were met with the usual fate of improvers. We were pooh-poohed, then abused, and then imitated. The last was the only thing I cared for, and now I have the satisfaction of seeing the establishment of forty training colleges, all founded on the principles first exemplified at Battersea College, which I am glad to see still maintains its superiority in the number of first classes it obtains in the yearly competitive examinations. I take the credit of having set the machine going; it has been worked efficiently by the teachers I now see around me, and I could almost envy the retrospect of many I see here, when they consider the thousands they have raised by their instruction from the deepest ignorance and poverty to a state of comfort and respectability, and imparted to them that which has secured their welfare and independence in this life, and inspired them with the hopes of a brighter and happier life hereafter.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The following arrangements have been made :—

MAY 26.—*No Meeting.*

JUNE 2.—"Toughened Glass." By PERRY F. NURSEY, Esq., C.E.

MEETINGS FOR THE ENSUING WEEK.

MON. ...Fisheries Preservation Society (at the HOUSE OF THE SOCIETY OF ARTS), 3 p.m. "Conference on Pollution of Rivers."
Royal Geographical, University of London, Burlington-gardens, 8 p.m. Annual Meeting.
Birkbeck Scientific Society, Southampton-buildings, W.C., 8 p.m. Mr. J. H. Shirley, "The Halogens." (II.)
British Architects, 9, Conduit-street, W., 8 p.m.
Linnean, Burlington House, W., 3 p.m. Annual Meeting.

TUES. ...Inventors' Institute (at the HOUSE OF THE SOCIETY OF ARTS), 4 p.m. "Conference on Patent Law."
National Indian Association (at the the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Mr. Framjee R. Vicaji, "The Social and Political Effects of Railways in India."
Royal Institution, Albemarle-street, W., 3 p.m. Professor Gladstone, "Chemical Force."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 9. The President's Annual Conversazione, in the Galleries of the Indian Museum, Exhibition-road, South Kensington.
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Mr. G. T. B. Lloyd, "The Beothucs of Newfoundland." (Part II.) 2. Professor Busk, "Description of some Beotic Skulls from Newfoundland." 3. Mr. T. G. B. Lloyd, "The Stone Implements of Newfoundland."

WED. ...Cymmrodorion Society (at the HOUSE OF THE SOCIETY OF ARTS), 7½ p.m.
Geological, Burlington House, W., 8 p.m. 1. Mr. Frank Rutley, "Notes on some peculiarities in the Microscopic structure of Felspars." 2. Mr. Ralph Tate, "The Lias about Radstock." 3. Mr. H. G. Seeley, "The Axis of a Dinosaur from the Wealden of Brook, in the Isle of Wight; probably referable to *Iguanodon*." 4. Mr. H. G. Seeley, "An Ornithosaurian (*Doratorhynchus macrurus*, Seeley), from the Purbeck Limestone of Langton, near Swanage."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. C. H. E. Carmichael, "The Petrarch Collection at Trieste, with Notes on the Centenary Edition of the 'Africa,' and on the Unedited Writings of Petrarch."
Archæological Association, 32, Sackville-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THURS...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Morley, "Inner Thoughts of Shakspeare's Plays (III.)
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "The Progress of Physico-Chemical Inquiry."
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

FRI.......Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Colonel Lane Fox, "The Evolution of Culture."
Junior Philosophical Society, 6A, Victoria-street, S.W., 7½ p.m. Mr. John A. Combs, "The Atomic Theory."
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Classification of Plants." (III.)

SAT.......Royal Institution, Albemarle-street, W., 3 p.m. Prof. Douglas, "The Chinese Language and Literature."

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FRIDAY, MAY 28, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The Society's Conversazione will be held on Friday, June 25th, at South Kensington Museum, by permission of the Lords of the Council on Education. Cards will be issued in due course.

CHEMICAL SECTION.

A meeting of this Section was held on Friday evening, May 21st, Mr. F. A. ABEL, F.R.S., in the chair.

The paper read was—

ON MODERN BLASTING AGENTS.

By Alfred Nobel,

The Founder of the Nitro-glycerine Industry.

It is intended in this paper, as far as its limited space will allow, to attempt to compare the concentration of power, velocity of explosion, and immunity from danger of modern blasting agents, being the three points on which mainly depend the success or unsuccess of a new explosive substance. But, before entering on that subject, it may be well to take a short retrospective view.

From the time of Schwarz, or some inventor before him, to the latter part of the last century, no explosive substance fit in any way to compete with gunpowder was discovered; invention in that direction was therefore locked. Then came the dawning era of modern chemistry, and with it the discovery of numerous explosives, such as the nitrates, chlorates, fulminates, chloride of nitrogen, &c., most of which are dangerous, but strong. Attempts were made soon after the discovery of chlorate of potash to apply it as a substitute for the nitrate in gunpowder, but the great liability of the new compound, as then made, to explode by slight friction proved a complete barrier to its use. Next came a period of comparative inactivity, until Pelouze, in 1838, announced that cotton could be converted into an explosive substance, and Schönbein, in 1846, began to apply it. The discovery created an immense sensation, and Government as well as chemists looked upon it as the great explosive of the future. Although that expectation proved over-sanguine, yet gun-cotton remains to this day a great and useful explosive. The excitement which it created raised the interest of chemists in nitro compounds, and amongst a whole series of such, which were quickly found, figured in 1846 one called by Sobrero, its discoverer, nitro-glycerine. That substance attracted but slight attention at the time, but has since become the most formidable of applied explosives.

From the gun-cotton epoch until now the chemistry of explosives has received but scanty additions to its already very numerous stock, which consisted of all the nitrate, chlorate, and perchlorate powders of all the fulminates proper, many unstable nitrogen compounds, of which chloride of nitrogen is the type, all the picrates, several nitrated ethers, nitro-mannite, nitro-sugar, nitro-starch, and a whole host of analogous compounds. But although the number of new explosive substances has not increased of late, yet the innovation of firing powders, by local detonation instead of a mere spark, which will be explained hereafter, has immensely widened the field. It may be broadly stated that there is not one of all the innumerable organic compounds known, which, intimately mixed with a powdered nitrate, or chlorate, and nitro-glycerine, will not explode on being fired by a strong detonator-cap, such as are now largely used in mines. Hence it will be readily understood how easy it is to multiply the number of detonating mixtures offered for industrial purposes, and how necessary it becomes to guard against inferior explosives.

It is not sufficient, indeed, that a substance is explosive, or even powerfully explosive, to render it useful for practical purposes. There are a great many other questions which have to be considered; in the first instance, whether it compares favourably with those substances already in use which it has to compete with; again, if the same power can be lodged in the same bulk; what the cost of manufacture is, and what danger or difficulties attend it; whether it offers the necessary chemical stability in all climates; whether its carriage and use are not too dangerous for its practical utilisation; whether it is hygroscopic, and how it is affected by contact with water; and finally, what influence the gases or fumes produced by the explosion may have on the health of the miners.

This explains why it is difficult, even with more powerful explosives at command, to supersede gunpowder. That old mixture possesses a truly admirable elasticity which permits its adaptation to purposes of the most varied nature. Thus, in a mine, it is wanted to blast without propelling; in a gun to propel without blasting; in a shell it serves both purposes combined; in a fuse, as in fireworks, it burns quite slowly without exploding. Its pressure, exercised in those numerous operations, varies between one ounce (more or less) to the square inch, in a fuse, and 85,000 lbs. to the square inch in a shell. But, like a servant for all work, it lacks perfection in each department, and modern science, armed with better tools, is gradually encroaching on its old domain.

Still all attempts in that direction were for a considerable time fruitless. Chlorate of potassium amongst others has been the chief ingredient in a great number of powders, which have failed, not because of their danger, for which there is a cure, but because the addition of cost to that of gunpowder, is out of all proportion with the slight addition of power.

More recently the picrates have turned up. Designalli's powder—picrate and nitrate of pot-

assium mixed—and Brugère's, wherein the picrate of ammonium is substituted for that of potassium in Designalli's mixture, are stronger than gunpowder, and would at a reasonable price do very well if they had nothing more powerful to compete with. As it is they command no sale.

The nitrates of sodium and barium have been tried as substitutes for saltpetre in gunpowder, but the hygroscopic nature of the one, and the low percentage of oxygen in the other, have checked their use.

Various mixtures have from time to time been proposed wherein the sulphur and charcoal of ordinary powder, one or both, were partly or wholly replaced by other combustibles; but such alterations have always tended to produce a slow explosion, which, for blasting, is the reverse of what is needed. They never were of any use.

Nitro-starch, proposed as a substitute for gunpowder, was tried and abandoned. It has very little power. Nitrated wood fibre is better, and is still, though not largely, used for guns. For blasting, both are equally worthless. Quite recently nitrated cane sugar, discovered by Sobrero, has been proposed as a blasting agent under the very expressive name of "Vizorite." Being of a sticky, resinous consistency, it is extremely difficult to manufacture, and especially to purify from adhering acids, and is on that account very liable to undergo chemical change, ending in what is called spontaneous combustion. It is, moreover, difficult to explode even with the strongest detonator-caps in use, and its blasting power is very much inferior to that of nitro-glycerine. But although only a few experimental cartridges have been made of that substance, yet its well-chosen name has impressed itself so strongly on the public mind that many believe it to be an article of large consumption.

Of far greater general interest is Dr. Hermann Sprengel's new class of explosives, produced mainly by dissolving substances rich in carbon in liquids rich in oxygen, of which latter nitric acid is the most important. Those mixtures are perhaps not very likely to come into practical use, owing mainly to the corrosive character of strong nitric acid and its ready solubility in water, which is a great drawback in a blasting agent; but the idea is of startling novelty, and Dr. Sprengel has embodied it in a pamphlet, which is one of the most remarkable that have lately appeared on explosives. In spite, however, of the great multiplicity of explosive compounds proposed or tried, only two have hitherto become of real utility, viz., gun-cotton, or pyroxylene, in general, and nitro-glycerine, with its compounds, and our attention must therefore rest chiefly with those.

When Schönbein first brought it out in 1846, gun-cotton received every possible encouragement, and its utility for initiatory purposes was investigated in France by a committee, of which such men as Piobert, Pelouze, and Combes were members. Acting on the advice of the committee, whose chief objection to gun-cotton was its want of chemical stability, the French Government gave up its use. Other Governments, and also individual enterprise, frightened by serious accidents attributed to spontaneous combustion, followed the example. Baron Lenck alone held on with untiring energy, and succeeded in establishing the manufacture of gun-cotton, which he greatly improved in Austria on a large scale, and in utilising it for artillery purposes; but after some explosions, due to spontaneous combustion, even Lenck's perseverance could not save the doomed explosive, and the Austrian Government gave it up in despair of success.

Thus far gun-cotton had been a failure, and it would probably have sunk into complete oblivion but for the great improvements made in its manufacture and applications by Mr. Abel, the eminent chemist to the English War Department.

Bearing in mind that the only serious objections to the use of gun-cotton were its want of chemical stability and its bulkiness, if applied to blasting, Mr. Abel sought to overcome those difficulties, and succeeded to an extent which has made gun-cotton practically a different substance from what it was before.

There is scarcely any doubt that the spontaneous decomposition of gun-cotton at the ordinary temperature is due to adhering impurities, from which it is very difficult to free the fibrous material even by careful and prolonged washing. But by reducing it to a pulp, which much facilitates its close contact with the washing medium (water or alkaline solution), Mr. Abel has overcome that great and serious drawback, and it is difficult to see how, with ordinary care, any acid can remain in the washed material now.

Unfortunately, public belief in the efficiency of the new system, and in the possibility of rendering gun-cotton safe, was much shaken by the fearful explosion of the Stowmarket gun-cotton factory, clearly due to a chemical decomposition of the material stored. But although the author is far from being convinced that the cause to which the explosion was attributed (adding acid to the gun-cotton purposely) was more than a vague supposition, yet he has not the slightest doubt but that pyroxylene, thanks to Mr. Abel's most important improvements, can be made safe and stable enough to warrant its practical use even in a dry condition.

The pulping of gun-cotton enabled the same inventor to bring it into the shape of compressed cartridges very suitable for blasting purposes. The specific gravity was thus more than doubled as compared with the twisted ropes previously in use; the result was that gun-cotton, which previously had no advantage whatever over ordinary powder, became a vary valuable blasting agent, and would be much more extensively used than it is now if it had only gunpowder to compete with. But in spite of some serious drawbacks (untimely freezing, poisonous nature, &c.) attached to nitro-glycerine compounds, their greatly concentrated power renders them formidable rivals even to that superior blasting material, compressed gun-cotton.

The utility of Mr. Abel's product received a new impulse, through the very interesting discovery of Mr. Brown, that it becomes, under the influence of the detonating ignition (firing by local explosion), a violent fulminate. It was for a time believed that this would secure for gun-cotton a great supremacy over all other explosives in mines, but nitro-glycerine compounds are still uppermost, for reasons which will be explained when we come

to investigate the relative power, bulk for bulk, of the two.

The true advantages derived from applying a detonating ignition to gun-cotton are in connection with its utilisation for military purposes, especially since it has been found that even wet gun-cotton can be brought to detonate at will. In that state it is quite innocuous, and it is evidently of vast importance to be possessed of a fulminate of considerable efficiency which can be safely exposed even to the enemy's fire. But this paper is not meant to treat of explosives as connected with warfare, and leaving gun-cotton we now turn to examine the state of progress made by its rival, nitro-glycerine.

The early trials made with a mixture of nitro-glycerine and gunpowder in 1863 went far to prove the great power of the explosive liquid. But the real era of nitro-glycerine opened with the year 1864, when a charge of pure nitro-glycerine was first set off by means of a minute charge of gunpowder. Its immense superiority over common blasting-powder was too evident not to be freely admitted, and it was speedily growing into favour when some fearful accidents checked its career. There is every reason to believe that they were due to strong concussion.

It may well be asked how the manufacturers could deal in an article so sensitive, but they were not aware at the time of the immense influence which the metallic packing then used (tin canisters) exercises, even when enclosed in wooden boxes, on the liability of nitro-glycerine to explode by concussion. That circumstance has contributed to blacken the character of the liquid explosive far beyond what it really deserves.

It was then proposed, and adopted as a temporary measure, to render nitro-glycerine inexplosive, or rather much less sensitive, by adding methylic alcohol, in which it readily dissolves. On shaking it with water, which takes up the alcohol, the explosive properties are fully restored, and the same detonator-cap, which has not the slightest effect on the mixture of nitro-glycerine and wood naphtha, explodes it after a moment's washing with water.

That method of protection against the danger of nitro-glycerine, although much patronised by chemists, had many drawbacks, and was troublesome for miners to adopt. It was really never intended for general use, but only to serve until modified nitro-glycerine, known under the name of "dynamite" (in America, "giant powder"), and invented already at an earlier date, could be adapted for practical use. That took some time, and the article was not put up for sale until about June, 1867.

Dynamite consists of nitro-glycerine absorbed in porous substances. It is erroneously believed that it was discovered accidentally through a leakage of nitro-glycerine which had run into porous silica, known under the name of "kieselguhr." The first dynamite made contained no silica; it consisted of porous charcoal and nitro-glycerine, and numerous experiments were made with various absorbents, such as porous terra-cotta, sawdust, ordinary paper and nitrated paper soaked in the liquid explosive and rolled into cartridges, before the porous silica was finally adopted. It absorbs practically from three to four times its own weight of nitro-glycerine, and possesses the valuable advantage over other absorbents of resisting a greater degree of pressure without parting with any of the nitro-glycerine which it holds. At first the new blasting agent, although substantially of as good a quality as it is manufactured now, made but slow progress, owing in a great measure to the strong prejudice existing against its chief ingredient. But gradually it has grown into favour, and numerous dynamite factories have sprung up, of which no less than fourteen are under the author's control. It is not uninteresting to follow the development of the trade as resulting from the figures of sale:—

Dynamite sold in	Tons.
1867	11
1868	78
1869	185
1870	424
1871	785
1872	1,350
1873	2,050
1874	3,120

These quantities are the total produce disposed of by the fourteen factories referred to above, but there are other factories in Europe besides. The rapid progress of the new explosive is to be attributed entirely to the great saving of time which it effects in blasting, the entire absence of accidents in transit and storage, the comparatively low cost at which it can be manufactured, and the good sense of the manufacturers in not overstraining the selling price.

The cost of the raw materials (1·15 tons of highly concentrated nitric acid, 2 tons of extra strong sulphuric acid, 9 cwts. of glycerine, and 5 cwts. of dried kieselguhr for every ton of dynamite), together with the packing, represented, at the opening of the dynamite trade, one-half, and represent now three-fourths of the nett price charged by the German factories. In Great Britain a considerably higher selling price leaves less profit to the manufacturers, owing entirely to the great stringency of the law and the extraordinary difficulties and expenses connected with the transit and storing of nitro-glycerine compounds.

The great success of dynamite has given rise to numerous other nitro-glycerine compounds, of which the most known are lithofracteur, the ammonia, colonia, and Hercules powders, Horsley's powder, dualine, seranine, and dynamite No. 2.

Of these the colonia and Hercules powders are nothing but mealed gunpowder, mixed with nitro-glycerine, substantially repetitions under new names, of the first nitro-glycerine preparation brought out in 1863.

Seranine and Horsley's powder are chlorate of potash preparations mixed with nitro-glycerine. The substitution of a chlorate for a nitrate adds little to the power, while it adds much to the expense of the compound, and also somewhat increases its danger.

Dualine was brought out by Mr. Dittmar, in Germany. It professed to consist of nitrated sawdust, or wood-fibre and nitro-glycerine, but it really consisted of ordinary sawdust, nitrate of potash, and nitro-glycerine. The liquid explosive mixed with nitrated wood-fibre is very strong, but its excess of power, weight for weight, over ordi-

nary dynamite, cannot be taken advantage of for blasting on account of its being much more bulky. Hence, as it is expensive and troublesome to manufacture, it cannot be recommended for use. As for the real dualine, as Mr. Dittmar brought it out, its use never went beyond experiments on a large scale in Germany, and it quickly died out altogether. Not so lithofracteur. It was originally a kind of crude blasting-powder, which the manufacturers improved by adding nitro-glycerine. Its ingredients have so much varied as to render it impossible to determine by analysis the normal composition for any length of time. The dealers evidently have great faith in the advantage of mystery. But what success they have had has not been owing to that resource, but indeed exclusively to the great commercial ability which they have displayed. They stated in a letter to the editor of the *Times* that lithofracteur is dynamite in disguise, but claimed as an advantage "the unique way in which the ingredients are mixed." Their agent, in a paper read before the Society of Engineers, on the 6th November, 1871, complimented their Mr. Engels "upon the singular uniqueness of his discoveries, which reflect credit upon his name, and proclaim a mental capacity of no ordinary stamp, even in Germany, where the average of intellectual power reaches so high a standard." Little can be added to an opinion so favourable.

The ingredients of lithofracteur as now published by the manufacturers are:—Nitro-glycerine, 55 per cent; kieselguhr, 21 per cent.; charcoal 6 per cent.; barium nitrate and bicarbonate of soda, or either of them, 15 per cent.; sulphur and manganese oxide, or either of them, 3 per cent.

Some time ago the dynamite and lithofracteur of Messrs. Kubo and Co., of Cologne, was analysed by Mr. Ulex, sworn chemist in Hamburg. The dynamite contained 66 per cent. of nitro-glycerine, 6¼ per cent. nitrate of barium, and 27 per cent. of infusorial earth. The lithofracteur contained 70 per cent. of nitro-glycerine, 5 per cent. of nitrate of barium, 2 per cent. of coal-dust, and 23 per cent. of infusorial earth.

Nitrate of barium being an oxidiser, it is evident that one of the two compositions must be irrational, for in one the nitrate is added without, and in the other along with a combustible material.

But lithofracteur has been pushed with much energy and ability, and although its consumption in Europe, where it has to compete with other explosives, equal or superior, is not large, it has opened for itself a considerable Transatlantic market.

The ammonia powder, invented by Ohlson and Norbin, though comparatively unknown, is far stronger than lithofracteur, and surpasses even dynamite in point of power. Its only drawback is the hygroscopic nature of its chief ingredient, which is nitrate of ammonium. But in every other respect it is a very superior blasting agent. It consists of 80 parts by weight of nitrate of ammonium, 6 parts of charcoal, and 10 to 20 of nitro-glycerine.

Dynamite No. 2 contains substantially the ingredients of gunpowder, less sulphur, *plus* nitro-glycerine, and is used for blasting mild rock.

This completes the list of nitro-glycerine preparations in use. Having now pointed out the approximate industrial importance of these modern explosives, which are actually applied as blasting agents, we shall proceed to compare their intrinsic value, beginning with

THEIR RELATIVE POWER.

The most vital question which concerns explosives is the evolution of their power, or rather concentration of power, absolute and relative. It is a subject to which the most serious attention has long been given, without leading us yet to a satisfactory result. Particularly as regards the power of fulminates even approximate information is wanting.

It is not only from a theoretical point of view that such knowledge is of importance. The manufacturers of explosives are frequently unable to estimate themselves the relative value of other powders and their own. Hence a confusion which leaves the practical miner no choice between wasting much time in trying new but inferior explosives, and giving up all idea of improvement.

It is, indeed, most difficult to form from experiments in mines alone a fair estimation of the relative value of two explosives. Thus in the mines of Clausthal, where the mining captains pride themselves on their practical experience, it was held for three months consecutively that the useful blasting effect derived from nitro-glycerine was increased from 30 to 35 per cent. by filling up the bottom of boreholes with small stones, in order to increase the height of column of the liquid explosive. Yet later on that method was given up altogether, as being based on a complete mistake.

The English Government Committee appointed in 1864, to report on the application of gun-cotton to mining and quarrying operations, also* "became strongly impressed with the great difficulty of instituting really comparative blasting and quarrying operations. In rock which appears uniform and quite sound, the blasting often brings to light veins, shakes, or fissures, which render a comparison of work done in two contiguous portions impossible. Even in very homogeneous hard rock differences in structure occur which modify the resistance opposed to the explosive agent, while it is almost impossible to have two blast-holes, for comparative experiments, so placed in actual practice that their position with reference to the exposed surfaces or faces of the rock, or in other words the direction of least resistance, should be more than approximately alike."

The writer of this paper has had frequent occasions to note the same result, and every attempt to arrive at accurate relative figures has proved a failure.

Under such circumstances the question naturally arises—Is there no speedier and more rational means of estimating the relative power of two substances than by experiments of such misleading nature? It is true that the power, and even the maximum tension, produced by an explosive cannot be said to be an absolute criterion of its value for blasting rock, where it must fulfil various other conditions; but still the knowledge of its relative power, specific gravity, and quickness of explosion is almost enough, waiving the question of safety, to enable us to appreciate without trial the approximate value of a blasting material.

* Report Relative to the Application of Gun-cotton. (House of Commons, 30th April, 1869.)

Explosive power may be estimated in two ways, viz, indirectly by theoretical induction, and directly by measuring the maximum tension of the gas at the moment of the explosion, or the mechanical work which it is capable of performing. For gunpowder both methods have been applied without showing much discrepancy in the final result. From Captain Noble's and Mr. Abel's recent experiments we gather that the maximum pressure exerted by gunpowder, when the density of the products of the explosion is equal to 100, or, in other words, when 1 kilogramme of exploded powder occupies the volume of 1 litre, is equal to 6,400 atmospheres, or about 42 tons per square inch; that its explosion produces about 705 units of heat, which, multiplied by its mechanical equivalent, represent a theoretical work of 486 foot-tons per pound of powder.

But highly satisfactory as are those figures, derived from actual measurements, they give no clue to the absolute or relative power of gun-cotton, nitro-glycerine, and other violent fulminates of modern application. They have been considered too powerful and too quick of explosion for even the strongest steel receptacle to resist their action, and hence, as far as we know, no attempt has hitherto been made to measure their explosive pressure by any instrument similar to those employed by Captain Noble and others to estimate the tension produced by exploding gunpowder.

There is good ground, however, for believing such apprehension to be imaginary. It is true that no receptacle of any kind will resist the pressure exercised by detonating nitro-glycerine, or even gun-cotton, if the chamber is filled with the explosive material; but, by leaving sufficient space, and suspending the charge so that it does not, at the moment of its detonation, touch any part of the sides of the chamber, the pressure exercised is so much inferior to the maximum tension which the explosive substance can develop, that there is not the slightest fear of rupture. By following that method, one single experiment will not, of course, suffice, but a series of such, with gradually increasing charges, will allow of observing in what ratio the tension increases with the density of the products of explosion, and how far it coincides for other explosives with the ratio found by Mr. Abel and Captain Noble for the gas of exploded gunpowder.

By aid of repeated calorimetric tests, made at the Depôt Central des Poudres, Paris, Messrs. Roux and Sarrau have sought to determine how much heat the explosion, or rather detonation, of various fulminates produces. They have thus found for nitro-glycerine 1,784, for gun-cotton 1,123, and for picrate of potash 840 units of heat, which, multiplied by the mechanical equivalent per unit, gives 778, 489, and 366 metre-tons per kilogramme of the substance as against 370 for the best sporting powder, and 267 for the ordinary trench-mining powder, which is of a very inferior quality. Comparing those figures with the heat produced by the combustion of gunpowder, as found by Mr. Abel (704 units), and taking it as 1·00, the mechanical power which nitro-glycerine is capable of performing would rank as 2·53, that of gun-cotton as 1·59, and picrate of potash 1·19.

M. Berthelot, following a different method, purely theoretical, arrives at much lower figures for the heat produced by the combustion of the same substances, and consequently also for the amount of work it represents. He admits that at the very high temperature which is a very general feature of explosive combustion, no complex chemical combination can exist, and that only elementary compounds, such as water vapour, carbonic oxide, and carbonic acid will be formed; so that when the chemical composition of such explosive substances is known, which are entirely converted into gas, it is easy to determine, without recourse to experiments, the nature of the gaseous products formed at the moment of their explosion. Hence, for instance, nitrate of ammonium, of which the formula is $NH^4\ NO^3$, would split up into $N^2 + O^2 + (H^2O)^2$.

Starting from this point of view, the correctness of which certainly does not appear to admit of the slightest doubt, M. Berthelot computes, from well-known tables, the heat produced by the formation of the gaseous products from their elements. He further calculates the units of caloric developed in the formation from its elements of the explosive substance to be dealt with, and takes it for granted, of course, that as much heat must be absorbed in disuniting the chemical tie as was freed in forming it. The heat lost in that operation he deducts from the sum of heat produced by the reunion of the disconnected elements, the balance representing the heat really developed in the explosive combustion. Thus, for each 227 grammes of nitro-glycerine, which the explosion transforms entirely into carbonic acid, water, nitrogen, and oxygen, M. Berthelot calculates the heat produced by the formation of the carbonic acid and water from the elements at 430,500 units, and the heat produced by the formation of the nitro-glycerine itself from its prime elements at 130,500 units, which, deducted from the total of 430,500, leaves 300,000 units of caloric freed, or 1,320 units per gramme of nitro-glycerine exploded.

The main drawback of that method is the difficulty in arriving at anything like a fair estimate of the heat developed in the course of the formation of a complex organic compound, such as for instance nitro-glycerine or gun-cotton. It is therefore probable that the figures arrived at by Messrs. Roux and Sarrau, by direct calorimetric tests are, until now, the more reliable.

The author has, for the last six years, made regular use of another method, which has been of great utility to him in enabling him to draw a tolerably correct comparison between the power of various detonating substances. It is based on measuring their ballistic power, and, though certainly open to some objections, it has the advantage of being extremely handy and sufficiently accurate for the object in view.

A mortar test is, indeed, more reliable for comparing detonating explosions than for slower compounds, for, in the latter case, the projectile may have left the mortar before the combustion is completed, while, in the case of fulminates, their explosive conversion is so rapid, that in all probability it is completed before the projectile has begun to move at all, thus acting upon it with the whole force of its initial tension. This is further confirmed by the fact that the bore of the mortar

can be made far shorter than for testing gunpowder without any considerable falling off in the range of projection.

The tables here annexed show the results obtained in testing the ballistic power of detonating gun-cotton, nitro-glycerine, dynamite, and various other compounds. From the figures therein contained, some important conclusions may be drawn.

If the ballistic power of detonating nitro-glycerine is expressed by 100, then in their comparison, weight for weight, compressed gun-cotton ranks as 71; dynamite, consisting of 28 per cent. of kieselguhr and 75 per cent. of nitro-glycerine, as 72; ammonia powder, as 83; gunpowder mixed with 20 per cent. of nitro-glycerine, as 50; gun-cotton mixed with its own weight of nitro-glycerine, as 83; Curtis and Harvey's strongest blasting powder, ignited with a detonator-cap, as 28; fulminate of mercury, as 30; and lithofracteur of the strongest kind (made of the ingredients specified in the Government licenses for that material), as 50·5.

In this estimate no deduction has been made for the power exercised by the fulminate of the detonator-caps, it being the same for all preparations, except gun-cotton, for which 0·16 additional weight of fulminate was used.

Interesting as it may be to compare the relative power of explosive substances, weight for weight, the power which they are capable of exercising, bulk for bulk, is of far greater importance in their application to blasting. It is easily computed when their specific gravity is known, which has been found for nitro-glycerine, 1·6; for gun-cotton, 1·00; for dynamite No. 1, 1·65; for ammonia powder, 1·55; for gunpowder, 1·00; and for lithofracteur, 1·20, which is also the specific weight of dynamite No. 2, and of most nitro-glycerine preparations containing large quantities of metallic salts.

When their power is compared, bulk for bulk, the various explosives range as follows:—

Nitro-glycerine	100
Ammonia powder	80
Dynamite No. 1	74
Lithofracteur	53
Gun-cotton	43
Curtis and Harvey's blasting powder fired by detonator	17½

Seeing that the maximum tension produced b[illegible]

TABLES SHOWING THE RESULTS OF MORTAR TESTS MADE WITH VARIOUS DETONATING MIXTURES, THE ELEVATION OF THE MORTAR IN EACH CASE BEING 10°.

No. of Experiment.		Parts by weight.	Weight of charge in grammes.	Distance thrown (shot = 32 lbs. weight) in links. 1st charge	2nd charge	3rd charge	Average [illegible]
1	Nitro-glycerine pure	..	5	308	297	295	[illegible]
2	Nitro-glycerine Compressed gun-cotton	3 3	6	290	302	305	[illegible]
3	Potassium chlorate Charcoal Nitro-glycerine	122 20 30	7	250	241	243	[illegible]
4	Potassium nitrate Charcoal Nitro-glycerine	101 17 25	10	279	263	281	[illegible]
5	Ammonium nitrate Charcoal Nitro-glycerine	80 6·5 20	6	299	300	302	[illegible]
6	Gun-cotton compressed	..	7	295	315	290	[illegible]
7	Patent gun-cotton powder	..	8	291	305	288	[illegible]
8	Fulminate of mercury	..	10	185	..	..	[illegible]
9	Fulminate of mercury Chlorate of Potassium	80 20	10	220	219	219	[illegible]
10	Gunpowder mealed Nitro-glycerine	80 20	10	305	298	295	[illegible]
11	Curtis and Harvey's extra strong blasting powder exploded with detonator	..	20	341	340	330	[illegible]
12	Picrate of potassium Nitrate do. Nitro-glycerine	60 30 10	7	222	237	229	[illegible]
13	Sodium nitrate Charcoal Sulphur Nitro-glycerine	85 17 16 30	10	282	307	313	[illegible]
14	Lithofracteur* as per Government license:— Charcoal Kieselguhr Barium nitrate Sulphur Nitro-glycerine	 6 21 15 3 55	7	218	211	205	[illegible]
15	Dynamite No. 1, consisting of— Nitro-glycerine Kieselguhr	 75 25	7	290	318	307	[illegible]

* This is the strongest mixture of lithofracteur ingredients as published by the manufacturers. The slightest addition of soda [illegible]bonate or manganese dioxide indicates a decrease of power, as shown by numerous mortar tests.

explosion of any given substance very rapidly increases with the increasing specific gravity of the gaseous products; that for instance, the gas of exploded gunpowder, according to experiments made by Captain Noble and Mr. Abel, exercises a pressure of 41·70 tons to the square inch, when its specific gravity is = 1·00, and only 1·47 tons per square inch, when the specific gravity is = ·1, there is every reason to believe that the maximum tension of the various products we have here enumerated is even more disproportionate than their ballistic power, and that a comparison of initial pressure would prove much more favourable to the stronger explosives than the figures we have given.

But even those figures are conclusive, and nitro-glycerine therein appears so highly superior to all other blasting agents as to make it almost a matter of regret that it cannot be used. But there are practical conditions in mining which considerably reduce the apparent useful effect in its favour, and place dynamite almost on an equality with the liquid explosive. This cannot be explained without entering into some details, for which the importance of the matter will serve as excuse.

To get the full benefit of a blast, there should be no air-chamber round the charge, for the expansion which it causes not only lessens the power in proportion to its dilution, but actually decreases the tension of the gas in a much greater measure. In the case of blasting powder such air space cannot be avoided, in consequence of its influence on the quickness of combustion. But with nitro-glycerine it seems as if its liquid state would specially favour the exclusion of all empty space, and so it does when it can be poured direct into a blast-chamber. But apart from the impossibility of pouring a liquid into horizontal bore-holes, or such as incline upwards, experience has shown that there is very great danger connected with that practice under any circumstances. An almost imperceptible seam or fissure in the rock—and they are scarcely ever absent—will cause a part or the whole of the liquid charge to leak into the smallest cavities, and remain there until the miner, in drilling a new bore-hole, strikes it, or strikes the rock in its proximity, when it goes off, causing a fearful accident. Hence nitro-glycerine cannot be safely used without cartridges. These, to hold a liquid, must be strong, which makes them rigid. They cannot be introduced into a bore-hole without leaving a considerable air-chamber round the charge, particularly as bore-holes generally deviate a great deal from the circular shape. It is difficult to calculate even approximately the relative proportions of the unoccupied space and the charge, but certainly with the small sized diameter of such bore-holes as are generally adopted for blasting with nitro-glycerine, the loss is at least equal to one-third of the whole space, so that three cubic inches of the chamber will hold on an average only two cubic inches of the explosive liquid. Dynamite has here all the advantages on its side, and it is much to be regretted that miners very frequently neglect to make use of it. Being highly plastic, the slightest pressure with a wooden rod compresses the charge in the bore-hole, so as to exclude all empty space. It is true that the small primer cartridge cannot be treated in the same manner, lest the detonator-cap affixed to it should be dislodged. But it forms only the upper part, and a very small portion of the charge, and the air-chamber which surrounds it is therefore of no practical importance. The increased effect derived from this mode of applying plastic explosives is far greater than is generally believed. All nitro-glycerine preparations possess the same advantage, but none are quite as plastic as dynamite. Nearest to it is lithofracteur. Gun-cotton, like nitro-glycerine, leaves a considerable air-chamber, owing to its rigidity, when made into cartridges.

Practically the advantage of being able to fill up the blast-chamber in a bore-hole amounts to the same as if the specific gravity of the same explosive could be increased, so much as to make up by weight for the want of bulk. In other words, what has to be considered is not the specific gravity of the explosive itself, but that of its gaseous products at their moment of initial tension, when they strike the rock or other resisting medium.

Since nitro-glycerine cannot with any degree of safety be used without cartridges, and since the unavoidable air-chamber represents an average of one-fourth, at the very lowest estimate, of the blast-chamber, a proportionate reduction should be made in computing its useful effect for blasting purposes. Dynamite thus rises nearly to its level, and ammonia powder becomes somewhat superior.

The author has considered it important to enter into this subject at some length, partly because it elucidates a question relating to the useful application of explosives, and partly because the use of an inert absorbent of nitro-glycerine is considered by many as inconsistent with a true utilisation of its power.

From the mortar experiments already referred to an approximate estimate may be formed not only of the power of nitro-glycerine preparations containing an explosive base or absorbent, but also of the power which that explosive possesses by itself, and when it detonates under the influence of detonating nitro-glycerine. For that purpose it suffices to make out the quantity of nitro-glycerine contained in a compound, and compute the distance of projection to which it would carry the projectile of the testing mortar. The difference of distance is due to the other ingredients, and permits of a tolerably near calculation of their relative power. It is true that the gaseous products of the exploded nitro-glycerine and those of its explosive partner may react on each other, and cause a slight loss or gain of power, but it cannot materially alter the relative value of the two.

The result of such a calculation shows that, weight for weight, when nitro-glycerine figures as 100, chlorate of potassium powders rank as 29 to 30, nitrate of potassium powders as 20 to 22, and nitrate of sodium powders as 22 to 23.

These figures are perhaps not quite accurate, and may require correction, but they are very important to establish, since by far the greater number of explosive substances brought out contain a nitrate or a chlorate, and since no matter which combustible substance is added the explosive power remains substantially the same when the same oxidising agent is employed. Hence when that ingredient is known, unless a combustible is added in excess, the power of a compound can be determined by calculation. How far it can be

utilised for blasting will then depend on the concentration of its power, and the rapidity of its formation, which leads us to examine the important question of quickening slow explosives by special firing.

That under certain conditions otherwise similar a quick explosion must be preferable to a slow one for blasting, and where blasting is the only object, is obvious. The same amount of expansion is produced in either case, but the maximum tension of the gas developed may be vastly different, and on that tension depends the blasting power. For instance mealed gunpowder under certain conditions burns with a tension scarcely sufficient to burst a straw, yet the same substance becomes under other conditions capable of tearing the hardest rock. The difference in action is due only to a difference in the rapidity of combustion.

It is therefore clear that of two explosives the more powerful one may, for want of quickness of combustion, be the less efficacious for blasting, and it becomes a matter of considerable importance to possess a ready means of overcoming the drawback of the slow action.

That problem has been solved by adopting a special mode of firing explosives, known as the detonating ignition. It consists in applying a strong local explosion instead of a spark or flame, and it modifies in a remarkable degree the natural quickness of combustion exhibited by explosive substances.

It is especially in connection with nitro-glycerine that this mode of ignition has led to remarkable results, and it was to suit the peculiar nature of that substance that it was invented. Nitro-glycerine indeed, without that special firing, though it is an explosive, is no blasting agent, as it cannot be applied with any degree of certainty that it will go off. Not so when fired by a local explosive. It not only detonates without any confinement, but it affords an extraordinary facility for setting off substances which, without its aid, are absolutely inexplosive. If, for instance, charcoal and nitrate of potassium are mixed without sulphur they form no explosive compound within the ordinary meaning of that term; but if from 10 to 15 per cent. of nitro-glycerine are added, a local explosion, produced by a strong detonator or fulminate cap, will cause the almost inert mixture to detonate with nearly the same rapidity as the nitro-glycerine itself. Nitrate of ammonium and charcoal, with or without sulphur, form a mixture so sluggish at the ordinary temperature, that when tried in a shell along with six ounces of gunpowder, the explosion of the latter failed to set it off or even to inflame it; yet mixed with 15 per cent. of nitro-glycerine it detonates with extraordinary violence. Sawdust, bark, rosin, starch, sugar, glucose, flour, dextrine, gum, &c., mixed with any nitrate, become, if a small portion of nitro-glycerine is added, most violent detonating fulminates. Nor is that all. Substances considered as absolutely incombustible will form explosives. For instance, chloride of ammonium, mixed with nitrate of potash and nitro-glycerine, will decompose explosively with formation of chloride of potassium, and the freed hydrogen unites with the oxygen of the nitrate. Sulphates are very much more sluggish, but if very finely divided and mixed with charcoal they also indicate a decided reaction, although too slow to be completed in the extremely short time which an explosion occupies. Chlorate of potash mixed with nitro-glycerine detonates even without the presence of charcoal or any other combustible. The number of organic compounds soluble or even insoluble in nitro-glycerine, which can thus be brought to decompose by detonation, is almost unlimited.

This extraordinary influence which the presence of nitro-glycerine exercises on slow explosives, and even seemingly inert substances, is easily accounted for. Being a liquid it comes in very close contact with the mixtures, and when the detonation ensues the fine layer of nitro-glycerine which adheres to every grain is instantaneously converted into an extremely dense atmosphere of gas, having a temperature of at least 3,000 to 4,000° C. Such a heat must quicken even the slowest combustion.

It is exactly the same cause which makes gunpowder burn with such extreme quickness, as numerous measurements indicate, in a gun, while its combustion in the open air is far more slow. When confined the hot gas accumulates in proportion as it is being generated, and the denser it grows the more heat it brings to bear on the reaction, which thus becomes almost instantaneous.

The action of the detonator-cap in setting off nitro-glycerine and other explosives is far more complicated, and not so easily explained. Some attribute it only to the heat produced by compression, some only to the heat of the gas given off by the fulminate of the cap, and others, again, to the dissociating power of a strong vibration. It is not unlikely, at least in some instances, that all those influences are brought to bear on the explosion, but it would be very difficult indeed to compute the part contributed by each. There can be no doubt as to the dislocation of certain unstable compounds by vibration alone, since the slight shock which sets off chloride and powder of nitro-glycerine, perchlorate of ethyl, &c., cannot possibly raise their temperature even locally to the degree at which they explode. Even in the case of nitro-glycerine, which exhibits no such extreme sensitiveness, direct experiments have shown that very violent vibration can cause it to explode. But if vibration alone suffices to set off nitro-glycerine, it is still less doubtful that heat alone will do it. Not only does it detonate when raised to the temperature at which its constituent elements dissociate, but a minute charge of gunpowder, so slightly confined that the gas which it produces has a very feeble tension, never fails to make it detonate. It suffices, indeed, to apply heat in any shape, so that it acts upon a very large surface of nitro-glycerine, for then the gas evolved can no longer escape as quickly as it is produced, and the pressure, accumulating with immense rapidity, brings on the explosion.

Nitro-glycerine preparations and gun-cotton cannot be brought to detonate by such means, but go off easily under the influence of a sharp local explosion, such as produced by a fulminate. Two opposite tendencies are here at work, one to set off the explosive acting on it by heat, vibration, or whatever cause it may be, and the other to throw it away by the propelling impulse due to the expanding gas. Both must be extremely quick in operating, and it is therefore easy to see how

a slight, apparently insignificant difference may turn the scale and cause an explosion or a mis-fire. For instance, in grinding chlorate of potassium and sulphur with care in a mortar, a series of small detonations take place, which do not spread, but a somewhat stronger blow or friction will set off the whole. Evidently in one case the propelling power is preponderant over the igniting tendency, in the other it is not. Even the quickest substance requires time to get heated, and unless the velocity implanted allows that time combustion cannot take place.

The author inclines to think that some extraordinary phenomena connected with the firing of explosives by local detonation, which have come to light through the interesting experiments of Mr. Abel, may be due to the cause here pointed out. If, for instance, seventy times as much nitro-glycerine as the fulminate of mercury required to set off a gun-cotton cartridge by detonation fails to do it, it may be owing to the immense rapidity with which the cotton is carried off by the current before the influence which tends to make it detonate has had time for its operation. If that explanation is correct, a partial confinement or slight addition to the resistance offered by the explosive acted on must cause a considerable difference in its behaviour; and, indeed, Mr. Abel found by repeated experiments that a charge of fulminate amply sufficient to set off compressed gun-cotton failed to explode the same material in a loose form; but by twisting loose uncompressed gun-cotton round the cap, and securing it well with a string, so as to increase its density and resistance to projection, it is brought to detonate with great facility without increased charge of fulminate. It has also been found that loose gun-cotton detonates more readily if impregnated with quite inert substances than in its isolated state, evidently because the additional weight opposes additional resistance to motion, thus allowing time.

It is probable, if this view be correct, that a very small charge of nitro-glycerine, brought to explode in a chamber wherein its gas can expand to a certain degree before it operates on the gun-cotton cartridge, will set it off. It is also probable that a slight increase of resistance, such as the confinement of the cartridge in a copper or tin tube, will cause gun-cotton to detonate with very minute charges of nitro-glycerine, provided the latter explodes detonatively, which is not always the case when small quantities of that substance are operated on.

Whether or not it is the intervening influence of mechanical motion which baffles the action of nitro-glycerine, chloride of nitrogen, and other violent fulminates, in setting off gun-cotton, it does not clear up the mystery which still surrounds the action of a local detonation on explosives. There are many points in favour of the theory that it is due mainly to the transmission of heat. One is the proof which we possess that such transmission can be almost instantaneous, for when nitro-glycerine, mixed with substances which are quite inert, or almost inert, makes them detonate, it is evident that the action is not due either to vibration or compression, but chiefly to the direct influence of heat. More telling still is the fact that the success of the detonating ignition depends a great deal on the state of division of the substance which it acts upon. Thus, thoroughly frozen nitro-glycerine cannot be brought to detonate even with a cap containing 1 gramme of fulminate of mercury, while frozen dynamite is much more readily exploded, and with a smaller charge, particularly when in a state of fine division. Frozen dynamite, containing only 70 per cent. of nitro-glycerine, goes off more readily than the more compact material holding 75 per cent. of the same substance. Melted nitro-mannite is more difficult to explode by a cap than the same substance precipitated, and in a state of fine division. This cannot possibly be accounted for on the vibration theory, but it is readily explained by the quicker transmission of heat due to a vast increase of the surface which it can act upon. Nor is it to be overlooked, that the compression brought about by the immense tension of the explosive atmosphere, liberates heat which must largely help to quicken the combustion.

Much may be said, however, in favour of either theory. But a new light will probably be thrown on the subject, by comparing the velocity with which sound is transmitted through various explosives with the velocity of their detonation, as has been found by Mr. Abel. Thus it is evident that if the vibration theory is correct the two velocities must coincide, or at least be decidedly proportionate.

The reasoning which led to firing slow explosives by local detonation was this: when a hammer strikes a very thin layer of nitro-glycerine on an anvil the blow produces a strong compression of the liquid, which liberates heat and raises its temperature to the point at which it detonates. But only that part which actually receives the blow explodes. If, however, the hammer is very heavy, and the blow strong, the explosion is no longer confined to the part which receives the direct shock, and the whole goes off. A local detonation, owing to the immense tension of its gas, must be very similar in action to a strong blow, and will thus compress the explosive liquid which surrounds it, causing it to detonate at will and to propagate the explosion throughout the whole mass by the same means. Whether that theory be correct or not it led to a result which affords considerable facilities for the utilisation of modern explosives. It enables us, with or without confinement, to turn a solid or liquid substance of very harmless appearance instantaneously into gas which occupies the same or nearly the same bulk, but has an expanding tendency which for nitro-glycerine gas must come near a pressure of 500 tons per square inch.

The suddenness of this exertion of power has led many to believe that the firing of an explosive substance by detonation adds to its power. Mr. Sarrau, in a very remarkable pamphlet which he has recently published on that subject, and which contains excellent information, classifies distinctly the two different degrees of explosion, of which he computes the relative power, and endeavours to explain the preponderance of what he calls explosiveness of the first degree, by admitting that possibly even those gases which are considered as permanent and elementary may under detonative influence dissociate into elements unknown, and form new combinations likewise unknown. But it is much more likely that the difference in power

found by Mr. Sarrau has been due to complete combustion in the one case and incomplete explosion in the other. The author has found scarcely any perceptible difference between the ballistic power of exploding and detonating gun-cotton which warrants the conclusion that under conditions of complete combustion the mode of firing only adds to the velocity of explosion, but not to the power of a substance. We now leave this interesting subject, and turn to one which is of greater importance to the public in general, viz., the relative safety of modern explosives.

Relative Safety.

There are four sources of danger from explosives—viz., the contact with fire or heated surfaces, concussion or percussion, want of chemical stability, and the poisonous character of the fumes produced by their explosion.

These sources of danger have to be considered, all but the last, in their bearing on the manufacture, transit, storage, and use of explosives; but clearly the nature of the fumes only concerns the underground consumers.

Danger from fire in connection with gunpowder has been illustrated by so many accidents of more or less magnitude, even recently, that a comparative immunity from that danger cannot be too much welcomed in a new power. Modern explosives offer that immunity to a remarkable degree, which is the more valuable since it no way interferes with their quickness of explosion when called for. Both gun-cotton and dynamite have been burned over fire in large quantities, as much as 1 cwt. or more at a time, without giving rise to the slightest explosion or loud report. Such a behaviour certainly is a great safeguard against accidental firing, but it is very apt to produce over confidence, and lead uneducated people to mistake relative for absolute safety. On that account it is perhaps to be regretted that public experiments, showing the innocuous character of new explosives, should have taken place.

What is needed for the safety of a blasting powder is not at all that one should be able to fire it in large quantities with impunity, but only that it should not be fired by a spark, and if accidentally fired by a flame should allow reasonable chances for escape. In that respect both dry compressed gun-cotton and ordinary dynamite offer every guarantee that can possibly be needed; and as for wet gun-cotton and some kinds of dynamite, for instance ammonia powder, they are absolutely more difficult to get to burn than most inert combustibles are. This explains how it is that there never has occurred any fire or explosion through accidental ignition of any blasting powder by a spark or flame. A gun-cotton factory might be burned down, all but the drying-house, where the quantities may be very small at a time, without the slightest danger of an explosion. A nitro-glycerine factory is practically almost as safe with regard to mere firing, for the liquid explosive is kept confined in receptacles wherein no fire can come at it, and besides a mere spark does not set it off. Dynamite is slow to catch fire, but burns rather fiercely when fired, and if the quantities are large or under confinement an explosion may finally ensue, but it cannot be ignited by a spark, which is a great guarantee, and if fired by a flame it leaves ample time to the workers to save themselves before an explosion occurs.

In transit, storage, and use, there is much less danger from fire than in the factories, for it is difficult to see how a substance which a spark does not fire, and which is made up into cartridges, and labelled "Explosive," could be set accidentally on fire when confined in a strong packing-box. Such accidents have never happened; but there is an analogous kind of danger special to nitro-glycerine preparations, against which miners cannot be too much or too frequently warned. Owing to the property of nitro-glycerine to crystallise at a low temperature, it becomes hardened, and must be frequently thawed in winter to refit the cartridge for use. In spite of warning instructions contained in every 5lb. package of dynamite, and of very suitable warming-pans, wherein the operation is easily and safely performed, miners will insist on doing it in their own way, and it is almost impossible to make them understand that a cartridge, which firing does not set off, cannot be slowly heated with the same impunity. Thus they will roast nitro-glycerine preparations near a fire or on hot cinders, or elsewhere, where it is really dangerous, and only too frequently accidents are due to that cause. It is, however, consoling to observe how such accidents are gradually becoming more and more rare, in proportion as miners get used to handle the new material, and how in Sweden and Germany, in spite of the duration of the cold season there, accidents of that kind are almost unknown. In those countries it is a very common practice to thaw the frozen cartridges, or sometimes only the primer cartridges, which will set off a frozen charge as well, by keeping them for half an hour or more in the pocket, near the body. It is not attended with any danger or inconvenience, as the author can testify from practical experience, having always done so himself in the course of his experiments.

Danger from concussion, which proved so disastrous with nitro-glycerine, has never until now, as far as known, been the cause of any accident, either from gun-cotton or dynamite. Still, the quantities of the latter material hitherto consumed represent more than fifty times the whole quantity of nitro-glycerine ever sold, so that the accumulated proofs of safety are not insignificant, and are growing daily stronger. But that safety is only in a very small degree due to the cause to which it is almost universally ascribed. There is a notion abroad that dynamite is quite insensible to a blow; that the porous material called kieselguhr cushions the nitro-glycerine particles so as to change completely the explosive properties; that the liquid explosive, when absorbed in porous silica, becomes endowed with much greater chemical stability, but for this there is scarcely any foundation whatever. The main danger to nitro-glycerine arose from the sensitiveness to concussion which it acquired through contact with a hard metallic, strongly vibrating substance, such as the tin canisters in which it was contained. The main safety of dynamite is derived from the absence of any hard vibrating material in immediate contact with the nitro-glycerine which it contains.

A tin cartridge filled with nitro-glycerine causes

explosion if it drops from a height of several ...red feet on soft ground; yet that same tin ...tridge, falling only three feet high on an anvil, ...tom foremost, is sure to set the charge off, ...ugh there is not a particle of the explosive on ...outside. Nitro-glycerine contained in a wooden ...rel, headed with wood, would be as safe against ...ordinary concussion as if it were common oil; ...only danger could spring from leakage, which ...ght expose it to a direct blow, but even that ...t be uncommonly strong to become dangerous ...ess produced by two hard, sonorous bodies ...king against one another.

...hen the canisters to hold nitro-glycerine were ...adopted, its sensitiveness to vibration was very ...erfectly known, and the square form easily ...n to a metallic receptacle was necessary to ...w for the expansion of nitro-glycerine at the ...ment of its crystallisation, when, like water or ...cerine, it bursts a cylindrical vessel in which it ...ontained. Later on the full extent of the ...ger only made itself too well known through ...ful accidents, caused in most instances by gross ...lessness in dealing with it, but proving not ...less that it could not, without material altera-..., remain an article of commerce.

...s already stated, there is not that amount of ...ference between the sensitiveness of nitro-...cerine and dynamite which the latter substance ...erally receives credit for. A great family like-... prevails between the two, and it therefore ...ms strange that those who have the greatest ...st in the inoffensiveness of a dynamite cartridge ...uld be frightened on perceiving the slightest ... of liquid nitro-glycerine on the inside of the ...er wrapper.

...ill a universal fear of exudation exists in those ...ntries where nitro-glycerine preparations are ...e used, and it is thus believed that they must ...t with their nitro-glycerine as a matter of ...se. But there is no reason whatever why a ...us substance should part with the liquid which ...holds absorbed, unless from some intervening .... It has done so on some occasions, but ...y when the packing-boxes containing dynamite ... been accidentally immersed in water, which ... the property of displacing the nitro-glycerine ... dynamite. To guard against it in future the ...king has been made water-tight as far as ...ticable.

Gun-cotton requires no such precautions, and ...ks, as regards safety from concussion in manu-...ture and transit, first amongst modern explo-.... Although dynamite has proved its safety ... a greater scale by a consumption of much larger ...ntities without accident, yet theoretically ...n-cotton is decidedly, in point of liability to ...xplode from concussion, the safer of the two. ...t in the hands of the miners the case becomes ...ersed. It very frequently happens that a gun-...ton cartridge is being inserted halfway into a ...e-hole for which it is too large. It has then ...her to be taken out or to be rammed down into ... bottom part of the hole: the latter is gene-...ly preferred, in spite of the danger which is ...ous, since gun-cotton is well known to go off ...th a blow. It is, of course, mere foolhardiness ...hich leads to accidents of that kind. Still nitro-...glycerine powders, from their plastic yielding ...ture, have here a decided advantage over gun-cotton. However, the danger most dreaded in modern explosives is not from concussion but from their supposed liability to chemical decomposition, productive of heat, which sometimes leads to ignition and explosion. It is certainly, where it exists, a matter of weighty consideration, and those who carry or store explosive substances are fairly entitled to require that they should not go off without external cause.

Numerous accidents from gun-cotton attributed, not without good reason, to interior chemical re-action, have very much shaken public belief in its stability. But, on the other hand, it has been known to keep, even in warm climates, without alteration, for twenty years. The same cause must always lead to the same result, and it is therefore evident that there is a difference in the material which decomposes from that which undergoes no change. But it is only quite recently that the true cause of chemical instability, which belongs to the whole class of nitrated organic compounds, has been clearly defined.

After their nitration, a certain portion of acid, sulphuric, nitric, and hypo-nitric, always adheres to those compounds, more or less, according to their form and structure. From a liquid explosive sub-stance the acids are easily washed out by churning it with water first and then with an alkaline solution. But a granular, flocky, or fibrous material retains the acids with far greater tenacity, particularly the nitric and hypo-nitric acids, which every nitrated organic compound has a strong tendency to retain.

It is quite clear that if there is hypo-nitric acid present, that highly corrosive material, which attacks almost every organic compound, even at the ordinary temperature, must be removed, if not it will slowly, but surely, lead to an incipient de-composition, which, acting on a nitrated sub-stance, sets forth portions of dioxide of nitrogen, or hypo-nitric acid, free.

From nitro-glycerine the corrosive acid is washed out with the utmost facility, and from the moment when the importance of that operation became fully appreciated it has never been ne-glected. Hence the great chemical stability ex-hibited by dynamite, which, although so largely used under all conditions of climate, has never shown the slightest tendency to decomposition. It sometimes indicates an acid reaction, but that is due to the absorbent and not to the slightest trace of hypo-nitric acid being present.

Much greater difficulty has been experienced in removing the acid from gun-cotton, and until Mr. Abel began to pulp it the process never was fully reliable.

The drying of gun-cotton after it has been thoroughly washed is the only operation which still appears to call for some improvement. It is highly probable that most cases of spontaneous combustion have been due, not to imperfect wash-ing, but to drying at too high a temperature, for no nitrated organic compound will resist inde-finitely even the heat of boiling water without undergoing a decomposition which sets hypo-nitric acid, or what comes to the same, dioxide of ni-trogen, free.

It is clear that no amount of washing gun-cotton can render it safe, if the impurity which it is meant to remove is added again in the drying process, through a decomposition which the ma-

terial itself undergoes. Gun-cotton ought, therefore, to be dried by currents of air, or with the aid of a vacuum at a temperature not exceeding 50° Centigrade.

The great influence of even the minutest quantity of hypo-nitric acid in starting a decomposition is not very easy to demonstrate by actual experiments on gun-cotton, or any analogous substance; but it is rendered very visible by mixing together certain substances, such as spirits of wine, or glycerine and nitric acid, with or without addition of nitrate of urea, which frees it from hypo-nitric acid. The pure nitric acid produces no decomposition even at a high temperature, while the slightest quantity of hypo-nitric acid will bring about, more or less quickly, even at 0° Centigrade, a violent decomposition. A similar use of nitrate of urea fer neutralising hypo-nitric acid in dried gun-cotton would not have the same effect, for alkali or amide must be in solution so that atom touches atom, if not, the reaction is localised and cannot be depended on.

Dr. Sprengel has started the ingenious idea of adding, for the same purpose, a soluble organic base to nitro-glycerine, but its chemical stability has hitherto proved quite sufficient without such precaution. Besides, when the nitro-glycerine crystallised, it would separate from the base, and on being thawed a uniform solvency might not be readily effected.

Undoubtedly the chemical stability of organic nitrated compounds is to a certain degree imperfect, and although some are quite stable enough to ensure safety in any climate, yet it is very desirable that they should be so far improved as to stand, for any length of time, exposure to the temperature of boiling water. This is not as yet the case with gun-cotton, and scarcely even with nitro-glycerine, when both are thoroughly washed.

Although nitro-glycerine has exhibited, upon the whole, a far greater chemical stability than gun-cotton, yet it acquires that superiority only after being thoroughly purified from acid at the factory. So long as it contains free hypo-nitric acid it cannot be stored at all in hot weather, and even during the course of its manufacture it has several times given rise to a decomposition, ending in explosion and loss of lives. This remarkable instability of the crude article contrasts so strongly with the great stability of the pure nitro-glycerine in dynamite, as to remove every trace of doubt regarding the decomposing influences of the adhering acids.

The doubt still attached to nitro compounds as regards their liability to spontaneous combustion has served as an excuse to railway companies for declining to carry them. But when thousands of tons of a compound are being yearly consumed, when foreign railways have carried it for years, and when it has been the object of a large trade, without causing any accident, it seems at least not unfair that public carriers should be prepared to give some explanatory reasons for declining to transport it. They generally take not the slightest trouble to investigate such matters, and nothing can afford a better illustration of their proceedings than the refusal of some companies to carry wet gun-cotton, which is absolutely safe, coupled with their free admission of gun-cotton powder, which, owing to its greater division and impregnation with a nitrate, is absolutely more dangerous than compressed gun-cotton even in its dry state.

Such a state of things as regards the carriage of explosives is much to be regretted, as being far from conducive to safety, and only throwing the weight of eventual risk off some powerful shoulders to distribute it in a far greater proportion over a great number of weaker ones. Explosives must be carried in one way or another, or we must cease to use coal, iron, granite, &c., and, in fact, every commodity dependent on mining operations; and since they must be carried, it is far better, and will lead to far less accidents, to have them forwarded openly, where they are handled by the trained servants of a public company, and where every precaution is or should be observed, than in the petty half-clandestine way which is now enforced, and which leaves dangerous blasting agents exposed to the rough handling of reckless and ignorant people.

On the other hand, it is evidently the duty of a railway company to see that they do not carry on their lines goods of such intensely violent character as to baffle every precaution, and endanger their own and other people's property. But when long experience has disproved the assumption of danger, they ought certainly, in the interest of the community, if not in their own, to give the matter due consideration instead of jumping at conclusions which lead to such errors as the one we have already pointed out of carrying dry gun-cotton, and refusing the same article when wet. This, however, is a digression from the subject from which it is time to return.

There are no accidents on record due to spontaneous combustion in mines. Local accidents from modern explosives are indeed almost exclusively to be attributed to injudicious thawing of nitro-glycerine preparations, to reckless removal of the tamping in boreholes after a missfire, to forcing in gun-cotton cartridges too wide for the borehole to receive them, and to playing with the detonator-caps. Against this kind of accidents education is almost the only remedy.

Although every accident caused by modern explosives has been carefully recorded, the saving of life which they effect in preventing accidents has almost entirely escaped notice, yet it deserves attention. That saving is due, firstly, to safety from fire, where small quantities are dealt with; secondly, to the absence of danger in loading bore-holes, since it is useless to ram the tamping; and thirdly, to the great reduction in the number of workers required for doing the same work as with gunpowder. By far the greater number of accidents in mines is due, indeed, to causes quite independent of the use of explosives, and it is evident that their number will be reduced in the same ratio as the number of hands.

Those guarantees of lessened danger will remain and be fruitful, while accidents due to recklessness or ignorance will greatly decrease in a short time under the salutary influence of Government inspection, general education, and experience.

Amongst the most grievous complaints of miners about modern explosives, which more or less relate to their danger, is the poisonous nature of the fumes emitted, which, in their opinion, expose them to most serious inconvenience.

Slight attention was paid at the beginning to those complaints, partly because if fumes are in-

rious, miners must allow them time to draw off, or proprietor must increase ventilation; partly also cause it is almost impossible, with the notions of dern chemistry, to account for the existence of sonous fumes. The great power of a detonating stance, like gun-cotton or nitro-glycerine, can ly be explained by the high temperature of the eous products produced, and theory tells and ctice proves that at very high temperatures no plex chemical combinations can exist. Hence o-glycerine, when it detonates, must split up carbonic acid, carbonic oxide, water, and ogen. M. Berthelot has recently given the t weight of his adhesion to that view, which, ed, is the only one that is tenable. Under circumstances it seemed difficult to explain reiterated complaints of poisonous fumes ing from the mines. About their existence e can no longer be any doubt, and the poisonous ent consists of hypo-nitric acid, against which onia would prove a very effective remedy. such fumes are never the products of a rational of the explosive substance, and it is quite evi- that hypo-nitric acid can never escape decom- tion in an atmosphere of 3,000° Centigrade or e with combustible elements in presence.

does not. But when a dynamite cartridge s instead of exploding, the combustion takes e at a much lower temperature, and the nitric contained in the nitro-glycerine gives off only of its oxygen, forming dioxide of nitrogen, h escapes, and in contact with the atmosphere converted into hypo-nitric fumes. It is easy ecome convinced by actual experiment of the ent atmosphere produced by a cartridge when ing or exploding. In the worst ventilated el twenty cartridges may be detonated with- as much inconvenience as is caused by the ing of one.

e frequent occurrence of bad fumes in mines proves, therefore, that the explosive substance udiciously used. The general mistake consists securing carefully the detonator-cap to the and especially the fuse to the cartridge. harging, the miner under such circumstances y draws fuse and cap out of the cartridge, ng them separated, so that the cap cannot bly exercise its detonating influence. What takes place is this. Part of the dynamite s, emitting hypo-nitric fumes, and part gene- explodes under the influence of accumulating and pressure. Thus the charge goes off, but a far inferior effect as compared to that of a er detonation, and with the emission of a great tity of red fumes of hypo-nitric acid.

is explains some curious discrepancies in the ments of miners regarding the influence of the s produced by the explosion. Working under l conditions of bad ventilation, some profess to experience the slightest inconvenience, and appear most seriously convinced about the ious character of the fumes; yet both are t, only those that have no bad fumes obtain ater blasting effect as well, a result which is entirely to the judicious use and fastening of detonator-caps.

he author, before he began to use a mortar for g detonating explosives, experimented a deal in mines with bad as well as good ven- tion, yet was never able to find the slightest inconvenience from the fumes, and may thus affirm from considerable personal experience that poisonous gases are the result not of the use, but the abuse of the substance.

What has here been said about the fumes of dynamite also refers to every other nitro-glycerine preparation, and also to gun-cotton when slightly damp; but when thoroughly dry it does not give off nitrous fumes to the same extent as nitro-glycerine, or dynamite, hence its gas, in case of imperfect explosion, causes much less inconvenience.

From what has been said here, though briefly, on the subject of fumes produced by modern explosives, it will be seen that they are not an essential property inherent in those compounds, and that the nature of their gases changes with the quickness of their combustion. The cause of that phenomenon is probably to be found in the cooling influence, under slow deflagration, of the surrounding medium, and the high temperature to which dioxide of nitrogen must be raised before it parts with its oxygen. With the question of fumes this account may end. It points to the following broad conclusions.

Gun-cotton and nitro-glycerine preparations are hitherto the only explosives which have in a certain measure and for certain purposes superseded gunpowder.

Gun-cotton, if manufactured of sufficient chemical stability, is decidedly, as regards its manufacture and carriage, the safest of all explosives. For storing and use in mines gun-cotton and nitro-glycerine preparations may be said to be equally safe.

The best nitro-glycerine preparations have over gun-cotton and some other nitro-glycerine preparations the great advantage of a superior concentration of power, which is the very secret of blasting, and effects great saving of time and labour.

DISCUSSION.

The Chairman said the great experience of Mr. Nobel, not merely in connection with nitro-glycerine, but with the general question of the application of explosive agents which he had studied, both from a practical and a scientific point of view, entitled his views to very great consideration indeed; but there were several debatable points touched upon in the paper on which he should be very glad to hear the opinions of gentlemen present.

Dr. Dupré said he had come rather to learn than to say anything, particularly as he had had very little experience in these matters. On one point, however, he was sorry that Mr. Nobel had gone a little out of his way, viz., with regard to the explosion at Stowmarket, and had thrown some little doubt on the explanation which had been given of its cause. He believed no one who impartially considered the circumstances could have come to any other conclusion than that it was due to acid having been added to the gun-cotton afterwards. He was one of the chemists sent down from the Home-office to examine into the accident, and he went rather prejudiced against the purity of the gun-cotton, but on going into the question with his colleague, Mr. Keates, they both came independently to the conclusion that it could not have been due to anything else than the addition of acid. As he had pointed out to the coroner, the whole of the constituents of the gun-cotton were exactly those of the finished product, plus the acid, which had evidently, therefore, been added. If it had been present during the manufacture the chalk must have been en-

tirely dissolved. Mr. Nobel had alluded to the fact that dynamite was sometimes found too acid, and suggested that that was due to the kieselguhr, which contributed to form it, having been burnt with coal containing sulphur, and that the nitro-glycerine absorbed the sulphuric acid formed. That would be very fair if the nitro-glycerine were pure, but as yet they had not found any specimen, not even of Mr. Nobel's own manufacture, which did not contain a small amount of nitre, and every chemist must know that when they had sulphuric acid, nitre and organic matter together, under certain conditions, a reaction took place by which hyponitric acid was produced, and this would be, therefore, an element of danger, so much so that in all cases such compounds should be totally free from acids.

Major Majendie said he did not profess to be specially familiar with the chemical side of the question, but there was one view of it which touched his own particular branch. The point, indeed, had been mentioned by Mr. Nobel, although he was sorry that it had not been treated more strongly and emphatically by him, namely, the question of what practically amounted—although not intentionally so perhaps—to misrepresentation of the danger attaching to these various substances. Mr. Nobel referred to the statements being made that these explosives might be burnt, and he thus appeared to be to some degree inviting people to do that which was dangerous. It was quite true, no doubt, that under certain conditions you might burn these explosives, for they had been burnt over and over again, but unfortunately these statements were put forward without the necessary qualifications, and the result was that the many people who had to deal with them argued that if they might burn them, therefore they might heat them, and he was sorry to say it came under the notice of his department every year, that a large number of accidents resulted from these very misleading statements. He had never been able to understand why persons should be told they could burn such materials. They would not buy them for the purpose of burning, and what was the use of informing them they could do under certain circumstances that which under other circumstances they could not do, and which under no possible circumstances did they require to do. To show the extent to which this mischief might go, he would mention that very recently one of his colleagues had come across an explosive agent which was absolutely labelled "non-explosive." This substance was sent about the country, was put into the hands of miners, and was commercially puffed off by having upon it those words. Happily, however, the law was sufficiently strong, even in its present imperfect condition, to enable Government to interfere, and they had done so, and he hoped effectually. Under an improved state of the law he hoped this sort of thing would not be possible without exposing the parties who made such statements to severe penalty. Probably, if these persons were asked why they labelled such a substance as non-explosive, they would say if you took a cartridge and burnt it, it was not explosive, and that might be true in a small experiment, but it was not true if it were to be treated as a non-explosive material, and stored like so much tea, sugar, or soap. He was sorry, therefore, that Mr. Nobel had not given a more emphatic warning on this point, to which he thought public attention could not be too strongly called.

Mr. Wills pointed out to Dr. Dupré that Mr. Nobel only doubted whether the acid had been added purposely to the gun-cotton at Stowemarket.

Dr. Dupré said that was the whole point which he objected to.

The Chairman said he had noted several points which had especially interested him, but the paper itself was so long that he would not occupy the time of the meeting by going into them in detail, especially as those which interested him most happened to be those upon which a discussion would be rather tedious. He referred in particular to Mr. Nobel's theoretical views with regard to the nature of detonation, and the mode in which it was transmitted and favoured by different explosives, as to which there were still differences of opinion. Some of the suggestions he had thrown out deserved the most careful consideration, but some of his arguments, based upon purely theoretical consideration, such as those brought forward by Mr. Berthelot, would, he thought, hardly be borne out by subsequent examination. With regard to measuring the pressure of explosive agents, he must mention that the method which Captain Noble and himself had already applied to gunpowder had been also applied in preliminary experiments, which would be farther continued, to gun-cotton, and would also, no doubt, be applicable to nitro-glycerine and its compounds. They would not probably be able to proceed so far as in the case of gunpowder, of which they had exploded no less than 2 lb. in a perfectly confined space, but they must be able to explode charges of sufficient magnitude in confined spaces to measure the heat developed and the nature of the products of combustion, in the most perfect condition of metamorphosis. There were many points which, if Mr. Nobel had been present, he should have liked to discuss with him, but which he would not enter into at length now. Dr. Dupré had referred to the question of impurity in gun-cotton, and, the nature of that impurity, and also the impurity in nitro-glycerine. He did not believe that the causes of spontaneous change were to be ascribed purely to the existence of oxides of nitrogen retained in these explosive substances in consequence of imperfect purification. It was well established, certainly in the case of gun-cotton, and he believed also in the case of nitro-glycerine, that there were certain small quantities of products formed by the action of the acid on the minute impurities contained in those substances—products which were themselves comparatively unstable, and which, therefore, were much more readily acted upon by heat, and in this way caused the development of hypo-nitric or other acid, and which brought about a change in the explosive agent itself. Mr. Nobel thought an unnecessary timidity existed when small quantities of nitro-glycerine were found to exude from cartridges made with these nitro-glycerine prepartions, and did not consider that, because liquid nitro-glycerine itself was so prone to detonation, that therefore the minute quantities thus exuding could give rise to similar dangers. There he could not agree with him, and he thought the facts with regard to accidents which had occurred during the la[st] few years distinctly showed that even the minute qu[an]tities exuding from cartridges might be very likely [to] bring about an accident. Therefore, this questio[n of] exudence was one of primary importance in connec[tion] with the safety of the nitro-glycerine preparati[ons]. With regard to the poisonous vapours from th[ese] compounds, he thought probably Mr. Nobel had ha[rdly] laid sufficient stress upon the fact that unless the pro[por]tion which the charge bore to the amount of resist[ance] which it had to overcome in a blasting hole was [very] accurately regulated—a thing almost impossible t[o do] in practice—you might not only have comparati[vely] complex gases given off, but you might actu[ally] have a mechanical dispersion in a very fine sta[te of] division of the nitro-glycerine vapour itself. La[stly], with respect to the point upon which Major Maj[endie] had touched, viz., the precautions necessary to g[uard] against accident in the application of nitro-glyc[erine] compounds or explosive agents generally, and [the] danger which might arise from encouraging an [idea] of false security in the minds of those using th[em], Major Majendie had correctly pointed out that alth[ough] the Government had been at the trouble of ma[king] elaborate experiments to elucidate these points, s[tate]ments were still being put forward as to the sa[...]

complete or comparative, of different explosive ... even when inflamed in considerable quantities. ... Majendie had referred to one particular material ... was described as non-explosive, and he himself ... only just read a circular with regard to another ... pound of the same class, in which it said that the ... rial when burnt loose was harmless, and if fire were ... to a large mass it would not explode unless com... into cartridges and fired by a detonating ... All such statements undoubtedly gave rise to a ... amount of mischief, because the man who used these ... rials was naturally prone to neglect even proper ... cautions. Familiarity with any material, however ... gerous, produced, if not contempt, at any rate in... rence with regard to its properties. This was seen in ... case of gunpowder, the explosive properties of which ... never hidden, and it must be more so with regard to ... other agents; the very fact that their explosion ... less readily brought about ought to lead to greater ... tion being exercised in their use, and great stress ... to be laid on the fact that they must not be ... with impunity, because they did not explode so ... ily, or because they would stand exposure to heat ... friction with comparative immunity. Above all, ... should not be treated in any way other than as ... stances intended to produce explosive results, and ... results only. He was sure Mr. Nobel himself would ... last man to desire to foster anything like want of ... in the use of nitro-glycerine preparations, and he ... have wished therefore that, in speaking of the ... that comparatively large quantities like 100 lbs. ... dynamite had been burnt without explosion, he had ... stated that somewhat larger quantities, when burnt, ... exploded with all the effects of detonation, and ... in the case of dynamite, as with gun-cotton and ... explosives, the exceeding of a very small margin ... safety at once brought about great risk of accident. ... conclusion, he begged to propose a most hearty vote ... thanks to Mr. Nobel for his interesting paper, con... taining, as it did, a vast amount of valuable matter, ... could not be appreciated by simply listening to the ... but merited most careful study.

The motion was carried, and Mr. Wills stated that ... was the last meeting for the present session, but ... the series would be resumed next session.

MISCELLANEOUS.

THE PATENT BILL.

The following remarks on a recent proposal by Mr. ... Wise for the modification of the Patent Bill ... appeared in a recent number of *Engineering* :—

In our issue of the 23rd ult. we published a letter ... Dr. Woolley with respect to the preliminary ex... amination of applications for patents as provided for in ... Patent Bill now awaiting the second reading in the ... Commons. In that letter Dr. Woolley supports the ... proposal in Mr. Lloyd Wise's paper lately published by ... that, whilst patents should be granted, notwithstand... ing the adverse judgment of the examiners, it would be ... desirable to make that adverse judgment public (or to ... which such adverse judgment). In other words, when ... whole of the facts have once been brought into ... juxta-position, the case should be allowed to stand upon ... its merits. Mr. Wise says substantially that it should ... to compel the insertion in the specification of two ... things: first, an acknowledgment of the existence of the ... matter the examiners may have found; and ... secondly, a specific statement of what the applicant ... nevertheless claims. This accords very much with what ... we have ourselves advocated when referring to Mr. E. ... pamphlet—viz., that any expression of opinion by officials as to novelty and utility is uncalled for, and that their functions should simply be to make a thorough search through the published records of things previously patented or in use—the result of their search to be laid before the applicant. Whilst it is for the public good that applicants for Letters Patent should receive every encouragement, it is, on the other hand, undoubtedly but reasonable that the result of any examination should, in so far as regards matters of fact as distinguished from matters of opinion, be placed on record for the information of the public. It would clearly not be desirable, as a rule, to go to the trouble and expense of making an examination, if, after all the facts had been raked up, the applicant might still take out his patent, in such terms as to include, to all appearance, the whole of the matter (if any) discovered by the examination, while leaving the public in the same position as if no examination had been made. We do not say it is probable that patentees would adopt such a course; but there might be cases where it would be done. Now Mr. Wise's plan undoubtedly possesses the merit of securing on the face of every specification a plain statement of facts, and of facts only, a course which on the one hand would not unduly hamper the patentee, and on the other could not be said to leave the public in the dark as to the basis on which the patent was made to rest. The proposed method really amounts to a combination of features existing in the practice of the present day. To say that the report of the examiners should not be published because it would unduly hamper the patentee, is only to say that the same practice should apply to the report of the examiners as that which already now applies to the objections of the law officers. For example, if an inventor applies for a patent, his provisional specification is submitted to one of the law officers of the Crown. If that officer rejects the application, say on the ground that the invention is not a proper subject for a patent, that objection is sent to the applicant in writing. The applicant may then explain his views, and contend that he is nevertheless entitled to a patent, and thereupon, if the law officer allows the application in spite even of grave doubts in his own mind, his allowance is communicated to the applicant in writing; but neither the original objection, nor the argument of the applicant, nor the communication of the law officer's clerk is recorded. The patent is granted for what it is worth, and is not hampered by any record of the adverse opinion of the law officer. Obviously, if it were so hampered, it would in a commercial sense be practically valueless to the patentee, for directly his invention was commercially introduced, assuming it ever got so far, it would naturally be openly infringed to such an extent that he would, unless a very wealthy man, be powerless to work against his opponents. On this point we agree with Mr. Wise that the publication of the adverse report of the examiners would be so serious a drawback, that the value of a patent would be greatly if not vitally injured, and the mode proposed by Mr. Wise of dealing with the result of the examination appears to offer a good solution to the difficulty. His suggestion that an acknowledgment of the prior matter found by the examiners should be inserted in the specification, is one which is frequently adopted at the present time in cases where a patentee is defining what is new in his invention when it consists of an improvement upon something that has been previouly patented.

It is satisfactory to find that this proposal is attracting attention, and we trust that the efforts now being made may result in the effective advocacy of a moderate course of procedure which shall commend itself alike to inventors and the public at large.

The General Summary of Statistics of Inspection for the year ending August, 1874, issued by the Education Department, shows that out of 12,246 schools inspected only in 1,137 schools was military drill taught. There appears to be no corresponding return for Scotland.

TRAINING SCHOOL FOR COOKERY.

The second report of the committee was read at a meeting of the subscribers held Tuesday, 25th May, at 3 p.m. The following extracts from the report may serve to show the progress of the school during the past year, and its progress for the future.

There are now at work the following classes:—

(*a.*) For learners, who learn practically cleanliness, which is of the first importance in cookery, and attend practical demonstrations.

(*b.*) A practice kitchen, where students themselves practice cooking suitable for families which spend from twenty to one hundred shillings weekly in the purchase of food to be cooked.

(*c.*) An artisan kitchen, where students especially intended as teachers, practice cooking for artisan families which spend from seven to twenty shillings weekly in the purchase of food to be cooked.

(*d.*) A course of practical teaching for students who are in training as teachers.

The demonstration class has been at work from the opening of the school. The work in the practice kitchen began in November, 1874. The work in the artisan kitchen began only in February, 1875. This kitchen has now the advantage of the instruction of a French bourgeois woman cook. Subscribers are invited to visit these classes, after 3 o'clock every day in the week except Saturdays, and to taste the cooking.

Recipes of a minute and careful character, giving every detail of the process to be followed, have been prepared for the learners' class and the practice kitchen. Others, for the artisan kitchen, are in preparation. These recipes form a sort of grammar of the principles of cookery taught in the school, and secure that uniformity in its teaching essential to a school. Each recipe is sold for one penny, and when all are compiled, they will be collected into a volume.

Since the opening of the school, 766 pupils have passed through it, of whom 198 have presented themselves for examination and have obtained learners' certificates. Some few pupils have taken the certificates of the practice kitchen. Three students have passed through the four courses named above and have obtained full diplomas as teachers. One is now engaged at a successful school for cookery at Leeds. The other two are employed in teaching in London. Time must elapse before teachers can be produced in sufficient numbers to effect much reform in national cookery, and the process of producing them must be slow.

The committee is in communication with the Lords of the Committee of Council for Education, as well as with the School Board of London. The Education Department makes grants of public money to encourage the teaching of cookery in elementary schools. Attendance at cooking lessons is paid for to the extent of one tenth part of the payment made for the whole attendance during the year, about 6d. each scholar, and 4s. is paid for each scholar who, passing the subjects in the 4th schedule, also passes in cookery and clothing. Teaching of cookery is specially encouraged in the training colleges by the Education Department. The School Board of London is about to establish district centres where cookery may be taught. A begining has been made in teaching cookery in elementary schools, by giving a lesson once a week to St. Mary's School, Soho. The scholars pay 3d. each for the lesson, and prefer it to the holiday on Saturday.

The statement of accounts presented with the report shows that the expenditure has been kept within the receipts. Out of a total receipt of £2,671, the students have contributed as much as £1,603. The outlay for alterations in the structure, fittings, utensils, printing, &c., has been unavoidably large in starting the school.

For the development of the school and the provision of suitable buildings, a much larger income will be necessary. The committee have established a rule that every annual subscriber shall obtain full value for every guinea subscribed by nominating students to become teachers.

The committee have under consideration the erection of a suitable building. Without such a building, the work of the school can never prosper as it ought. The committee propose to obtain necessary funds by donations, and have it in contemplation to issue debentures at 5 per cent. Donors will have also the right of nominating students to the extent of 5 per cent. per annum on the amount of their donations. Thus, a donor of 200 guineas to the building fund, may nominate a student as a teacher every year for a full course of instruction.

CAMBRIDGE LECTURE EXTENSION.

The following is the report of the Syndicate appointed by Grace of the Senate to organise and superintend courses of lectures and classes at a limited number of populous centres where the requisite funds should be guaranteed by the local authorities:—

In making arrangements for the organisation and superintendence of lectures and classes in populous centres, the Syndicate found it advisable to confine such lectures and classes to the interval between Michaelmas and Easter in each year. This interval they divided into two terms of twelve weeks each, one before and the other after Christmas. During the first term of the year 1873-4 lectures were delivered and classes held, under the superintendence of the Syndicate, in three centres, Nottingham, Derby, and Leicester. In the second term of 1873-4 the number of centres was increased to seven. In the first term of 1874-5, being the third term of the experiment, the number of centres was twelve. And during the present term lectures and classes are being carried on in the following sixteen centres:

Nottingham, Derby, Leicester, Lincoln, Chesterfield, in the Midland district; Leeds, Bradford, Keighley, Halifax, Sheffield, in the Yorkshire district; Stoke-on-Trent, Hanley, Burslem, Newcastle-under-Lyme, in the North Staffordshire district; Liverpool and Birkenhead, in the Liverpool district.

The subjects on which the lecturers are giving instruction during the present term are political economy, English constitutional history, English literature, logic, physical geography, geology, astronomy, physics, optics and spectrum analysis. A course of lectures is generally concluded in one term, though occasionally it extends over a longer period. The term's course comprises the delivery of twelve weekly lectures and the holding of twelve weekly classes.

The following regulations have been made for the conduct of these lectures and classes:—

"The teacher to remain in the lecture-room for some time after the conclusion of each lecture and class, in order to answer questions, or solve the difficulties which have occurred to pupils, and to give advice as to the reading of text-books and other means of efficiently studying the subject.

"Each lecture will be accompanied by a syllabus distributed to the pupils, and by questions. Those who desire to answer these questions to do so in writing at home, and be at liberty to submit their answers to the teacher for correction and comment.

"The class in each subject to be formed only from those who attend the lectures in that subject, and to consist of those who are desirous of studying it more fully. The class, at the discretion of the teacher, either to take up the subject of the lectures or cognate subjects bearing directly thereon and necessary for the better elucidation of the subject of the lectures. The teaching in the class to be more conversational than that in the lecture."

Written examinations have been held at the conclusion each course by examiners appointed by the Syndicate, m to any pupil who has attended the course; and ificates have been granted to the candidates who manifested sufficient merit in these examinations.

n most centres several courses of lectures and classes carried on simultaneously. These courses have been nged at such hours and for such fees as shall meet wants of the various classes of society. The lectures he morning and afternoon are chiefly attended by ng men and women of the wealthier classes. Among attendants at the evening lectures there are con-rable, and in some instances large, numbers of working classes. In Nottingham several trades' ons formed a guarantee fund, amounting to £60, and ertook to sell tickets among their members, of whom rge number attend the political economy course. Sheffield the members of the trades' council have been rumental in securing a considerable portion of the attendance which marks that town. In the districts a considerable number of elementary ol teachers attend the courses. It should be men-d that the Syndicate, in making their arrange-ts, have endeavoured not only to provide instruction, ar as possible, for all classes of society, but also to monise the plans of lectures and classes with existing l educational efforts.

uring the present term the number of lecturers em-ed is thirteen; the total number of pupils attending courses is about 3,500; and the sum payable to the ersity for the teaching, examinations, and certifi-s is £1,550. These 3,500 pupils are therefore ving the education thus afforded by the University ng the present term at the rate of about nine ings a head. It is to be observed that this sum does nclude the local expenses incurred for the hire of s, printing, and advertising; but these are so very ent in different localities that any general statement their average amount would be altogether mis-ing. The Syndicate append to this report a table, which the numbers though only approximate are ntially correct, showing the attendance at the rent courses in the various centres. It is obvious this table that the numbers attending the courses fferent places are very different. The Syndicate, ever, are glad to report that the quality of the work is equally satisfactory throughout; and they see eason to depart from the opinion expressed by them their report to the Senate last Easter term on results of the experiment for the first year, that "have reason to be well satisfied with the working he scheme, and believe that by means of it accurate methodical instruction has been received by a con-rable number of persons who would not otherwise had the opportunity of obtaining such instruction."

The expenses of a three months' course of one lecture one class each week consist of two portions (1) the payable to the University for the teaching, exam-on, and certificates, which has varied from £45 to according to circumstances, and (2) the local nses of hire of rooms, &c. In cases where sufficient loyment for the lecturer has not been provided one town, the Syndicate have been able to supply teaching at the rate above named owing to the co-ration which they have been able to arrange between ous neighbouring towns.

In all cases the Syndicate have required that a local mittee be formed, and a guarantee fund raised by committee sufficient to meet the whole expenses of locality concerned during the stipulated period over ch the arrangements extend. The local committees ome instances represent single towns, and in other s groups of towns. In all cases the sum payable the Syndicate has been a fixed sum independent of the ber of pupils. The fees paid by the pupils are d by the local committees, and vary from 1s. 6d. to £1 1s. for the complete course; but in few cases exceed 10s. The local arrangements are so various that it is not easy at present to state to what extent the guarantee fund in each locality will be drawn upon; but as nearly as an estimate can be formed the total amount to be received from fees by the local committees during the present term will be about £1,400. As each locality, however, is responsible for its own pecuniary arrangements only, a statement of the collective result is of less importance than a statement of the results in particular places. In some places the whole expenses (including local expenses) have been more than met from fees alone; but in some places the amount got from this source has fallen far short of the total expenses. In such cases the deficiency has been supplied by the local committee making a call on the local guarantors.

While it seems not improbable that in some places the scheme will altogether cease, or be continued in a more or less desultory manner, there also is some indication that in certain important centres it will assume a methodical, form embracing a regular curriculum, and will receive considerable permanent endowment from local munificence.

The Syndicate do not anticipate much difficulty in continuing to supply a sufficient number of competent teachers.

The powers of the Syndicate expire at the end of the ensuing Easter term. As most of the arrangements requisite for the due working and development of the system have to be made many months in advance, the Syndicate recommend that the Senate should at an early date appoint a standing Syndicate for the organisation and superintendence of lectures and classes in populous places.

S. G. PHEAR, *Vice-Chancellor*.	HENRY LATHAM.
W. H. BATESON.	I. TODHUNTER.
B. F. WESTCOTT.	JOHN LAMB.
J. B. LIGHTFOOT.	E. W. BLORE.
G. D. LIVEING.	G. F. BROWNE.
W. M. CAMPION.	JAMES STUART.
E. H. PEROWNE.	

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the month of April, 1875, When they are counted by sight the words "by sight" are used, when by turnstile the word "machine":—

	Voted in 1874.	Number of Visitors. How counted.
1. British Museum	£102,442	return refused.
2. National Gallery	6,346	74,819 (by sight).
3. Kew Gardens and Museum	17,862	33,049 (by sight).
4. South Kensington Museum	38,024	63,257 (by machine).
5. Bethnal-green	5,810	43,449 (by machine).
6. National Portrait Gallery	1,748	...
7. Geological Museum, Jermyn-street	8,998	2,972 (by machine).
8. Patent Office Museum	1,490	15,626 (by machine).
9. Edinburgh National Gallery	2,100	4,857 (by machine).
10. Edinburgh Museum of Antiquities	...	4,551 (by machine).
11. Edinburgh Museum of Science and Art	9,824	27,951 (by machine).
12. Edinburgh Botanic Gardens	1,750	...
13. Royal Dublin Society	1,823	...
14. Dublin Museum of Natural History	1,672	...
15. Glasneven Botanic Gardens and Museum	2,148	...
16. National Gallery of Ireland	2,380	15,967
17. Geological Society, Dublin	500	...
18. Museum of Royal Irish Academy, Dublin	2,084	...
19. Zoological Gardens, Dublin	...	12,356
20. Tower of London	2,236	30,194 (by sight).
21. Royal Naval College, including Greenwich Painted Hall	1,416	24,760 (by sight).
22. Royal Naval Museum, Greenwich	...	3,390 (by sight).

CORRESPONDENCE.

FILTERED THAMES WATER, AND SPRING WATER FROM CHALK STRATA.

SIR,—At the discussion after the reading of Mr. Hogg's recent and valuable paper on "River Pollution, with Special Reference to the Impure Water Supply of Towns," some misapprehension appeared to exist in the minds of more than one speaker as to the respective characteristics of Thames water after being passed through artificially constructed sand filters, as practised at water works, and those of spring water derived from subterranean chalk strata.

Want of time prevented my then being able to fully speak to these points. Will you, Mr. Editor, be good enough to find space for the following remarks?

Spring or subterranean water from chalk and many other geological strata, is, in its normal condition, characterised—

1. By having at its source an uniform temperature summer and winter, equal to the average of the climate of the year, which in this country differs but little, being about 50° Fahr.

2. By being clear, transparent, bright, and when seen in large bulk, pure blue, the natural colour of uncontaminated water.

3. By being well aërated, and holding in solution eight or more cubic inches of gas per gallon, namely, two or more inches of oxygen, and six of nitrogen; by being pleasant, refreshing, and wholesome when drunk.

4. By being free from living organisms, vegetable or animal, and from all dead organic matter in mixture or solution.

On the other hand, Thames, and most river water, after being passed through filters at waterworks, is characterised.

1. By having in the heat of summer a normal temperature of 68° to 72° Fahr., *i.e.*, 18° to 20° warmer than spring water; and, in the cold of winter, a normal temperature of 34° to 36° Fahr., *i.e.*, 14° to 16° colder than spring water.

2. By being more or less opaque, and devoid of the transparency, brightness, and when seen in large bulk, deep blue colour of spring water.

3. By holding in solution, more especially in hot weather of summer and autumn, a less quantity of oxygen gas than spring water, and being less refreshing and wholesome when drunk.

4. By holding partly in suspension, partly in solution, especially after heavy rains in hot seasons, manure washed from land, the droppings of animals and other fæcal and impure matter, solid and liquid; by abounding in life, vegetable and animal, and being liable to be inoculated by means of drains with the virus of specific diseases, which virus often maintains active vitality, and causes ill-health and even death to those who drink it.

Spring water, obtained from chalk strata, owes its origin to the rain that falls on the tops and sides of chalk hills. To the north, west, and south of London, alone, there is an exposed area of chalk equal to from three to four thousand square miles. The tops of these hills vary in height from three hundred and fifty to nine hundred feet above the surface of the sea. The annual average depth of rain falling on these hills amounts to from twenty-eight to thirty inches. The chalk of which the hills are composed varies in thickness from six hundred to one thousand feet.

Chalk itself is pervaded in every direction by numerous minute pores of aggregate capacity sufficient to enable a cubic foot of dry chalk of average quality to absorb about two and a half gallons of water, *i.e.*, four-tenths of its bulk.

At depths varying from one hundred to five hundr[e]d feet (more or less) from the surface, the mass of th[e] chalk below is saturated with water; that is, the po[res] in the lowermost mass are saturated with water d[e]rived from rain that, in the course of past centuries, h[as] slowly percolated down from the surface.

The chalk lying above this saturated strata (as b[e]fore said) varies from one hundred to five hundred f[eet] in thickness; in their normal state the pores contain b[oth] air and water. The heaviest rain, sometimes as m[uch] as two inches in depth in an hour, falling on the ch[alk] hills, is at once absorbed into the soil and minute p[ores] and crevices of the chalk at or near the surface.

Chalk is a stratified formation consisting of lay[ers] varying from one to two or more feet in thickn[ess] reposing one upon the other, having thin spaces [or] interstices between each layer, and being irregul[arly] divided at places by perpendicular and slanting fiss[ures]. The top of the uppermost layer of chalk is crack[ed] broken up, by the action of rain and frost, into c[om]paratively small pieces.

The rain once absorbed into these pores and cr[evices] for the most part percolates gradually down int[o the] mass below, until it reaches the lowermost layer or str[atum]. Chalk, owing to the minuteness of its pores, by [its] capillary attraction will retain a certain amount of w[ater] diffused through it. Beneath the surface the p[ores] are partly filled with air, and partly with water; w[hen], however, rain falls on or reaches the top surface [of a] layer of chalk, the water, displacing the air, enters [into] the uppermost portion of the layer and thus causes [the] water originally contained in it to pass out below [into] the top of the next layer.

In this manner water by turns enters into the top, [and] passes out of the bottom of each successive layer; thus, in process of time, rain at the surface d[escends] descends into the lowermost layer or stratum. [The] very gradual percolation and passing down of the w[ater] through the mass of the porous and creviced chal[k is] greatly assisted by the varying pressure of the a[tmo]sphere.

When the barometer falls, some air makes its [way] out of the pores and the interstices between the cr[evices] and lines of bedding. When the barometer rises [the] air makes its way into the pores and interstices.

Porous bodies, such as chalk and charcoal, hav[e the] remarkable property of condensing oxygen into [their] pores; the oxygen in this state is known to enter [into] combination with other bodies with great readiness [and] force; owing to this property, aided by the pow[er of] gases to diffuse, and the variation of the barometer, [the] water, while sinking through subterranean strat[a, is] effectually freed from organic matter, and absorb[s and] takes into solution eight or nine cubic inches of a[tmo]spheric air per gallon, absorbing, however, a larger [pro]portion of oxygen than nitrogen, as is the proper[ty of] all pure water.

This breathing of the hills, so to speak, with [every] change of the barometer, takes place in all seas[ons], spring, summer, autumn, and winter. Owing to [this] the subterranean water attains the mean temperat[ure of] the atmosphere at its source, and, as before expl[ained] becomes effectually purified from all organic conta[mina]tion; in consequence, it is clear, transparent, b[right], well aërated and oxygenated, pleasant, refreshing [and] wholesome as a beverage.

The proportion of rain-fall that percolates [on an] average of years into the interior of chalk hills, prob[ably] amounts to from 14 to 18 inches in depth over their [sur]faces. As the average thickness of the chalk is [...] hundred feet, of which more than one-third consist[s of] pores, it follows that it would take a depth of [...] hundred and sixty feet of rain, or the produce of [...] centuries, to saturate the pores, and that a dept[h of] three and a-half feet of chalk would absorb the pr[opor]tion of rain-fall percolating through the surface d[uring] one year. It thus appears certain that generation[s]

...must have passed away since the water now ...ble from the lower strata fell at the surface.

...compare this slow and delicate process of nature ...the rapid and coarse process of artificially filtering ...water, and note how different the operation—how ...the result. River water in the hot weather of ...attains to a temperature of from sixty-eight to ...-two degrees. At this temperature it is conveyed ...the filter beds, mostly composed of layers of coarse ...and fine gravel, covered by coarse river or washed ...d. The layer of coarse sand varies from three to ...in thickness, and is the agent relied upon for ...ing the water. The whole of the interstices ...the gravel and the sand is fully filled with water. ...of water, varying from three to four feet in ...is kept over the surface of the sand during the ...of filtration; the water passes through the sand ...rate of about 48 gallons per superficial foot in ...-four hours, equal to two gallons, or four inches ...th per hour. The coarser solid matters held in ...ion or mixed with the water to be filtered are ...at the surface of the sand while the water is ...through the filter, but urine and other foul ...matter uninterruptedly pass with the water. The ...animacules, together with their ova, also readily ...through the interstices between the particles of sand, ...being much too large to arrest such minute matters. ...surface of the filter, as the water passes through, ...covered with leaves, blossoms of trees, decaying ...ayed vegetable matter, manure, and other things, ...ing to the season, washed from the land by rains ...floods, together with living animacules, fat, and ...grains, particles of undigested food-matters, dis-...ed into the river by means of ditches, drains, or ...

...hot seasons, when the river water is at a normal ...rature of 68° to 72°, the partially decomposed organic ...so arrested at the surface of the filter, shortly ...further decomposed; animalcules finding here ...pabulum, or nourishment, freely increase and ...ly. Water takes more or less decomposing ...matter into solution, according as it is com-...ively warm or cold. Water at 70° takes more de-...ing organic matter into solution than water at ...hence in hot periods of summer and autumn the ...in necessarily passing through the layer of de-...ing matter on the surface of the filter, freely ...a portion of the noxious matter in solution. Thus ...water is kept impregnated with organic matter that ...as food for the animalcule, so fully and so ably ...ed by Mr. Hogg.

The interstices between the gravel and the sand, of ...the filter is composed, being fully charged with ..., to the exclusion of all air, the only oxygen ...able to oxidise any of the dead organic matter in ...water is that dissolved in the water itself, so that ...any of the dead organic matter while passing ...the filter become oxidised, this is done by the ...up or diminishing the oxygen gas in solution in ...water. Again, it has been conclusively proved that ...diseases, such as cholera and typhoid fever, have ...unfortunately propagated in summer and autumn, ...river water is warm, after being passed through ...filters previously to being drunk.

Eggs of numerous animalcules, and seeds of numerous ...easily pass with water through coarse sand filters, ...afterwards germinate, grow, multiply, die, and be-...putrescent. Though by filtration grosser matters ...strained out of water, yet the filtered water still re-...many of the worst impurities of the original water. ...render river water artificially filtered, fit to be ...pared with spring water, it would be necessary ...

1. The temperature be lowered 20° or so in summer, ...raised 16° or so in winter.

2. It be rendered at all times transparent and bright, ...when seen in large bulk, true blue in colour.

3. It contain in solution eight cubic inches of gas, *i.e.*, two of oxygen, six of nitrogen per gallon, and be pleasant, refreshing, and wholesome.

4. It be free from organic matters, living or dead, in suspension or solution.

I respectfully submit, Mr. Editor, that no filtered river water now, or ever supplied to the metropolis possesses, or has possessed, any one, much less every one, of these—the four qualities that so essentially characterise uncontaminated spring water.—I am, &c.,

SAMUEL COLLETT HOMERSHAM.

19, Buckingham-street, Adelphi,
May 24, 1875.

OBITUARY.

M. A. G. Findlay.—Mr. A. G. Findlay died on the 3rd inst., at Dover, in the 64th year of his age. Though he will be remembered as the author of several atlases and other geographical works, including his "Atlases of Ancient and Comparative Geography" (published in 1834), it was as a hydrographer that his name was best known. His principal works in this direction were his nautical directories and charts, the former alone (according to a statement in the *Athenæum*) amounting to 6,000 pages, while the whole of his works reach a total of 10,000 pages. His connection with the Royal Geographical Society was long and intimate, and, had he lived for another year, would probably have been consummated by the award of the annual Gold Medal. He was never a member of this society, but on several occasions he contributed to its proceedings. The principal papers read by him were, one on "The various descriptions of Lighthouses and Beacons," read December, 1847, and a continuation of the same subject, read March 5, 1858, on "The progress of the English Lighthouse System."

GENERAL NOTES.

Industrial Exhibition at Manchester.—The second of a series of industrial exhibitions, projected by the Manchester Society for the Promotion of Scientific Industry, was opened at Cheetham Hill, Manchester, on the 14th inst. In the absence of Lord Derby, Mr. Hugh Mason presided at the opening meeting. After a few preliminary remarks, he introduced Dr. Anderson, late superintendent of machinery to the War Department, at Woolwich, who delivered an address upon "Tools," after which Mr. Hugh Mason declared the meeting open. The exhibition contains 1,200 entries, sent in by 300 exhibitors. The different departments of the exhibition include engineers' and mechanics' tools and appliances in the working of metals, wood, and stone, and domestic appliances for lessening labour in the household, &c.

An Enamelled Ceiling.—Among the decorative works in majolica, mosaics, *sgraffito*, stained glass, &c., which were originated in the South Kensington Museum some years ago, when the late Marquis of Salisbury and Lord Granville were Lords President, but which have lately been going on slowly or been actually suspended, is a ceiling made of thin plates of iron and enamelled. The ceiling has just been put in its place in the central refreshment-room, and is probably the first experiment of the kind which has been attempted. The decorations of this room were designed to resist all dirt and impurities incident to a public room where food is eaten by an average of 10,000 persons a week. The walls and columns are of majolica, the floor is paved, and the ceilings are of iron enamelled. The whole gives an impression of perfect cleanliness, and every part might be washed down by a fire-engine weekly, if necessary. The iron ceiling was designed and painted by Mr. James Gamble, a successor and pupil of the late Godfrey Sykes, who practically founded the school at the Museum. The artistic work

of the ceiling was done at the South Kensington Museum, until the action of the decorative studio was virtually suspended. The manufacturing part of the ceiling was done at Birmingham by the Enamelled Iron Company, the white enamelled plates being sent from Birmingham, and painted with arabesques by the artist.

British Academy of Arts at Rome.—Mr. William Agnew, of Manchester, has appealed for donations and subscriptions for the British Academy of Arts at Rome, which, it may not be generally known, has been in existence since 1823. Mr. Hamilton, then the English Ambassador at Naples, the Duke of Devonshire, Sir Thomas Lawrence, Sir Watkin Winn, the Duke of Bedford, and others noted for their intelligent appreciation of the claims of art were among the earliest supporters of the Academy. Its main object at that time was, and indeed is, the maintenance of a free and permanent school for the benefit of all British artists studying in Rome. For nearly 20 years before his death the direction of the Academy was entirely in the hands of John Gibson, the sculptor, and Mr. Agnew says that, without any disrespect to the memory of this distinguished man, it may with certainty be averred that in this fact lay a misfortune, and that the usefulness of the Academy and indeed its future were prejudiced thereby. At the commencement of the past year a committee was appointed to inquire into the cause of the decadence of the Academy. These were not far to seek, inasmuch as the books proved that there had been no committee for 20 years—that, in fact, the Government of the institution had been an absolute one, and not an elective one. It has been determined to recognise the Academy upon a broad, efficient, representative basis, and the property to be vested in the following trustees:—Messrs. J. Severn, Penry Williams, Laurence Macdonald, and Holme Cardwell. Money, however, is wanting.

Patents for Inventions Bill.—The following petitions referring to this Bill had been presented to the House of Commons by the 17th inst. Against proposed Bill:—April 13, Sheffield Associated Engineers; Samuel Paget, president; and another (by Mr. Mundella). April 16, Members of the Sheffield Trades' Council; Thomas Rolly, president; M. Prior, secretary. April 16, United Shipping Trades' Council of Liverpool; (name illegible), chairman (by Viscount Sandon). April 20, Members of the Bury Trades' Council (by Mr. Phillips). April 23, Members of the Philosophical Society of Glasgow; William Thompson, president; and another (by Mr. Anderson). April 26, Members of the Walsall and District Trades' Council; S. Welsh, president; Charles Heap, secretary (by Sir Charles Forster). April 26, Oldham Amalgamated Trades' Council; C. W. Needham, president; John Smith secretary (by Mr. Sergeant Spinks). April 26, Dundee United Trades' Council; D. C. Cathro, president; J. Crockett, secretary (by Mr. Yeaman). April 27, James Napier, and other inventors (by Mr. Anderson). April 27, Members of the Glasgow United Trades' Council; John Crichton, president; and another (by Mr. Cameron). May 4, Inventors in Dundee (by Mr. Anderson). For alteration:—April 26, Members of the Birmingham Chamber of Commerce; Ralph Henton, chairman (by Mr. Dixon). April 30, Members of the Leeds Chamber of Commerce; John Banan, president (by Mr. Wheelhouse). No petitions had been received in favour of the Bill.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Tijdschrift uitgegeven door de Nederlandsche Maatschappij ter bevordering van Nijverheid for 1874.

An Address upon the Thermal Paths to the Pole. By Silas Bent. Presented by Matthew S. Fife.

Transactions of the National Association for the Promotion of Social Science (Glasgow meeting), 1874. Edited by C. W. Ryalls, LL.B. Presented by the Association.

Catalogue and First Annual Report of the Public Library of Indianapolis. Presented by the Libra[ry] Committee.

Memoirs of the Geological Survey of India. Vol. 1[0], part 2, and Vol. 11, part 1. Palæontologia Indi[ca], Part 1, series 10. Records. Vol. 7, parts 1-4. Pr[e]sented by his Excellency the Governor-General of Ind[ia] in Council.

Notes on Building Construction. Part 1. First Stag[e] or Elementary Course. Presented by the Publisher[s], Messrs. Rivingtons.

London International Exhibitions of 1873 and 18[74]. Printed Documents and Forms, and the Key. Present[ed] by her Majesty's Commissioners.

In the Beginning. Remarks on certain modern vi[ews] of the Creation. By R. H. Sandys, M.A. Presented [by] the Author.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock. The follo[w]ing is the last meeting of the Session:—

JUNE 2.—"Toughened Glass." By PERRY F. NUR[SEY], Esq., C.E.

MEETINGS FOR THE ENSUING WEEK.

MON. ...Asiatic, 22, Albemarle-street, W., 3 p.m. Annual Me[et]ing.

TUES. ...Cymmrodorion Society (at the HOUSE OF THE SO[CIETY] OF ARTS), 7½ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Dr. Gladstone, "Chemical Force."
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m. Annual Meeting.

WED. ...SOCIETY OF ARTS. John-street, Adelphi, W.C., 8 p.m. Mr. P. F. Nursey, "Toughened Glass."
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THURS...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Mr. J[ohn] Miers, "The Barringtoniaceæ." 2. Dr. Gilbert, "F[airy] Rings."
Chemical, Burlington House, W., 8 p.m. 1. Mr. J. Coleman, "The Effects of Cold and Pressure on [the] Gaseous Products of the Distillation of Carbonaceous Shales." 2. Dr. Campbell Brown, "The Agricultural Chemistry of the Tea Plantations of India." 3. Mr. A. Phillips, "The Structure and Composition [of] Pseudomorphic Crystals, having the form of Orthoclase." 4. Mr. Pattinson Muir, "Nitrosyl Bromide and Sulphur Bromide." 5. Dr. Stenhouse and Mr. Groves, "The Action of Chlorine on Pyrogallol." [6.] Mr. W. H. Perkins, "Some New Derivatives [of] Alizarine." 7. Mr. R. W. Williams, "Some Metallic Derivatives of Carmiarine." 8. Dr. E. W. Pr[evost], "Note on the Action of Chlorine on Acetamide." [9.] Mr. Ferdinand Kopfer, "The Action of Dilute Mineral Acids on Bleaching Powder." 10. Dr. Wright and Mr. Beckett, "Note on Sulphate of Marceine and [other] Marceine Derivatives."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "The Progress of Physico-Chemical Inquiry."
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

FRI........Royal United Service Institution, Whitehall-yard, 3 p.m. "Experiments at Eastbourne."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Prof. Tyndall, "Whitworth's Planes, Standard Measures, and Guns."
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Classification of Plants." (IV.)
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. Mr. A. J. Ellis, "Ancient Greek Pronunciation."
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W. Mr. C. Drake, "Concrete Building Materials."

SAT........Royal Institution, Albemarle-street, W., 3 p.m. Professor R. K. Douglas, "The Chinese Language and Literature."
Actuaries, Quadrangle, King's College, W.C., 2 p.m. Annual Meeting.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,176. Vol. XXIII.

FRIDAY, JUNE 4, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The Society's Conversazione will be held on Friday, June 25th, at South Kensington Museum, by permission of the Lords of the Council on Education. Cards will be issued in due course.

CONFERENCE OF INSTITUTIONS.

The Twenty-second Annual Conference between the Council of the Society and the representatives of Institutions in Union will take place at the Society's House, on Friday, June 25th. The chair will be taken at 12 o'clock, by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.

Secretaries of Institutions and Local Boards are requested to send, *immediately*, the names of the representatives appointed to attend the Conference; and early notice should be given of any subjects which Institutions or Local Boards may desire their representatives to introduce to the notice of the Conference.

FOOD COMMITTEE.

A meeting of this Committee was held on Thursday, May 27th. Present, Benjamin Shaw (in the chair), Sir Antonio Brady, Major-General F. Eardley-Wilmot, R.A., F.R.S., C. Wren Hoskyns, and James A. Youl.

INDIA COMMITTEE.

A meeting of the Committee was held May 28th; present — Dr. Boycott (in the chair), Thomas Briggs, A. Cassels, F. Shaw, W. Maitland, with Col. Hardy, Secretary for the Indian Section, and P. Le Neve Foster, Secretary of the Society. The Rev. James Long also attended. The Committee had under consideration a memorial about to be presented to both Houses of Parliament from the Edinburgh East Indian Colonisation Society, a copy of which, and the Duke of Argyll's reply thereto, and a number of other papers and correspondence, all on the subject of the colonisation of the hill districts of India, had been forwarded by Dr. Archibald Graham, President of the Edinburgh Society above mentioned. After discussion and deliberation, the Committee passed the following resolution, which the Secretary was requested to communicate to Dr. Graham. Resolution:— "The India Committee of the Society of Arts, Manufactures, and Commerce, while fully sympathising with the general objects of the Edinburgh East Indian Colonisation Society, are not prepared to advise the Council of the Society to support the special proposals embodied in the memorials about to be presented to Parliament by the Society above named."

TWENTY-THIRD ORDINARY MEETING.

Wednesday, June 2nd, 1875; Lieut.-Col. A. Strange, F.R.S., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Adams, Read, St. Ives, Hunts.
Calver, George, 20, Tufnell-park-road, Holloway, N.
Clemence, Samuel Quick, Villiers-street, Strand, W.C.
Cobb, F. Stewart, the General Post-office, E.C.
Ormiston, Frederick Aldridge, 3, Clifton-villas, Gipsy-road, Lower Norwood, S.E.
Park, John Carter, Blenheim-house, Bow-road, E.
Seward, Thomas, Petworth.
Thomas, William Henry, C.E., 15, Parliament-street, S.W.
Thompson, Alfred Boyle, M.D., 18, Serjeant's-inn, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Bland, John, 40, Bedford-place, Russell-square, W.C.
Deal, George, 13, Carlyle-square, Chelsea, S.W.
Joseph, Samuel A., 44, Queensborough-terrace, W.
Markham, Sam Stenton, F.R.I.B.A., 32, King William-street, E.C.
Michell, Robert, F.R.G.S., 103, Abingdon-road, Kensington, W.
Rogers, J. Banting, Robertsbridge, Sussex, and 4, Three Colt-street, Limehouse, E.
Schmitz, Dr. Leonhard, 26, Belsize-park-gardens, N.W.
Scott, John Charles Addyes, J.P., 3, Ormonde-terrace, Regent's-park, N.W.
Semple, Alexander, 10, Maida-vale, W.
Tayler, George, 5, Stanley-gardens, Belsize-park, N.W.
Thynne, John Charles, Little Cloisters, Westminster, S.W.
Wanklyn, Professor James Alfred, 117, Charlotte-street, Fitzroy-square, W.
Whiston, William, Chapel Chorlton, Newcastle, Staffordshire.
Woodhouse, Henry John Cam Frederic, 14, Warwick-court, Holborn, E.C.

The paper read was:—

TOUGHENED GLASS.

By Perry F. Nursey, C.E.

If there is one substance which, more than any other, may be considered as having promoted in a pre-eminent degree the advancement of civilisation, the development of science, and the material progress of nations, that substance unquestionably is

glass. If there be one manufacture more than another, the origin which may be said to stretch away so far into the past as to be not merely coeval with, but antecedent to, the existence of science, it is certainly the manufacture of glass. In support of the first position, it is only necessary to instance the important part glass has ever played, and still continues to play, in experiment and research throughout the whole range of chemistry, and in practice throughout the whole circle of the applied sciences. Consider but for a moment what it has done for astronomy, what, too, it has effected for natural philosophy and in the domain of physics. Reflection prompts the inquiry, where would have been the revealed marvels of earth, water, and air, but for its assistance? And universal experience bears witness to the extent to which we are indebted to glass for our health, our personal comforts, and our luxuries.

The second position is as self-evident as the first, and is supported by written and graven history. The children of Israel, in their bondage, were probably as familiar with the production of glass as they were with the manufacture of bricks, inasmuch as research has revealed the fact that the art of glass-working was practised in Egypt 3,500 years since, before the exodus of the Israelites from that land. Representations of glass-blowers following their avocations have been found sculptured on some of the monuments, the hieroglyphics upon which prove those monuments to be as ancient as that event, and glass ornaments have been discovered in tombs as old as the days of Moses. At Thebes was found a bead of glass $\frac{3}{4}$ in. in diameter, and of the same specific gravity as our crown glass, upon which was inscribed the name of a monarch who lived 1,500 years B.C. The Jews would seem to have carried away with them from Egypt a knowledge of the art, which was also acquired by the Greeks, and afterwards by the Romans, who were successively the conquerors of that land. The British Museum contains examples of cinerary vases found in Roman barrows, and which are supposed to be of Egyptian or Roman manufacture. The ruins of Herculaneum enclosed a number of glass vessels, and we have evidence that some at least of the inhabitants of that city and of Pompeii had glass windows to their dwellings.

Of the origin of this ancient manufacture we have but scant and questionable record; its antiquity may be such that tradition even has failed it. The discovery is stated to have been made by the Phœnicians, a party of whom, according to Pliny, landed from a ship on the banks of the river Belus, which flows past the base of Mount Carmel, in Palestine. Their cargo consisted of natron, and finding no stones on which to rest their cooking pots, they took some lumps of natron, and made a hearth. The heat of the fire fusing the soda and the sand of the river, glass was produced. The Sidonians of the neighbourhood are said to have wrought the discovery into a practical shape, and to have practised the art of glass-making with considerable success. The former part of this statement, however, is open to question, as it is doubtful whether a fire in the open air could produce such a result. It is far more probable that the manufacture of glass was first suggested by the vitreous formation attendant upon the firing of bricks and pottery, or the reduction of metallic ores, in both of which processes an impure glass, or slag, is produced. The Phœnicians, however, well understood the manufacture of glass, and carried it on exclusively for a long period.

In later times the Venetians were the first to attain a degree of excellence in the art of working glass. The French subsequently took up the manufacture, and, under royal and noble patronage, made great advances in it. In England the manufacture of window-glass was commenced in 1557 in Crutched-friars, flint-glass articles being shortly afterwards produced in the Savoy-house, Strand, within a short distance of the building in which we are now assembled.

The first sheets of glass for mirrors and coach windows were made in 1673, at Lambeth, by Venetian artisans, under the patronage of the Duke of Buckingham. In 1771, the British Plate-glass Company obtained its charter, and started works at Ravenhead, near St. Helen's, Lancashire, and during the last forty or fifty years British manufacturers have made rapid advances in this important art, and in some departments have attained an unquestionable pre-eminence.

But, notwithstanding that the manufacture of glass extends back so far into the past that its age may be counted by thousands of years, we do not appear to have at any time produced, or to be producing now, an article differing materially, as regards its physical features, from the glass of the days of Pharaoh. It may possibly be of a finer nature in some respects, and there may be some delicate variations of manufacture which the refinements of science have introduced to meet the instinctive demands of a higher civilisation; but, in the main, the glass of to-day is the glass of three thousand years ago. It is, in its normal condition, a transparent solid, very hard and yet exceedingly brittle, and is produced by the fusion of silicious and alkaline matter. Improvements in its manufacture, both as regards materials and manipulation, of course have taken place, but down to the present time no great change in its physical character of a practical nature has been effected, its great hardness, its extreme brittleness, and its transparency, still co-exist, nor has any one of these qualities ever been superseded, as far as I am aware, by any other in conjunction with the other two, save only transparency, which it need hardly be observed is often exchanged for opacity. Its brittleness, however, has always remained, with a slight exception, which is still confined within the domain of experiment.

It is true that the normal brittleness of glass is greatly lessened by the process of annealing, which consists in placing the manufactured articles while hot in an oven, where they are allowed to cool gradually. Were it not for this, glass would be useless, owing to its extreme frangibility. If a glass vessel be allowed to cool directly it has been made, and if when cold a small splinter of flint be dropped gently into it, the vessel will fly to pieces with great violence, sometimes directly, and sometimes not until after the lapse of several minutes. A slight scratch, too, will frequently cause unannealed glass to break, and even to become reduced to powder, whilst on the other

and, singularly enough, it will often resist a smart blow. These curious physical properties are exemplified in the Bologna phial and the well known Prince Rupert's drops. Mr. Charles Tomlinson, the talented editor of "The Cyclopædia of Useful Arts," which bears his name, some years since came into possession of some of these phials. They average four inches in length by one inch in diameter, with a thickness of about one-eighth of an inch. A leaden bullet dropped into one of these phials from a height of three feet will not break it, nor will a hard blow on the outside with a stick of wood fracture it. If, however, a grain of sand or a small splinter of flint be dropped into the phial, it will crack and fall into fragments. This result is sometimes produced immediately, and at others not until after several minutes have elapsed. This remarkable property, Mr. Tomlinson states, appears to be destroyed by age, inasmuch as some of the Bologna phials in his possession, which were about fifty years old, would not break on a grain of sand being dropped into them. They, however, flew to pieces upon the interior surface being scratched with a file. The phials, having been preserved for so many years in a moderate and sometimes perhaps a warm temperature, may thus have been subjected to a slow and gradual although partial annealing, which has destroyed their extreme fragility.

Similar phenomena are exhibited in a higher degree by Prince Rupert's drops, which derive their name from the prince who introduced them into England in 1661, exhibiting them first before Charles II. These *lacrymæ vitreæ*, or glass tears, as they are also called, are made by allowing melted glass to drop into cold water, when a pear-shaped drop is formed, one extremity being globular and the other tapering off to a point. They may be hit smartly on the thick end without sustaining any damage, but if only a fragment be broken off the tail, the drop bursts with a report, and is resolved into dust. Both the Rupert drops and the Bologna phials, however, may be divested of these properties by very careful annealing, that is by heating and cooling them slowly.

The phenomena exhibited by the Bologna phials and the Rupert drops are clearly referable to the peculiar physical property possessed by glass, and common to few if any substances besides, water excepted. This is the property of expansion, developed in glass and water, whilst passing from the fluid into the solid condition. If glass be allowed to cool very gradually, the particles are found to arrange themselves in such a way as to give the glass a fibrous nature. In this condition the glass is elastic, and susceptible of long continued vibrations; if, however, a body of glass be cooled suddenly by dropping into water, as in the case of the Rupert drops, expansion is checked by reason of a hard skin being formed on the outer surface of the glass; it is, in fact, in a condition known as case-hardened, and the exterior coating preventing the interior atoms from expanding as they solidify, they are held in a state of compression with but little mutual cohesion. If a Prince Rupert's drop be examined, the inner substance will be seen to be cracked and divided into a number of small parts, the whole being held together by the external skin. The tendency of the inner particles is to expand and fill their proper space, this tendency causing an outward pressure, which is resisted by the superior compressive strain of the skin so long as it remains intact. By striking the drop smartly on the thick end, the balance between the opposing forces is not disturbed, the drop vibrating as a whole, and the vibrations not being transmitted from the exterior to the interior; if, however, the tail of the drop be broken off, a vibrating movement is communicated along the crystalline surface without reaching the internal parts. This admits of internal expansion, by which the cohesion of the particles composing the external skin is overcome, and the glass at once reduced to fragments; in other words, as the exterior surface of the glass is cooled more rapidly than the particles beneath it, the two portions of the glass are in different degrees of tension. A stretched skin is formed over a number of particles, which exist under different conditions from those of the skin, and which have a constant tendency to assume a similar condition to them. This they will do under a gentle and continued heat, but they fly to powder on being suddenly liberated. If any mass of metal be allowed to cool rapidly, there will be an observable difference between the constituent particles on the outer and inner sections, but the process of annealing will cause the particles to arrange themselves evenly throughout the whole mass.

I have thought it desirable to enter into the considerations affecting the phenomena exhibited by unannealed glass, inasmuch as it has been considered by some that toughened glass, to which I shall shortly direct attention, is glass in an analogous condition to that which obtains in Prince Rupert's drops. The fallacy of this opinion, however, will presently be seen.

I have already referred to the process of annealing. All glass articles undergo this process before they are fit for the market. They are placed in ovens, and subjected to a slow heat for a certain number of hours or days, according to their nature, and are allowed to cool gradually. By this means their extreme brittleness is to some extent overcome, or, in other words, they are slightly toughened. The theory of this process is, that the mass of glass being allowed to remain for a length of time in a condition approaching fluidity, the heat increases the bulk of the outer particles, and renders them so soft as to allow the inner parts to expand and arrange themselves regularly. That a re-arrangement of particles does occur during the process of annealing has been proved by Mr. Pellatt, who once experimented with two glass tubes, each forty inches long. One piece, which was sent through the leer, or annealing chamber, contracted 1-16th of an inch more than the other piece, which was cooled in the open air. Mr. Tomlinson states that the fragments of a Bologna phial, when put together, do not fit as do the fragments of annealed glass. Glass articles, such as gauge-glasses and lamp-glasses, are sometimes still further annealed by the users before applying them to their intended purposes. This second annealing consists in placing the articles in a bath of cold water, raising it gradually to 212°, keeping it at that temperature for several hours, and then allowing it to cool very slowly. Glass has also been annealed in boiling oil, but I am not aware that either the water or

the oil processes of annealing enter very largely into the practice of glass manufacture.

Another aspect under which glass sometimes presents itself for notice is that of devitrification. This condition depends mainly upon the number of bases the glass contains. In a glass containing several bases, and melted or cooled slowly, the silica is divided among these bases, forming, according to Dr. Ure, new compounds in definite proportions, which, by crystallising, separate from each other, so that the general mixture of the ingredients which constitute the glass is destroyed. It becomes then very hard, fibrous, opaque, much less fusible, and a better conductor of electricity and of heat, forming what is known as Réaumur's porcelain. This condition can readily be produced, more or less perfectly, by melting the glass and allowing it to cool very slowly, the most complex vitreous compounds giving the best results.

In the various processes to which I have referred, and which have for their object an alteration in the normal condition of glass, it will be seen that in no one case is its inherent brittleness and liability to fracture arrested, and at the same time its transparency preserved. Nor does it appear that, during the thirty centuries over which the history of glass manufacture extends, any attempts to bring about such a result have ever been made. If made, they have certainly not proved successful, at least on a practical working scale, or we may be satisfied that such an invention would rapidly have come into general use. It has remained for our own times, which have seen such remarkable scientific developments, to witness the production of a process by which glass is practically deprived of its brittleness. The inventor of this process is M. Francois Alfred de la Bastie, a French gentleman of property, who was educated as an engineer.

Many years since M. de la Bastie was impressed with the desirability of rendering glass less brittle, and so extending the sphere of its usefulness. Aware that the fragility of glass results from the weakness of the cohesion of its molecules, he argued that, by mechanically forcing the molecules closely together, and rendering the mass more compact, the strength and solidity of the material should be increased. This is exactly the line of argument an engineer would follow—it is one which led Sir Joseph Whitworth to produce such splendid results in the well-known Whitworth metal, and it is one also which has led to success in casting in other departments of engineering. It is, however, not one which landed M. de la Bastie on the right side of all his hopes and fears, inasmuch as he found, after long trial and experiment, that mechanical compression failed to influence glass in the slightest degree, even when applied while the material was in a fluid or soft condition. He therefore changed his tactics, and commenced to apply to glass a system of tempering, such as is usually applied to steel, namely, submitting it to a bath of heated oil. He knew well that by immersing heated glass in cold water he would only put the material in a state of unstable equilibrium, so that the least shock would cause it break up, as in the case of the Rupert drops. He then sought to invert this result, to diminish, or even to remove, the extreme fragility of glass by tempering it by immersion in a fluid other than water. In attaining this object two essential objects had to be determined. Firstly, the point at which glass can be tempered without being put out of shape, and secondly, the medium to be employed for the immersion of the glass. The first condition M. de la Bastie found to be that degree of heating at which softness or malleability commences, when the molecules are capable of closing suddenly together, condensing the material when it is plunged in a liquid at a somewhat lower temperature. The second condition he found was satisfied by having a fluid capable of being raised to a much higher temperature than that of boiling water, without entering into a state of ebullition. For this purpose, and after a long series of experiments, M. de la Bastie devised an oleaginous compound, formed of oils, wax, tallow, resin, and other similar ingredients in certain proportions.

Although the invention is apparently a most simple one, there are many delicate conditions involved, the disregard of any one of which constitutes the precise difference between success and failure. It thus happened that, seven years since, just as M. de la Bastie had perfected his invention, and had produced highly satisfactory results, he lost the clue to his success, and for two years was baffled in every attempt to re-discover it. He at length succeeded in regaining his secret, and has since been engaged in perfecting his invention, and putting it into a practical shape. He had to carefully adjust all the numerous details, for although the invention consists in simply heating the glass, and dipping it while hot into a heated oleaginous bath, there are many conditions involved. Thus glass articles may be underheated, and will not be susceptible to the effect of the bath, or they may be overheated, and will lose their shape; or, again, they may be heated to the right temperature, and yet be spoiled during the process of transference into the bath. Then, again, the exact proportions of the oleaginous constituents of the bath, and their precise temperature, have an important influence upon the ultimate result. All these points, however, with many others, have been definitely settled by M. de la Bastie, who has for some time past worked his process experimentally, and is now erecting a factory in France, in which to carry it on practically and commercially.

It may be as well that I should here mention that it is recorded by Pliny, that in the reign of Tiberius a combination was said to have been devised by which a flexible glass was produced, and that the machinery by which it was made was destroyed in order to prevent a depreciation in the value of the precious metals. We have, however, no evidence that this was the toughening process invented by M. de la Bastie, and the statement to which publicity has recently been given, in no whit detracts from the merits of that gentleman as the inventor of an important economic process. Nothing more than the bare fact above alluded to is on record, except it be, perhaps, that the hapless inventor was destroyed as well as his apparatus. But there was no Society for the Encouragement of Arts, Manufactures, and Commerce in those days.

In carrying out his process, M. de la Bastie finds it necessary to raise the glass to be tempered to a very high temperature. The hotter it is the less

the risk of breaking the glass, and the greater the shrinkage or condensation. Hence the advantage, and often the necessity, of heating the glass to the point of softening, which is attended by the difficulty that glass in the soft condition gets readily out of shape, so that it must be plunged into the bath almost without touching it. In plunging the hot glass into a heated combustible fluid the latter is apt to take fire, and cannot easily be extinguished, so that time and material are lost. These difficulties M. de la Bastie has overcome by placing the tempering bath in immediate communication with the heating oven, and closing it so as to prevent access of air. The oven being charged with the articles to be tempered, they are made to slide into the adjoining bath without being handled, and the contents of the bath, having no supply of external air, are not liable to inflame. In order that the shape of the tempered articles may not be affected, particularly flat ones, the floor of the oven is made to cant, so that, when the glass is heated on it, it is turned to a sloping position, and the glass slides into the bath, along a surface arranged in it at the same angle as that of the oven floor. The clearness of the glass may be affected by the dust of the furnace flame, which is apt to settle on the glass and chill its surface. This is avoided by heating the glass in a muffle, to which the flame has no access, being heated externally. The shock of the fall of glass into the bath is prevented by fixing in it a sheet of wire gauze, or asbestos fabric, for the glass to fall on. Of course the condition of working would be considerably modified, where glass manufacturers adopted the toughening process in their own works. In such case the toughening process would simply take the place of the present annealing process, than which it is much more speedy and economical. The glass would then be treated just at the point at which it passes from the fluid to the solid condition, and would not require reheating. By the substitution of this process for that of ordinary annealing, the saving would be considerable. There would be, first, the saving of the fuel used in the annealing ovens; next, the saving of the time required for annealing; thirdly, the saving in breakages, besides a saving of labour as well as in other directions.

The physical change which glass thus treated undergoes is no less complete than remarkable. Its extreme brittleness is exchanged for a degree of toughness and elasticity, which enables delicate glass articles to be thrown indiscriminately about a room, and more substantial ones to resist the impact of heavy iron weights falling from considerable heights. Upon my first making the acquaintance of toughened glass articles at the offices of Messrs. Abel Rey and Brothers, 29, Mincing-lane—Messrs. Rey being the representatives of M. de la Bastie—watch glasses, plates, dishes, and sheets of glass, both coloured and plain, were thrown across a large room, and fell spinning on the floor. Water was boiled in a tempered glass saucer for some time over a brisk fire, and the saucer was quickly removed to a comparatively cold place, and stood on iron, but was in no way affected by change of temperature. A small piece of plate glass was held in a gas flame until the corner became very hot. The glass proved a bad conductor of the heat, which did not extend any appreciable distance beyond the point of contact with the flame, neither was the glass cracked from unequal expansion, nor was it damaged by sudden immersion in cold water. In order to judge of the comparative resistance offered by untoughened and toughened glass to the force of impact, a piece of the former, measuring six inches by five inches by one-eighth inch thick, was supported in a frame about half an inch from the floor. A two-ounce brass weight was then dropped upon it from 12 and 18 inches respectively without damage, but on the height being increased to 24 inches, the glass was broken into several fragments. A piece of toughened glass of the same size, but rather thinner, was then treated in the same way, at heights increasing a foot at a time, up to ten feet, but without producing the slightest visible impression. I say "visible" impression, because it is possible that, by the repetition of the blows, the structure of the glass may have become imperceptibly altered. We all know that by repeated blows the fibrous nature of wrought iron becomes exchanged for the crystalline character of cast iron. Finding the two-ounce weight to make no impression, an eight-ounce iron weight was substituted, and was dropped on the glass from a height of two feet, and then of four feet, without fracturing it. On the height being increased to six feet, however, the glass broke with a distinct report. But here another phenomenon presented itself; instead of the toughened glass being broken into some twelve or fifteen large angular pieces as was the ordinary glass, it was literally reduced to atoms. There were, it is true, some pieces about half an inch square, but these were traversed in all directions by delicate lines of fracture, and, on being gently touched, crumbled into small pieces, and many of these small pieces were easily reduced by gentle pressure into mere atoms, so thorough and so complete does the disorganisation of the entire mass appear to be. All these points will be practically demonstrated at the conclusion of my paper. A similar result is produced by placing a piece of toughened glass flat on the table, with a corner projecting over, and endeavouring to chip the corner off with a hammer. The corner will, after a series of smart blows, be broken off, but the whole mass will be at the same moment disintegrated and reduced to atoms. Another peculiarity about toughened glass is that the fragments are by no means so sharp, and therefore so capable of piercing the flesh, or of causing incised wounds, as are those of ordinary glass.

One important point of difference between M. de la Bastie's toughened glass and Prince Rupert's drops is that, although the skin of the former may be scored through with the diamond, the body cannot even then be broken through by ordinary force, much less does the mass fly to pieces and disintegrate, as in the case of the Rupert drops. Still wider will this difference appear, when I state that toughened glass is readily susceptible of a high degree of polish, and it can be cut by the wheel for lustre work and such like. The glass can likewise be engraved, either by hydrofluoric acid, or by Mr. Tilghman's elegant sand-blast process, a process which has been described in the *Journal of the Society of Arts.** It will thus be seen that

* See *Journal*, February 12th, 1875, p. 257.

toughened glass presents features which appear to some extent paradoxical.

It would appear that toughened glass possesses enormous cohesive power, but that if the equilibrium of the mass is disturbed at any one point, the disturbance, or disintegration, is instantaneously communicated throughout the whole piece, the atoms no longer retaining the power of cohesion. It is as though the glass was endued with a nervous system, a shock to which at any one point instantly and utterly demoralised the whole. It is important to note that neither transparency nor colour in glass is in any way affected by the process of toughening, and the ring, or sound emitted upon the glass being struck, is nearly as clear in toughened as in plain glass.

In order to determine the relative values of ordinary glass and the toughened material, as regards their strength, I suggested to Messrs. Rey the propriety of instituting experiments, with the view of ascertaining their respective resistances to ordinarily applied stress. In these experiments I have been ably assisted by Mr. Kirkaldy, whose perfect testing machinery has, for some years past, supplied a want long previously felt by the engineering profession.

Twenty pieces of glass in all were submitted to bending stress, ten being toughened and ten untoughened. The glass was of French manufacture, and was that known as "Rive de Giers." Each piece of glass measured, as nearly as possible, six inches in length by five inches in breadth, and the samples had a mean thickness of ·2259 of an inch. Each piece was placed with a bearing of half an inch at each end, and the weight was brought gradually upon the centre, in some instances by the testing machine, and in others by direct weights. Taking two pieces of glass, having about the same sectional area—the one tempered and the other untempered—Mr. Kirkaldy's certificate shows that the untempered glass yielded under a strain of 279 lbs., whilst the toughened glass did not give way until a stress of 1,348 lbs. had been reached. The same proportion, however, did not occur throughout the series, the toughened glass giving in some instances lower results. This arose from two causes, the diminished area of some of the samples of glass, and from the fact that, in some instances, the process of toughening had not been perfectly carried out; for the samples were prepared by M. de la Bastie under purely experimental conditions. The imperfect tempering was made manifest, after the destruction of the glass, in three ways chiefly, firstly, by the glass showing needle fractures, such as are seen in untoughened glass; secondly, by a faint milky line presenting itself in looking at the glass in section; and thirdly, by portions of the glass, a square inch in area, remaining unfractured, whilst the whole surrounding mass was reduced to atoms. But above and beyond all this, it was evident that the strains applied were such as could not possibly come upon glass articles in ordinary use; they were long-sustained pressures, tending at every increment of weight to alter the relative position of the particles of the glass, but affording them no opportunity of returning to their normal position, or, in other words, of utilising the elasticity of the mass. Glass articles in ordinary use are subject to sudden sharp blows, either from falling down, or from some extraneous substance being brought smartly in contact with them. Under these conditions the elasticity of toughened glass is called into play, and enables it to sustain a shock immeasurably beyond that which would suffice to destroy ordinary glass, as is shown by the experiments first described. Hence the proper tests for glass, either toughened or plain, are precisely those of smart and sudden impact, and not of prolonged stress.

Examination and experiment with this remarkable substance have revealed a number of most interesting facts with regard to its physical character. The limits of a paper, however, forbid me entering upon these considerations at such length as I could wish, and as the subject deserves. I may, however, mention that the microscope reveals the fact that the fractures follow a regular order, which gives a uniform shape to the crystals which they produce. Large crystals can be subdivided into several smaller ones with a similar result. The edges of the atoms, too, are not jagged and serrated, as are those of ordinary glass, hence their diminished tendency to cause incised wounds, as already mentioned. This peculiarity would afford a means of ascertaining whether the glass had been tempered or not.

The physical character of toughened glass has been made the subject of careful investigation by M. Victor de Luynes, who made the results of his researches the subject of a lecture, which he delivered at the annual meeting of the Société de Secours des Amis des Sciences. I hoped to have embodied in my paper some of the results obtained by M. de Luynes, but, unfortunately, the rules of the Société do not permit the publication of lectures until they have passed the examination of a committee, which process M. de Luynes' paper is now undergoing. I may, however, mention that M. de Luynes had a furnace and bath in the lecture-room, and before his audience he tempered glass objects, which were afterwards successfully tested. As a general result, M. de Luynes has found that toughened glass will bear from 50 to 100 times the strain of ordinary glass. M. de Luynes also examined both plain and toughened glass by the aid of polarised light, the results of his examination going to show that toughened glass owed its peculiar characteristics to a condition of intensified compression.

I have explained what toughened glass is, how it is produced, and what are its leading features so far as at present ascertained. It therefore only remains for me to indicate the direction of its practical application. I say "indicate," for were I to enumerate all the purposes to which it can be usefully applied I should simply become wearisome. It is possible that there is not one corner in the whole domain of the arts, sciences, and manufactures, where its presence will not in time be made manifest in some way or other, and its usefulness appreciated, while for purposes pertaining to social life its application would seem to be unlimited. The miner would have a safer safety lamp than even Davy gave him, and the engineer's gauge glass would stand the highest steam pressure and alternations of heat and cold without fear of mischance. In chemical works it would supersede lead for tanks, and the present costly and unreliable glass pump-tubes

would be far less expensive, and infinitely more durable. So with brewers; they would find it a most useful friend in their vats, which they could thoroughly and easily cleanse, and keep free from those secreted stale germs of organic life, which develop and reproduce themselves in the process of fermenting beer, in a highly objectionable manner. For water pipes it would offer the advantages of strength, without corrosion. Assayers, I am told, would use it instead of platinum in some processes. In silk-spinning machinery, slider eyes, or guides, which are so soon cut through by reason of the speed at which the silk passes through them, would be rendered very durable if made of toughened glass. Another application, which has suggested itself to an ingenious American gentleman since the first notice of M. de la Bastie's invention appeared, is the manufacture of printing types, and rollers for printing presses, and this idea is now being developed into practical form. Seeing the wide range of domestic and social wants which toughened glass promises to meet, I know not where to begin, and were I to begin I should not know where to end. I can only observe in this connection that toughened glass promises to supersede porcelain and similar wares, and to add real and permanent value to glass utensils of every kind. It will probably supersede enamel on ordinary utensils, and in other similar directions.

It might be thought that this invention would prove a disadvantage to the glass trade, but the widely increased use of glass for purposes which its brittleness has hitherto unfitted it should be a sufficient answer to any such objectors. If there were any such, they would naturally be those connected with the glass trade. But I do not find them there. On the contrary, some of our most eminent glass manufacturers are now negotiating with M. de la Bastie's agents for licenses to work the patent in England. I may observe, that it is not at all improbable that the invention will receive its first practical application in the Aquarium now in course of erection within a short walk of the house wherein we are now assembled.

Such then is one of the most notable inventions of modern times, an invention so remarkable, so unique, and apparently so fraught with import to the arts, sciences, and manufactures, as to render it probable that the name of De la Bastie will one day occupy no mean position amongst those of men by whose genius science has been enriched, and the nations practically benefitted.

At the conclusion of the paper, Mr. Nursey exhibited various specimens of the toughened glass, which he submitted to most severe tests, but only with the greatest difficulty did he succeed in fracturing one piece by repeated blows with a hammer.

DISCUSSION.

The Chairman, in inviting discussion, said there did not seem much room for discussing facts, as there could not be any doubt about them after what had been seen, but there were some interesting points of theory on which it would be well to have the opinions of any gentlemen present who were qualified to deal with them. He should like to ask if the chemical composition had been determined after the annealing process had been gone through, to see if any change had taken place; and also, in view of the suggestion that the toughness was owing to a compression of the particles, whether the specific gravity were found to be altered.

Mr. Nursey replied that no chemical analysis had yet been made, though the propriety of it had been suggested that very day. He did not know if the specific gravity had been determined, but M. De Luynes had stated certain facts which tended to show that there was a compression of the molecules; for instance, he had shown by means of polarised light the same phenomena of colour which were produced in ordinary glass by forcible compression.

Mr. Dallmeyer, being called upon by the Chairman, said he had not yet had that opportunity of examining the glass quietly at home which he should desire before expressing any definite opinion upon it. The question had been very pertinently put, what was the nature of the change which took place? and he did not think the evidence adduced was sufficient to show that it was due to compression. He should like to have a piece which he could shape into a prism, so as to analyse the light transmitted by it, and in that way he could form some idea of its real nature. In order to apply it for optical purposes it would require to be cut into pieces, and he had not understood from Mr. Nursey how that could be done. A friend of his, however, had informed him that in endeavouring to do so it flew to pieces.

Mr. Hartley agreed with the last speaker that they had not yet sufficient evidence to give a definite opinion upon this subject, but if in any remarks he made he should appear to throw any doubt on the process, he did so entirely for the sake of obtaining information, and any knowledge he possessed was entirely at the service of the patentee. Many very nice experiments had been shown, but nothing which was new to him, and he should like to ask whether the specimens exhibited had been annealed before they were submitted to the patent process which, as he contended, hardened the glass, but did not render it tough. He had in his hand a piece of the glass which had been thus treated, and he noticed that the edges were melted round, and showed a surface similar to that of the face of the glass, and this alone was sufficient to account for everything they had seen. Nothing more damning could, in his opinion, have been produced than the piece of glass which had been fractured with the hammer, and the fragments of which were on the table, for this showed that glass so treated was simply a Prince Rupert's drop on a larger scale. Prince Rupert's drops were produced by dropping the molten glass into water, and here the same process appeared to be carried further by mixing an oleaginous mixture which could be heated to a much higher temperature, perhaps 400° or 500°, the result being that a much greater force was required to produce a fracture, but when it did take place it was of the same character, only the fragments were proportionally larger. He contended that the glass was not toughened, for there was no sign of elasticity about it, but hardened, and no doubt for some purposes, such as types, and many other things, for which hardened glass was required, it would be very valuable; but for the ordinary purposes of windows, roofs, &c., they wanted elasticity, which this did not possess, and therefore he did not think it would find favour in the commercial world. Again, the diamond would not touch it, and for many purposes this was a great disadvantage; in fact all the ordinary processes of annealing were employed to get rid of that very quality of hardness which had been exhibited. At the same time, it was a perfectly new idea to cool the glass in a liquid heated to a much higher temperature than water would reach, and for that the inventor was entitled to all credit, and to any advantages he might derive from his patent. Had he known of the paper in time he would have brought some specimens of glass treated in different ways, which he should have liked to exhibit,

for some of them would he believed have appeared as remarkable as the experiment which had been shown, and which would have fully justified him in the remarks he had made. In conclusion, he repeated that any information which he had obtained in his former connection with the glass manufactury was quite at the service of those who were engaged in this undertaking.

Mr. Langdon Davies said he knew nothing about glass beyond what he had heard to-night, but he dropped one of the pieces of glass exhibited from a height of about four feet on to an iron grating, when it rebounded at least one foot, and this he believed showed that it possessed elasticity.

Mr. Powell said his firm had tried some experiments in the direction indicated by Mr. Nursey, the result of which he would state. They had first heated some manufactured articles in a kiln and then placed them in a mixture of tallow and oil heated to a high temperature, but, perhaps owing to the want of skill, had failed to produce the desired effect. On that very day, however, they had repeated the experiment, bringing the heated mixture into close proximity to the kiln, and dropping the articles directly into it without allowing them to cool. In many instances they broke either in the oil or before they reached it, but two or three which were saved proved to be much more perfectly annealed, and to be capable of withstanding much rougher treatment than when annealed in the ordinary manner; and this, although they were only about two minutes in the mixture, whereas it took twelve hours to anneal them in the usual way. Some molten glass was also dropped into the oil, and the lumps when taken out did not break very easily, but when they were fractured they shivered into a number of fragments such as had been described. He had brought with him two tumblers which had been treated in this manner, and though he did not think they would stand so much knocking about as the specimens Mr. Nursey had shown, they were much more perfectly annealed than ordinary tumblers.

These articles were handed up to the Chairman, who dropped them on the floor from the height of three feet without injury. On breaking one of them with a hammer, he said the fracture did not differ materially in appearance from that of ordinary glass.

Mr. Powell said he should like to know if the glass could be cut by the wheel after treatment, and if so whether it lost its virtue.

Mr. William Botly could corroborate what had been said in the paper with regard to the annealing of glass, for he remembered more than thirty years ago, when going over a large glass works, he made a glass jug, which broke to pieces immediately he took it into the open air, for want of being annealed.

The Chairman, with reference to Mr. Hartley's observation that the glass was not tough, but hard, said, if he knew anything about experimenting at all, he should say that nothing to test the hardness of the glass had been tried that evening. The word toughness might be objected to, and it was a quality rather hard of definition; he would rather substitute the word strength, and all would agree that the strength of the glass had been proved beyond any doubt. If it were indispensable that elasticity should be combined with strength, all he could say was that as strength existed there must be elasticity. It was said that this glass could not be cut with a diamond, this he had already read in the *Times*, and it of course was an objection, but if it limited its use in one direction it would be much extended by its strength in others. Mr. Hartley said it would be of no use for railway roofs, but he was not sure that glass for such purposes was cut with a diamond, and if it were, no doubt some other process could be devised; all he could say was that if it were so applied, he would much rather be under a roof of that kind if an accident were to happen and it flew into a thousand small fragments, which would injure no one, than be under a roof of ordinary glass, which might come down upon his head in a mass of considerable weight. The theoretical point which had most interested him was this, that whereas in the other processes of annealing that condition was only a temporary one, in this he understood it was permanent. Annealing was a process, as generally understood, by which a substance was rendered tough by being heated and then gradually lowering the temperature; but if it were again heated, and not gradually lowered, the effect of the former process was lost. Such was the case with steel, for instance, and some other substances, such as speculum metal. For instance, the speculum of Lord Ross's great telescope was subjected to a cooling process, which lasted sixteen weeks before it was considered safe to work it, but if it were re-heated and plunged into water the result would be disastrous. This glass, however, was stated not to suffer from such treatment, which seemed to indicate that some change other than that of ordinary annealing took place. He did not consider it material whether the glass was annealed previously or not, the great point being that it was brought into the condition they had seen, and whether by one process or six mattered very little. With regard to its use for optical purposes, one of the greatest *desiderata* was homogeneity, which certainly was a great element of strength, because any mass which was in a state of greater cohesion in one part than another was *pro tanto* in a state of unstable equilibrium; so in optics, if the structure were not homogeneous, the passage of the rays of light would not be equal. As great strength and homogeneity generally co-existed, he thought good results might be expected from optical experiments.

Sir J. Heron Maxwell was sure no one wished to throw cold water on this invention, which would evidently be of great value to the public, and especially to heads of households. He only hoped they would not find their windows broken by little boys trying experiments on the quality of the glass.

Mr. J. Millington inquired whether wine-glasses, tumblers, and such-like articles, which were cut before being annealed, would be at all damaged in appearance by this process?

Mr. Nursey, in reply, said he was much obliged to those who had brought forward objections, because it was only in that way that the truth could be arrived at. He had stated nothing as a fact but that which had come under his own observations; possibilities and probabilities he had put as such, and they might be gone into at much greater length, for he felt that the field for this invention was indeed a wide one. He had had of course to take it in its crude form, as it had not been developed in actual practice, having only arrived at the experimental stage. With regard to cutting, it could not be accomplished by the diamond, but M. De Luynes was now engaged in experimenting in that direction, and although he had not yet attained success, he entertained great hopes of doing so very speedily. With regard to railway station roofs, skylights, and so on, it might not be generally known that these were now made in certain recognised sizes, the sheets of glass being manufactured accordingly, so that the difficulty which had been suggested would not arise in such cases, though it would with old windows and odd sizes. Its use for optical purposes had not yet been determined, but watch glasses showed no sign of deterioration or change. As Mr. Hartley had suggested, the glass was previously annealed, being bought from ordinary manufacturers and heated afterwards, but he could not admit that these objects were, in any sense, Prince Rupert's drops. The process was widely different, and so were the results. It was said there was no elasticity in this glass, but no one would say so who had witnessed the temperature in Mr. Kirkaldy's testing room. With reference to the last question which was asked, he might say that the glass

ld be cut and polished by the wheel after being ...

Mr. Hartley moved a vote of thanks to Mr. Nursey, ... was carried unanimously, and the proceedings ...nated.

MISCELLANEOUS.

...NUAL MEETING OF THE NATIONAL TRAINING SCHOOL OF COOKERY.

...e second annual general meeting of this school was ... on Tuesday, 25th May, by permission of the Duke ...herland, at Stafford-house.

... Royal Highness the Princess Louise, and a ...ous company, especially ladies, were present.

...e Duke of Westminster having taken the chair, the ... was read by the Secretary, Mr. Fladgate. This ... has already appeared in last week's *Journal*, ...

...e Hon. E. F. Leveson-Gower, M.P., as Chairman of ...ecutive Committee, moved the adoption of the re... In barbarous countries, he observed, nearly the ... population are engaged in the production of food, ...en in England at the present day nearly half the ...ation are so employed, and another fourth in...ly in manufactures which are exchanged for food ... But after good food is obtained it is surprising ...ttle is done to treat it economically and keep it ...ble. No doubt the great majority of those who ... to their classes belonged to the upper ranks, and ... their instruction; but the expense of the artisan ... was without adequate return, although they ... look to receive sufficient return for it from the ...nment, for its effect in elementary schools for the ... He called attention to that part of the report ... said that any well-educated lady who became a ...ied teacher of cookery might thus obtain an in... of £100 per annum, and that any subscriber of ... annually could nominate a student to be ...

...t.-Col. Ducane, C.B., seconded the resolution.

... Chairman having invited questions,

... A. S. Bicknell made some observations thinking ... ought to be reduced. He himself went to ask ... a few lessons, and was told that male learners ... received. He thought the male half of the ...n, young men in lodgings with bad cookery ... alternative of the public-house, ought to be ...red.

... H. Cole replied that the object of the school was ... ask the public to pay for the sweetbreads which ... ladies spoilt in learning how to cook. That ... ladies came was a happy accident, which helped ... the school by paying remunerative fees. But ... object was to train teachers who should in turn ... knowledge of cookery broadcast. The fees of ... who do form the majority enable the school ... He was told, indeed, by judges of cookery ... school had attained good technical results. The ... of the Executive Committee was well known ... the finest judges of cookery in London, and had ... they prepared a *consommé* as well as his own ... that was saying a great deal. They did not ... teach artisans who came by ones and twos. The ... was to instruct 15,000,000 people by training ... to teach them. Gentlemen, of course, are ... animals, but there was one simple recipe for ...er in lodgings.

...r H. Cole then rose to propose that the thanks of ... meeting should be presented to her Majesty's Government through the Lords of the Committee of Council on Education, who since the foundation of this school had acknowledged the importance of cookery in education and proclaimed it in the revised and re-revised code of this year. £1,000,000 and more of public money was entrusted annually to the Committee of Council, and they have laid down that in every girls' school where the girls pass in the fourth standard, if they also pass in "Food and its Preparation," and in "Clothing and Materials," the school will receive for every such scholar an addition of 4s. to the annual grant. They further laid down in the re-revised code of April last that the time given by boys to drill or by girls to a cookery lesson, if not more than two hours a week, and with the approval of the Inspector, might be counted as school attendance to the extent of 40 hours in the year. The next thing this school might properly ask for was that the Committee of Council should not tie up cookery and clothing, but declare that if they are worth 4s. together, they are worth 2s. separately. In the training colleges, also, throughout the country, the practical teaching of cookery will now, to the extent of two-thirds, be paid for by the State. The expenses of this school in preparing teachers were great, because the students ought to be kept a considerable time at practice. They had even to send the cooks to a teacher of elocution in order that they might learn how to speak intelligibly to a class of 30 or 40 persons. If the experiment were to be properly tried, the society ought to have £1,000 a year in subscriptions for three years. The work was to be done, not for the few, but for many millions of our country people, and every place of from 5,000 to 10,000 inhabitants should have a school where young ladies and old ladies (if there were any) and the artisans' families could learn how to cook.

Mr. J. Macgregor (of the London School Board) seconded the resolution, and said that now the Education Department had given the grants, it was the duty of the educational organisations, like the National Society, and the one thousand of School Boards in England to do the rest. So far as could be tested, there was the most anxious wish among the humblest class to be taught cooking.

Mr. Buckmaster, being called upon by the Chairman, said he had lectured in many places in the country, often at the request of clergymen, gratuitously, and had found the warmest interest taken in the subject. He had lectured in Cambridge—where a farmer complained that he would make the men unwilling to work by showing them how to live on 4d. a-day—and in Scarborough, Wigan, Staleybridge, and Brighton, &c. In Liverpool the School Board had taken up the subject, and a committee of ladies had been formed. There was a school at Leeds under one of the South Kensington students. At Wakefield a few ladies taught domestic cookery, cottage cookery, cookery for the sick—the cottage cookery being given to the mill girls in the evening for a penny each. At Bushey, near London, a kitchen had been annexed to the schoolhouse. A good deal of prejudice had to be overcome before the poor could be taught to use such cheap and useful food as haricot beans, sheeps' heads, soups, and stews.

The Lord Provost of Glasgow (Mr. J. Bain) described the Glasgow establishments, where working-men have the choice of two soups, hot and cold meat, and plum-pudding for 5½d. Home cookery, however, he said would be better, because the wife and children sometimes suffer when the father dines out.

Mr. Lucraft (of the London School Board) defended the working classes against imputations of wilful waste. He thought they were not more guilty than the rest of the community. A better knowledge on these points had lately been obtained, and he was glad his class would get some portion of it. This could not be, except through Government grants and by the School Boards elected by the ratepayers.

Mr. Wrench supported the claim of teaching for men by saying that when the English army lay below Balaklava, while the French were enjoying their dinner our men were starving.

The Duke of Westminster proposed a vote of thanks to the Duke and Duchess of Sutherland, which **Lord Sydney** seconded, and it was carried with acclamation.

Sir H. Cole proposed a similar vote to the Chairman, which was seconded by **Mr. James Bateman, F.R.S.**, and passed with applause.

The Duke of Westminster, in replying, said that the success which had been obtained was entirely due to the exertions of the Executive Committee. This society had only made a beginning, and their task required much time, attention, and money. The statement of Mr. Buckmaster showed that as soon as instructors are trained they would find places. If this society could get the funds, they would provide instructors. Good cookery would improve domestic happiness and prove an antidote to drunkenness. He said the Duke of Sutherland had directed the galleries to be opened to any visitors who liked to see them.

PETITIONS AGAINST THE PATENT BILL.

Up to the present time fourteen petitions have been presented to the House of Commons against the Patent Bill. The petition of the Sheffield Trades Council has been adopted by the Bury Trades Council, the United Shipping Trades of Liverpool, the Inventors in Dundee, the Manchester and Salford Trades Council, the Wigan Trades Council, and the Hull Trades Council. It sets forth that if the Bill becomes law it would materially lessen the encouragement at present given to those who devote their time, talents, and capacities to the origination and discovery of useful inventions, and would cause practical men to go elsewhere and carry their inventions with them. They are further of opinion that it would retard the progress of the industrial arts, and that it is no improvement on the present law. The Birmingham Chamber of Commerce thinks that sub-sections (1) (4) and (6) of clause 11 are unnecessary, and that the true functions of examiners (placed in order of importance) are (1), novelty; (2), sufficiency of specification, and (3), expediency of fourteen years' protection. Clause 6 should, they think, be amended by leaving open the number of examiners to be appointed. A full schedule of fees should be published for the various proceedings contemplated by the Bill, and if a foreign patentee does not work his patent in England, he should be compelled, when applied to, to grant licenses to natives of this country. The petition concludes with a suggestion that the fees should be reduced.

The Leeds Chamber of Commerce recommends that the complete specification be examined as regards priority only, all considerations as to utility being excluded. The examiners are not to possess the power to veto any patent, but simply to offer their advice to the applicant. A record of such advice is to be kept at the Patent-office, and is to be open to public inspection. Valuable inventions often require a long time before they can be brought into working order, and the Chamber is of opinion that seven years is too short a period. It is recommended therefore that the regulations respecting the duration of patents remain as they are under the enactments now in force. The Liverpool Polytechnic Society is of opinion that paid Commissioners, in addition to the law officers of the Crown, should be in Parliament. The provisional specification, as at present, should be retained, but the final specification should be examined as to sufficiency, and as to whether it accords with the title and with the provisional specification. No examination
should take place as to utility or merit, and
foreign patentee should be permitted to apply throu
an authorised representative. Compulsory licenses a
only to be granted when the process in questi
is applicable to, and desirable for, the working
an existing patented process, but in any ca
the machinery for granting such licenses is cumbro
and requires to be simplified. Prolongations might
granted by the Commissioners of Patents after d
inquiry made to them, and on payment of a high fee
the applicant. The term of seven years is wholly i
adequate, fourteen years being in most cases the le
time in which the prospect of remuneration is suffic
to induce a patentee to spend time and money on an
vention. The Society think that seventeen years,
the United States, would offer further stimulus
invention. They propose, in conclusion, that
Patent Museum should be converted into a gen
museum of science applied to industry, and placed un
under a minister of the Crown responsible to Parliam
It is to be maintained by the surplus fees of the Pat
office. The Malleable Ironworkers' Association of E
land, Scotland, and Ireland, are of opinion that the
will be detrimental to inventors, especially to th
belonging to the working classes. The present sy
of provisional specifications should be continued, an
examination, except as to novelty, is either requisi
desirable. The appointment of referees is there
unnecessary. The duration of a patent, instead of b
limited, as proposed by the Bill, should be extend
twenty-one years, and every patent should rem
force during the full term of the grant, irrespecti
any foreign patent. No patent should be revok
non-user, and compulsory licenses (the terms to be
by a public authority) should only be issued whe
improvements are applicable to existing processes.
terms for the use of an invention by the Crown shou
be fixed by the Treasury, but by the public authority
referred to. The deposit of models should not be re
in any case, and the fees for a full patent should n
ceed £10, the first step, affording a preliminary
visional protection, not to cost more than £1. The Li
pool Chamber of Commerce entirely approves the
ciple of the Bill, but entertains some doubt as t
propriety of appointing unpaid Commissioners.
examiners should be persons of the highest qualific
and the salaries should be such as to secure the servi
thoroughly efficient men, as the practical working
measure must greatly depend upon the manner in
the examiners perform their duties.

GROWTH AND USES OF INDIAN SAN WOOD.

The sandal-wood forms a conspicuous feature
finest produce of the Mysore provinces. This tr
described by Captain Von Someren in the report
the administration of the forest service of India,
very unequally in different parts of the country
attains the greatest bulk and height in Talooks
moderately heavy rainfall, but the perfume of wood
in such localities is not so strong as of that gro
more arid spots, especially where the soil is red and
It will thrive among rocks where the soil is goo
trees in such places, though small, are generally
of oil. The bark and sap-wood have no smell, b
heart-wood and roots are highly scented and rich
The girth of a mature tree varies according to ci
stances from 18 to 36, or in exceptional cases 40 i
It attains maturity in about twenty-five years.
older the tree, the nearer the heart-wood comes
surface, while the bark becomes deeply wrinkled,
underneath, and frequently bursts, disclosing i
specimens the absence of all sap-wood. Such trees

their size may be, should at once be felled, as they rapidly deteriorate. The heart-wood is hard and heavy. The best parts are used for carving boxes, album covers, ... and other useful and ornamental articles. The ... which are the richest in oil, and the chips go to the ..., while Hindus can afford to show their wealth and respect for their departed relatives by adding sticks of sandal-wood to the funeral pile. A very large quantity was used up in this way at the cremation of the late Maharaja of Mysore. The wood, either in powder or ... up into a paste, is used by all Brahmins in the pigments used in their distinguishing caste marks. The ... forms the basis of many scents, and is sometimes used—especially in the carved work seen in Bombay—for dis...ing with its scent articles which, being really carved in common wood, are passed off as if made from true sandal.

Sandal-wood is found in open places exposed to much ... and sometimes in tracts of jungle land, of which ... acres have been kept as reserved forest. It occurs, however, chiefly in scattered patches or in single trees, on the banks of canals, and on hedge banks and ...ns of fields. It grows from seed, and is said to ... in twenty-five years; it is rather difficult to ..., but the practice of dibbling in seed in suitable soil ... to answer best. If the country is too moist for it ...ent of the wood is less. Ryots are naturally ... averse to having the sandal-trees in their fields, ... they are so strictly preserved wherever growing. ...dreds of seedlings are ploughed up yearly. As the revenue survey proceeds with its operations, and ... ryot gets a more permanent interest in his land, ... as cultivation extends, the number of trees in ... country will diminish, and the reserves now being ...d will be more valuable than ever.

The state monopoly of this product seems to be of ... date, extending back to the Hindu Princes who ...ded Hyder Ali. In 1790 an order was issued by ...o Sultan for the preservation of sandal-wood, im...g a penalty on the cutting of it without permission ...1796, the East India Company obtained from Hyder ... grant conferring and ratifying to them the privi... made over to them by the several Malabar powers, ...g the sole purchasers and exporters of the sandal... ... the territories possessed by them. By the treaty ... Hyder Ali, dated August 8th, 1870, the company ...ed the sole and exclusive right of purchasing all sandal-wood produced in Mysore. The wood is ...y sent to Bombay, and is exported by sea to China ... Arabia.

CORRESPONDENCE.

... PATENTS FOR INVENTIONS BILL, 1875.

...—The Bill introduced by the Lord Chancellor to ... the Patent-laws having been considered by the ...n patent agents at several general meetings, to ... all of them were summoned (and at which Mr. H. ..., of Messrs. Robertson, Brooman, and Co., pre...), they have passed resolutions suggesting the ...ing amendments, which, from the practical ex... acquired in the exercise of their professional ..., they consider are essential for the better protec... of inventors' rights, and the advantageous working ... Patent-laws:—

1. That, to ensure efficiency, it is desirable that one or ... paid Commissioners should be appointed, to be ... for their technical, scientific, and legal know... before whom all matters and cases in reference to ... should be heard and decided, subject to an appeal ... the Lord Chancellor.

2. That all patent agents be registered under such regulations as the Commissioners shall make, and such be allowed to practice in all matters before such Commissioner or Commissioners.

3. That the number of examiners and assistant examiners is inadequate, and that neither the referees for patents nor the duties proposed to be performed by them are necessary or desirable.

4. That application may be made by the applicant lodging a provisional specification as provided by the Act of 1852, which has been found to work well, and should be retained. That the final specification should be filed within six months from the date of application, the proposed examination being made after the filing of the complete or final application.

5. That notice of filing the complete or final specification be published, and that any person having an interest in opposing the grant may lodge notice of opposition, with particulars of his objections, within a prescribed time, the objections (if any), with particulars thereof, being referred to the Commissioner or Commissioners, with the report of the examiners.

6. That the filing of the complete or final specification be equivalent to notice to proceed; and that formal notice to proceed, if necessary for any reasons, be given at the same time. That the patent shall be sealed within three months from the date of filing the final specification. That the provisional protection shall be for nine months.

7. That giving power to the examiners to decide as to the utility, value, great importance, or frivolous character of an invention, is not desirable. That the examiners shall report not only whether the specification is *prima facie* sufficient, but also whether it accords with the title, and with the provisional specification.

8. That it is not desirable in any case to limit the duration of a patent to seven years, but that on the contrary the duration of every patent should be for 21 years.

9. That the examiner shall lay his report, with application, specifications, and relative documents, before the Commissioner, or Commissioners, who shall consider the same, and shall hear the applicant, and any opponent, and then make public the application and specifications only.

10. That all patents granted ought to remain in force irrespective of foreign patents. That a patent shall not be granted on the application of a foreign inventor, unless the applicant declares himself to be the first and true inventor, or his authorised representative, and no patent shall be granted in respect of a communication from abroad, except from the true and first inventor.

11. That there should be no power to revoke a patent for the non-user thereof.

12. That it is desirable to restrict the obligation to license to cases where the improvements are applicable to existing processes.

13. That, in default of agreement, the terms between an inventor and the Crown should be settled, not by the Treasury, as proposed, but by the same authority as shall fix the terms for a compulsory license.

14. That it is not desirable to require the deposit of models in any case.

15. That the rules, when made, should be sanctioned by Parliament before coming into operation.

16. That it is desirable that all stamp duties required to be paid by inventors be very materially reduced, and that the entire stamp duties for the grant of letters patent should not exceed £10.

That a clause should be introduced providing for certain days of grace for payment of stamp duties being allowed on payment of a moderate penalty.

I am, &c.,
C. Graham Carlton, Secretary,
The London Patent Agents' Committee.

14, Clement's-inn, Strand, W.C., June 1st, 1875.

AGRICULTURAL STATISTICS OF INDIA.

Sir,—It was not possible for me to get in a word at the discussion of the above subject the other evening. I will therefore thank you to be kind enough to find space for a few remarks in your next issue by way of keeping the "ball rolling," and keeping public attention on the question from flagging.

The Government of India is at its wit's end to find a proper and effectual means of raising a revenue without oppressing and starving the people, and straightway adopts any and every conceivable plan but the right one. They tax the people's salt—they withhold the land from the people, and keep it in a state of jungle, occupied by snakes and tigers only, rather than parcel it out to the people, both native and European, on sound principles. They take the best agricultural land (in some districts) from the cultivation of bread stuffs in order that they may gain filthy lucre by forcing on the Chinese Government a policy which is repugnant to the latter, and which they (the Chinese) have repeatedly protested against, viz., the policy of supplying the most degraded classes of the Chinese with opium, and thereby promoting the demoralisation and brutalisation of the people, thus committing a threefold crime.

First. Starving our own people in India by cruelly preventing them cultivating the soil for their daily bread.

Second. By forcing upon the Chinese Government a policy they protest against (and rightly so), and, as a natural consequence,

Thirdly. Preventing our own people at home in England expending their operations in honourable and prosperous industry by supplying the 400,000,000 of Chinese, &c., with clothing, the produce of our own spindles and looms.

The manufacturing nabobs at Manchester are continually straining at that infinitely small gnat, the 5 per cent. duty on their goods in India, and they are quite right in so doing, but wrong in swallowing at the same moment that mighty big camel in the shape of 50 to 100 per cent. duty which we levy on the tea or coffee of India and China. This is very inconsistent and very unjust; moreover it is suicidal on their part, for it is the means of prompting capital to embark elsewhere in competition with them where there are no such weights put upon them.

At this very moment there are mills building in Bombay to take away our cotton industry (and why should there not be, that is, if done under the perfect law of liberty of commerce ?), and at Calcutta mills are being erected for jute spinning and weaving; in fact, I have had submitted to me samples of bags from there equal in price and quality to any made in Dundee. The effect is already felt in Dundee, and short time is the result; so that the Manchester and Dundee manufacturer will soon have to shut up and convert their spindles and looms into ploughshares.

We shall, therefore, shortly have to read a paper on the Indian Manufacturing Statistics, rather than Agricultural. Mr. Markham's paper was a very able one, and would have been very necessary had there been any surplus agricultural produce worth the trouble and expense of erecting statistical establishments. But as it is, it is only putting the cart before the horse. The land policy is wrong; for instance, in Scinde and the Punjaub there are eighty-eight millions of acres, out of which only sixteen millions are cultivated, and these sixteen millions of cultivated acres have to feed and employ nearly twenty-five millions of population. Therefore, the only way to "bell the cat" is to have a "sound waste land policy;" this I have repeated over and over again, in season and out of season, and although I may be wrong, I have never heard anyone produce arguments to prove me so yet, although I am open to conviction.—I am, &c. T. Briggs.

GENERAL NOTES.

British Association.—The forty-fifth meeting of [the] British Association will be held at Bristol, commen[cing] August 25th. August 1st has been fixed as the last day [for] receiving papers to be read. Up to August 19th, tickets [may] be had by members on writing to Professor A. W. Willia[m]son, University College. After that date a personal appli[ca]tion is required. The reception room, Bristol, will be ope[n] Monday, August 23rd. The terms of membership are Life members a composition of £10; annual members the first year, and £1 every succeeding year; Associates the year £1. Application to be made at the office of [the] Association, 29, Albemarle-street, W.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Signalling on Railways.

Sir David Salomons, Bart., will exhibit in [the] Society's Great Room, on June the 7th, some mo[dels] illustrative of his method of signalling on [rail]ways, and will explain their construction [and] action. Members and others interested are inv[ited] to attend. Time from twelve to four.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4 p.m. Exhibition of Sir David Salomons' "Method of Signalling on Railways."
Royal Institution, Albemarle-street, W., 2 p.m. G[eneral] Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7[½] Mr. St. John Day, "Some Recent Arrangeme[nts] Continuous Brakes."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m.
Victoria Institute (at the House of the Society of [Arts]) 8 p.m. Annual Meeting. Address by the Rev. [...] Main.
Social Science Association, 1, Adam-street, Adelphi, 8 p.m. Dr. Cornelius Inglis, "The more In[timate] Union of the English-speaking Nations."

Tues. ...Birkbeck Scientific Society, Southampton-buildings, 8 p.m. Mr. E. G. Clayton, "Sodium and the [...] Manufacture."
Photographic, 9, Conduit-street, W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W. Captain Richard F. Burton, "The Long W[...] Salona," and 2. "The Ruined Cities of Pharia, & [...]
Royal Colonial (at the Pall-mall Restaurant, Wa[terloo]-place), 8 p.m. Mr. H. B. T. Strangways, "Forty [Years] Ago and Now."

Wed. ...Geological, Burlington House, W., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, 3 p.m.
Royal Society of Literature, 4, St. Martin's-place, 4½ p.m.
Archæological Association, 32, Sackville-street, W., [...]

Thurs... Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri....... Junior Philosophical Society, 6a, Victoria-street, 7½ p.m. Mr. A. T. Walmisley, "Building Stone[s] [...]"
Astronomical, Somerset House, W.C., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 Professor Bentley, "Classification of Plants." (V[...]

Sat....... Royal Botanic, Inner Circle, Regent's-park, N.W., 3[...]

URNAL OF THE SOCIETY OF ARTS.

No. 1,177. Vol. XXIII.

FRIDAY, JUNE 11, 1875.

...cations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The Society's Conversazione will be held on ...day, June 25th, at South Kensington Museum, ...permission of the Lords of the Committee of ...ncil on Education. Cards are issued this day.

CONFERENCE OF INSTITUTIONS.

...e Twenty-fourth Annual Conference between ...Council of the Society and the representatives ...stitutions in Union will take place at the ...ety's House, on Friday, June 25th. The ...r will be taken at 12 o'clock, by Major-General ...ARDLEY-WILMOT, R.A., F.R.S., Chairman of ...ncil.

...retaries of Institutions and Local Boards are ...ted to send, *immediately*, the names of the ...sentatives appointed to attend the Con...ce; and early notice should be given of any ...ts which Institutions or Local Boards may ... their representatives to introduce to the ... of the Conference.

...TIONAL TRAINING SCHOOL FOR MUSIC.

...command of H.R.H. the Prince of Wales, ...ident of the Society, a Conference will be ...at Marlborough-house, on Tuesday, the 15th ... at 3 p.m., to promote the establishment of ...Scholarships for the City of London and ...ropolitan District. Invitations to the Con...ce have been issued to the Lord Mayor and ...oration; to the Members of Parliament for ...City, the Metropolitan Boroughs and the ...e Counties; to representatives of the principal ...y Companies; to the Council of the Society of ...; and to merchants, bankers, and others in...ted in the School.

...e following letter from his Royal Highness ...e Lord Mayor was read at the meeting of ...Court of Common Council, on Thursday, the ...d instant:—

"Marlborough-house, May 25, 1875.

"My Lord,—Your Lordship is doubtless well aware that efforts have been made for some time past by the Society of Arts to establish a National Training School of Music.

"A suitable building for the school has been erected by the liberality of Mr. C. J. Freake, close to the Royal Albert Hall, at Kensington, which is nearly finished. The admission to the school will be by means of free Scholarships obtained by public competitions held in various centres of the United Kingdom. The best instruction will thus be given to young persons of musical talent.

"Your Lordship will see, from the following statement, that valuable and extensive support has been promised for the foundation of these free Scholarships by the great towns in the country; and the organisation has proceeded so far that I have thought that the work of establishing Scholarships for the City of London and the metropolitan district might now be entered upon.

"I propose, therefore, as President of the Society of Arts, to hold a conference at Marlborough-house on Tuesday, the 15th of June, and to invite gentlemen representing the Corporation, the great City Companies, the merchants and bankers of London to take part in it.

"I address myself naturally, in the first instance, to your Lordship, to request you to afford me your valuable assistance and experience, so that the conference may have successful results, and may contribute towards giving to musical talent a free musical school worthy of the country and equal to those which are established in so many parts of the Continent. This was an object in which my father took a deep interest, and it is my great desire to help to carry it into effect.

"I am, my Lord, your obedient servant,

"ALBERT EDWARD, P., President of the Society of Arts.

"The Right Hon. the Lord Mayor."

On the motion of Mr. Lawley, chairman of the City Lands Committee, a deputation from the Corporation to the proposed conference was appointed, composed of the Lord Mayor, Alderman Sir Benjamin Phillips, Alderman Sir Francis Truscott, Alderman Finnis, Alderman Cotton, M.P.; the Sheriffs; Mr. Lowman Taylor, Mr. H. A. Isaacs, and Mr. Davis Sims.

BRITISH MUSEUM VISITORS.

The following notice of motion in the House of Commons, for the 3rd inst., was given by Sir John Lubbock—

British Museum (Visitors),—Copies of letter, dated the 24th day of October, 1873, from the Society of Arts to the principal librarian of the British Museum, asking to be furnished monthly with the returns of the number of visitors to the Museum, and enclosing a dozen printed forms to be filled in monthly with these numbers:

Of reply, dated November, 1873, from the Museum declining to furnish the information asked for, and pointing out that the total numbers visiting the Museum in the year was given annually in the Blue Book:

Of application, dated the 20th day of January, 1875, from the Society of Arts to the British Museum renewed:

Of letter, dated the 17th day of February, 1875, in reply from the Museum, stating that the second application had been submitted to the trustees, who adhered to their original decision:

Of letter, dated the 13th day of March, 1875, from the secretary of the Society of Arts to the secretary of the Treasury, drawing attention to the publication of the monthly returns of visitors to the various public

museums, and asking the influence of the Lords Commissioners to induce the British Museum trustees to furnish the monthly returns:

And, of reply, dated the 23rd day of March, 1875, from the Treasury, that their Lordships cannot interfere with the decision of the trustees.

Sir John Lubbock writes to the Secretary of the Society of Arts as follows:—

15, Lombard-street, E.C.,
5th June, 1875.

My Dear Sir,—With reference to your letter of the 21st May, the Treasury have, I am sorry to say, declined to give the correspondence asked for.—I am, dear sir, yours truly, John Lubbock.

P. Le Neve Foster, Esq.

INDIAN SECTION.

A meeting of this section was held on May 13th, Lord Napier and Ettrick, K.T., in the chair.

The paper read was—

THE RUSSIAN ADVANCE IN CENTRAL ASIA, IN ITS COMMERCIAL AND SOCIAL ASPECTS TOWARDS INDIA AND THE EAST.

With Extracts from Schuyler's Report on Turkestan, and a Map Pointing out the Projected Railway Lines from Russia through Siberia to Pekin, through Central Asia to Hankow, and through Tiflis and Tehran towards India.

By the Rev. James Long.

When it was proposed to me by the Secretary of the Society of Arts to read a paper on "The Russian Advance in Central Asia in its Commercial and Social aspects towards India and the East," I at first declined, from an apprehension that the subject of Central Asia, treated solely in its commercial aspect, might still more lull English public opinion, which is in a dangerous state of somnolence on the events hurrying on with such unexampled rapidity in Central Asia, and which are raising issues that may strain British power to the utmost, and sap English rule in India. I was therefore unwilling to contribute in any degree to perpetuate the popular delusion that, as regards Central Asia, there are no serious grounds for alarm in the relations between England and Russia. I believe there are strong grounds for apprehension, and that the public mind needs stimulants, not opiates. The former, however, are supplied in Sir H. Rawlinson's excellent and exhaustive work on "England and Russia in Central Asia," just published.

However, having watched in India with deep interest the progress of Russia in the East for the last twenty-five years in relation to its influence on India, as well as the moral and material improvement of Asia, and having spent two years in Russia studying the working of serf emancipation, and the great reforms which characterise the glorious reign of the Czar liberator, I thought I might contribute my mite, the result of personal observation and investigations made through the Russian language* itself, to introduce the very interesting and important subject of "The Russian Advance in Central Asia in its Commercial and Social aspects towards India and the East." To treat the question as it deserve would occupy a volume, and I can only glance at the leading topics in the form of suggestion.*

As a missionary I cannot be indifferent to the dangers of a drifting, shifting policy regarding Central Asia, which may involve the two great Empires of England and Russia in a collision and thereby throw back the moral, material, and religious improvement of India and Russia for a considerable period, as much of the time and money devoted by both Governments to education and social objects would under such circumstances have to be directed to military objects.

The thirty-six Missionary Societies and the hundred foreign missionaries that labour in India have a deep stake in the preservation of that Empire of 250,000,000 from revolt and plunder, in the upholding British rule as the firm guardian of Christian civilisation and of trade. The opening out of roads and the extension of British influence are as important auxiliaries to Christianity in the East, as, eighteen centuries ago, the Roman civilisation was to Europe.

Peter the Great, Central Asia, and Calcutta.

The place where we meet is suggestive; it is only a short distance from the house Buckingham-street, Strand, which Peter the Great occupied when he came to London 1698, working as a ship-carpenter at Deptford and studying that commercial spirit which was so anxious to transplant to his own country. That very year the foundation of Calcutta was laid. The ground was bought for £1,600, but East India Company considered the price high—and now the foreign trade of that amounts to forty millions sterling, while that Bombay is thirty millions. The foundation Calcutta was laid about the time Peter laid of St. Petersburg. Since that period both Empires have advanced, England north from Calcutta Russia south from St. Petersburg, till both becoming such neighbours in Central Asia the great problem is now to prevent the becoming a collision. But while Job Charnock the founder of Calcutta, only contemplated a factory for the sale of goods, and the rulers of Bengal for the next eighty years never looked to a territory reaching to the Himalayas, Peter the Great a far-seeing man, regarded his new city as a window into Europe, but he wanted to open another to look into India, hence his expedition to Khiva. St. Petersburg rose a few years after, like Calcutta out of the swamps and lairs of wild beasts. In Russia had only one port, Archangel, and no larger than a fishing boat: now she has seventh part of the habitable surface of the globe with the Pacific, Baltic, and perhaps ultimately the Persian Gulf, as her seaboard, and her empire converging on India.

The Vital Importance of the Central Asia Question.

No question of the day is of deeper interest

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* The man who wants to get accurate information about Russia must seek it through the Russian language. Very few of the many works that appear in Russia are translated, and they consequently remain unknown to the English public. This is a serious loss.

* Statistics can be amply supplied in the Consular Reports, Lumley on "The Tea Trade of Russia," David Ker, Russia itself publishes very elaborate Statistical

England than this Central Asia question in the following aspects:—The British Empire will have, as ten years elapse, a great semi-oriental Empire stretching 9,000 miles from the Black Sea to the Sea of Japan, backed with two millions of bayonets, placed close to its Indian frontier, and separated only by barriers easily passed. When the English people talk of the difficulty of invading India, they ignore the thirty invasions of India that have already taken place from Central Asia (the Hindu-Kush has nineteen passes through it); and that the Afghans ruled Northern India for centuries. As to the physical difficulties of marching troops, they are not to be exceeded by what Diebitsch encountered in the Balkans, Kauffman at Khiva, and England in Abyssinia. Russia is an Empire looked up to with ignorant admiration by millions of discontented natives in India, and is embarrassing a peaceful policy there; Russian influence is creeping down through the Hindu-Kush, and the frontiers of Kashmir, and it may soon be a question—Is Afghanistan to be Russian or English? for the element of a neutral zone is vanishing into thin air. The family quarrel in Kabul between father and son is in the background a contest for English and Russian ascendancy, and Afghanistan is the glacis of the Indian line of defence and its great outwork. Through English negligence and the inefficiency of diplomatic agents not knowing Eastern languages or Eastern opinions, Persia is becoming almost a Russian province, and we may soon see realised what Sir R. Alcock calls "the inevitable tendency of Russia to press down to southern seas." Certainly, Persia with a demoralised population, little larger than London, can be but a feeble barrier, and Mr. Disraeli's statement, in his celebrated speech at Manchester, may soon be fact, "that the entire command of the Black Sea will be in the hands of Russia, and that the time may not be far distant when we may hear of the Russian power in the Persian Gulf." That policy, therefore, which shuts its eyes to eventualities, and wraps itself up in a fool's paradise, is to be deprecated. Missions for trade advance in Central Asia have in the background bayonets. We are near the rapids, let us steer so as not to get into the current.*

The world is not yet come to the peace millenium, as the events of the last few years clearly show; the sword of Damocles is still hung over us, and we must remember railroads in Asia and ships can carry soldiers and artillery as well as merchandise. The Russian army does not forget the Krimea, and would long to have revenge by the occupation of Delhi, while England's interference in Poland has left a rankling feeling behind in Russia. There are the rivalries of trade, and the Moscow protectionists urge on military movements as giving them new and exclusive markets. Of late England has necessarily taken an antagonistic position to Russia in the question of the Brussels Conference; this has created an intensely bitter feeling towards England in the Russian press, while the *Golos* of St. Petersburg has openly discussed the question of the invasion of India. The approach of Russia to Merv and Herat, which must occur ere long, may lead to political complications. British inaction and Russian railroads on the Indian frontier some ten years hence, will be a great temptation to military adventurers. Internal troubles and Communism in Russia are best checked by giving employment to unruly spirits abroad—such was Nicholas's policy in order to divert the nation from brooding over domestic evils. Turbulent spirits found in the army a field to exhaust their ardour.

While the above form grounds of anxiety as regards our future relations with Russia, on the other hand in India and England various writers unacquainted with Russia have, in treating of the advance in Central Asia, ignored the natural development of Russia, her commercial and social necessities. They forget that the Russian wave touches India in one point, but rolls on to its true destination in Eastern Turkestan and China. The alarmists' attempt to arrest Russia's progress up to a certain point is, to use the language of Major Abbot, "as vain as to try to confine a vigorous young forest sapling within the glass walls of a greenhouse." The alarmists looked on every move of Russia in Central Asia as a menace to India, and raised the cry of "Wolf, wolf," so loudly and frequently, that when real grounds of caution, or even alarm, arise as at present, the public mind has become almost callous. Sir H. Rawlinson characterises those alarmists as "the panic mongers of Calcutta and London, talking about the proximate invasion of India," and now, when the real and pressing question for both Empires is how to prevent the contact with Russia coming to a collision the panic-mongers are quite bewildered, and direct the public mind in the wrong direction. The invasion of India is a chimera at present, though held out by the military Russian party as a future means of neutralising English action at Constantinople—but England is no longer a stickler for the moribund Turkish Empire. The real danger the alarmists face not—the diplomatic influence of Russian agents serving as a lever to foment dissension and revolt in India; and the only remedy—the diplomatic intervention of England.

As the rules of this Society prohibit the discussion of political questions—though this Central Asia problem is not one of party politics—happily the distinctions of Whig, Tory, and Radical are not introduced on Indian subjects which relate to the very existence and stability of the British Empire, I will merely state a few points without discussing them.

1. If Russia occupies Merv, should England not occupy Herat and Kandahar? Russia's position on the Oxus removes the chief physical difficulties in an invasion of India, giving a secure basis of operations.

2. Should not England have English agents in Afghanistan to represent her interests, exercise a proper influence, and remove the very unsatisfactory state of things at present, where, to use the language of Sir H. Rawlinson, "The British agent at Kabul does not occupy that position of independence and authority to which he is entitled as the representative of the Government of India, being unable, as it is believed, either to obtain or communicate any trustworthy information of a

* Vambery's writings on Central Asia are very valuable. He was long considered an alarmist, but time has shown he was in the main a true prophet.

confidential character?" The *Quarterly Review*, in a late excellent article on the Central Asia question, states—"British agents and representatives are excluded as completely from Afghanistan as they ever were from Japan or China, and we can neither make out what is passing in the Amir's mind nor give him a definite impression of what is passing in ours."

3. Should England not take the responsibility of preventing incursions on Russian territory from Afghanistan, otherwise Russia must interfere in Afghanistan, for whose good order she holds England responsible?

4. The recent advance of Russia may require 20,000 additional English troops in India. How are the men and money to be supplied?

5. The disturbing effect of Russia's approach to India among a population of 250,000,000, many of whom, especially the Moslems, exceeding 40,000,000 in number, are bitterly opposed to English rule. How is this to be met?

The question of the military aspect of the Russian advance is not within the scope of this paper, and it has been treated ably in various works by Green, Goldsmid, Trench, Vambery, the latest and best of which is Sir H. Rawlinson's "England and Russia in the East."* Fully master of the subject, Sir Henry has produced a series of most valuable and authentic statements, which will appear like revelations of the unseen to a numerous portion of the British public, and ought to rouse them from the extraordinary indifference in which they are regarding the security of an Empire in which England has such a stake, moral and material. If England is apathetic, the natives of the East are not, and the conviction is unfortunately increasing among them that the English lion, growing old and careless, is practically yielding the superiority to Russia in Asia.

Ignorance of Central Asia in England.

The ignorance regarding Central Asia in England is something marvellous, more than that, it is dangerous. Let us glance a moment at the country. Turkestan is the region lying between Siberia, Afghanistan, the Caspian, and China; it is the bed of a sea that once covered 8,000 square leagues, and it is regarded as the cradle of the Aryan race, from whence they emigrated, the Hindu portion went to India, the ancestors of the English and Russians to the land of the West, and now they meet again after a 3,000 years' separation. Here, before their divergence, they spoke in words which are the common heritage of India, Persia, and Europe, and which bring the difficult Russian language within the sphere of European philology, and make the Russians and English brothers in race. The Tartars, once the terror of Europe, issued from these regions to swarm over Western and Southern Asia, and to strike terror even into the Pope himself, as also into the Danes, who, during one season, not knowing whence these Tartars might issue, were deterred from setting out on the herring fishery to Scotland. The history of Central Asia is connected with the Greeks of Bactria, and the ancestors of the Hungarians; Buddhists and Brahmists, Medes and Persians, have acted their parts on its stage. We have there Balkh, the mother of cities, the birthplace of Zoroaster, and the capital of Cyrus, Samarkand, and Bokhara, illustrious in Moslem times.

But the main point in Central Asia now is that under Russian rule it has become a neighbour to English territory in India, where England has a mighty stake, and yet takes little interest in its bearings on her great Dependency.*

The Russian Advance in Central Asia.

Russia's advance in Central Asia since 1847 has been like an increasing tide, noiseless, ceaseless, but effective; during that period our North-West frontier in India has also been greatly extended, the Punjab and Oude have been annexed, but Russia has gone ahead of England, for she has acquired a territory equal in size to Great Britain, France, Germany, and Turkey in Europe united, though the population is not larger than that of London. The wave rolls on, and, as the Emperor Nicholas used to say, Russia has no boundary in Central Asia. Within a quarter of a century Russia has moved down from the north of the Caspian 500 miles south and 1,400 miles east, until she is now within 250 miles of Peshawar,† with her influence extending where her arms have not reached, as Sir H. Rawlinson, in his recent work, "England and Russia in the East," states:—"Instead of two empires divided by half the continent of Asia, as of old, there is now intervening between their political frontiers a narrow strip of territory a few hundred miles across, occupied either by tribes torn by internecine war or nationalities in the lowest stage of decrepitude, and traversed by military roads in all directions." To this we may add his most suggestive remark, "India is a country where a certain amount of discontent must be ever smouldering, which can be fanned into a conflagration by the contiguity of a rival power." The recent conquest of Khiva gives Russia the Oxus, with its navigable stream and fertile banks, in a position with regard to Afghanistan like that of the Rhine to France, or the Indus on our North-West frontier. The wave may roll on south until it reaches the Persian Gulf or Indian Ocean, for in Oriental nations there is no capacity of resisting a European power. As a Russian general said to me at St. Petersburg, "Native states are like a pack of cards, knock one down and the whole go."

One of the causes of this Russian advance lies in the commercial influences which are leading to the occupation of new territory as a field free from European competition; but there are others, for as soon as Russia began to recover from the Tartar invasion she directed her attention to the East. As early as 1560, when England had not a foot of land in India, and did not even dream of it, Russia received at Moscow an Embassy from Bokhara and Samarkand. Russia was subsequently taught by the Krimean war a bitter lesson, and she has profited by it; instead of entangling herself, as she

* See an excellent pamphlet, "The Central Asia Question, from an Eastern Stand-point."

* In a conversation I held two years ago at Washington with the late Charles Sumner, on Central Asia, he concluded his remarks thus:—"But, sir, America knows as little of Central Asia as of Central Africa"—that may be an excuse for America, but not for England.

† In a straight line to Hazrat Imam, which is nominally under Bokhara, but Russia has under her control the right bank of the Oxus, and ere long she may have the left bank and its dependencies.

did for a century, in European politics, she followed the slope to the East, for which she is so well adapted from her geographical position and semi-Orientalism. What Count Gerowski, one of her ablest writers, said twenty years* ago is becoming realised:—"The Slav and Russian current will undoubtedly turn towards Asia. There in those vast spaces is the immense field opening for their action, and no other nation or race can fulfil this mission. If mankind is to form in the future a harmonious whole, the solitudes of Asia must be stirred up, vivified, and the death-like quiet prevailing there must be broken. Culture and civilised treatment must dispel the atrophy north as well as south of the Himalaya." The crusading religious element is strong with the Russian people, whose land was for three centuries desolated by Moslem hordes. What the "No Popery" cry has been in England the "No Moslem" has been in Russia; its people cannot forget that Timur sacked Moscow, and that Russian Grand Dukes held the stirrups of the horses of Islam chiefs.

THE COMMERCIAL ASPECTS OF THE RUSSIAN ADVANCE.

Serf emancipation, and the various and great reforms in operation in Russia, have woke up the national energies which had long been pent up by despotism and a bureaucracy; they have been directed in the way of trade, in which nobles as well as people share; this has led to covering Russia with a network of some 10,000 miles of railway, and to numerous societies for trade, banking, &c. I will give an illustration of this new spirit in the history of the Russian Steam Navigation Company—a Company composed entirely of Russians. It was formed in 1857, when the Black Sea fleet was destroyed; it was largely subsidised by the Government, and gave employment to the officers and sailors of the late fleet; it has been a great success, its original shares of 150 roubles have risen to 650, and are not to be bought. It pays 15 per cent. dividend and employs 87 steamers, which touch at all the ports of the Black and Caspian Seas, as well as to the chief ports from Constantinople along Asia Minor and Palestine, to the Canal of Suez, and ply regularly between Odessa and London. They have opened out the Black Sea to Russia; in 1859 they cut through the jungle at Poti to make the beginning of a great harbour;† they encountered terrible obstructions in the old *tchinovnik*, or bureaucratic system, of Russia, but they have overcome them. The mines on the Black Sea have been utilised by them, and they use at present 100,000 tons annually of anthracite coal.‡ They own also 600 miles of the Odessa railway; they opened out steam communication between Odessa and Bombay, but it did not succeed, as they could not compete with foreign steamers.

The commercial development of Russia in the East has been greatly hindered by the dearness and difficulty of communication; water and iron are both necessary—the water way and the iron way; hence the railway system so rapidly developed in European Russia, is now stretching its arms into Asia, as a prop of the protective* system which is strong in Russia as Moscow, like Manchester, requires foreign vents; but the protection interests have made the Caspian a *mare clausum*, and English tea and cloth are declared contraband in Central Asia, though they were exported from Bokhara to Samarkand and Tashkend, for Manchester could send goods cheaper to Eastern Turkestan than Russia could from Moscow.†

As a step to her commerce, colonisation is encouraged; already Russians find their way to Badakshan, and beyond Lake Issikul. At Vernoe a military agricultural colony for veteran soldiers has been established to give solidity to the frontier towns; some 5,000 were settled there a few years ago, and these numbers have been since much increased. David Ker, in an article in the *Geographical Magazine* on the mineral wealth of Central Asia, states:—"On my way up the Syr Daria I saw caravan after caravan of Russian peasants plodding eastwards, drafted from the villages to the wild regions lying between Lake Balkish and the Chinese border, and the same fiat which sent them thither can at any moment people the mines and factories of Turkestan with the artisans of Central Russia." England may learn something from this as to the question of European colonies in the Himalayas.‡

CENTRAL ASIA AND COMMERCE.

Russia's possession of the valley of the Oxus, like her conquest of the Caucasus, is not an ultimate point, it is only a resting-place or stage in advance. She considers it important politically in enabling her to check English interference with Russia on the Bosphorus by counter interference with England on the Indus, and in gaining access to the Hindu-Kush with its nineteen passes. A country like Turkestan, whose population is only 3,000,000, and the majority nomads, and whose wants are few, and mode of life simple, cannot be the main prize coveted. On this subject, considerable attention has been lately directed by the English and Russian authorities to a report on Khiva, written by Dr. Schuyler, the *attaché* to the American Embassy at St. Petersburg, and published by the American Government; Dr. Schuyler's official position and freedom from prejudice against Russia, have attached great importance to his observations; he states, regarding the Russian trade in Turkestan:—"It is falling off, rather than increasing during the last eight years. The population of Central Asia is not large, its wants are few, very little can be exported there with advantage except prints, cotton goods, clothes, and tea. The only goods imported from Central Asia are cotton (very bad in quality), silk,

* "Russia and Her People," pp. 295. 1854.

† Poti is a signal instance of Russian perseverance; a town rising out of a swamp. The first steamers in 1859 had to cut their way through the primeval forest, and the climate was so deadly that in one autumn, out of a garrison of 600 soldiers, 200 died of malaria; it was another Calcutta in unhealthiness.

‡ There are 16,000 square miles of coal on the lower Don and in the Caucasus.

* The protective system is defended on the political ground that the great want of Russia being a middle class, as a link between peer and peasant, between the upper and lower strata of society, the best way to secure it is by mills and manufactures, which can only be maintained against foreign competition by protective duties.

† Russian piece-goods are even now exported into Thibet, a country with magnificent flocks and gold-fields, which extend 700 miles.

‡ Hodgson, so long known as the able Resident of Nipal, has published an interesting work on "Colonisation in the Himalayas," in which he points out the importance it would be to the stability of British rule in the East.

and a few fine sheepskins. The communications are so bad as to render trading very difficult." He represents the country as burdened with a great number of officials. The deficits in the budget for 1873 were 7,000,000 roubles. Turkestan is not, then, the El Dorado or Promised Land that some fancied.*

Russia's great object lies in China with its 300,000,000, which could be tapped from Kashgar. Russia will gain wealth in China that Turkestan can never yield. Elias, in his tour, states that the coal fields of China cover 400,000 square miles, yet its mines are unworked, and there are no railroads. Here is a region where, not losing like as with the anarchical tribes of Turkestan, Russia will realise solid cash. Yakab Beg, whose rule extends 1,300 miles to Tarfan, has pacified the country; but if China, whose dominion once extended to the Hindu-Kush, should attack him, he may have to become a feudatory of Russia in order to get the means of resistance.

Russia as a Civiliser.

The question has often been put how can Russia, who is so backward herself, civilise Asia; it is true, Russia cannot for a long time do for Central Asia what England has been doing for India. She has not got the class of trained officers, civil and military, who have effected so much in India—her system of *tchinovniks* or bureaucracy is, notwithstanding the efforts of Government, still a foul blot—her centralisation in St. Petersburg is a great obstacle; but these evils are being gradually removed, and it may be safely said no country has advanced more rapidly within the last ten years. Englishmen ought to sympathise more with Russia in her reforms, and should cherish the hope that the day may arrive when Central Asia shall present a country improved under Russian administration as the Punjab and Oude have been under English. Still Russia is even now far ahead of the native barbarism, and by her serf emancipation and other reforms she has given pledges of what she is capable of.†

She is doing much for geographical and historical research in Asia, as the records of the Imperial Geographical Society and the explorations of her travellers show. Roads have been opened out and trade fostered, while a great network of railroads is begun. The population of Tashkend, the capital of Central Asia, has risen from 50,000 to 150,000, and will be larger, as it is the converging point for trade routes from China, Bokhara, and Russia. Security of life and property is being obtained. What a contrast to 1866, when 400,000 Chinese and Kalmuks were murdered by the Musulmans in the Kashgar territory. Old Kuldja, situated in a lovely valley, reclaimed by the industry of the Chinese, had a population of 150,000, the greater part of whom were massacred by the Musulmans when the city was taken. It is thus described by Mr. Dilke, the only Englishman who has visited it:—"Not one stone is left on another; broken down and scattered walls, uninhabited save by bats and scorpions, with here and there a ghastly skeleton lying half concealed in the rank grass alone testifies to its vast extent and once flourishing condition." Dr. Schuyler also states:—"On the road from the frontier to Old Kuldja I passed eight ruined cities, formerly large, populous, and wealthy, without now a single inhabitant; in many of them the walls of the houses, with their paintings and decorations, are still standing." The Musulmans in the late war in Eastern Turkestan killed several million Chinese; they made in various places a wholesale slaughter of men, women, and children.

What a field then has Russia before her in the north of Mongolia, with its buried cities, where Karakorum flourished, the capital of Jhengis Khan, in which in the early part of the 13th century were to be seen traders from Europe, and goldsmiths from Paris.

What a problem to restore, in spite of its silting up and eastward tendency, the Oxus to its old bed, which flowed into the Caspian three centuries ago.

Central Asia was in Timour's day the garden of the East, and Turkestan was called a jewel set in sand. Russia has to remedy the evils arising from the destruction of forests with their friendly shades, and the desolation of barbarians, that have reduced these once smiling countries to deserts, which can only be restored to cultivation by irrigation and planting; it is robbery, murder and war, which have converted these fertile regions into deserts, and their best day was the capture of Tashkend, in 1865, which finally established Russian supremacy. The lawless anarchical state of the country has been the great barrier to trade, and it is only the centralising rough hand of Russia which can put that down.

Persia also fallen and prostrate can only be raised by the foreigner; as she is now she is described as divided into two portions, desert with salt, and desert without salt.

There is much, however, to be done before Turkestan can become productive. The opening out the old channel of the Oxus so as to bring a shipping trade from the frontiers of Afghanistan to St. Petersburg by the Caspian and Volga seems one of the important measures of the day, and may do in a measure for Central Asia what the canal of Suez is doing for the South, but Central Asia itself is too poor and too thinly populated a country to make this pay. It is the region beyond Russia looks to, the wealth of India and of China.

The East opened out—The Suez Canal.

Though Lord Palmerston at one time denounced Lesseps' project of the Suez Canal as "the visionary scheme of an adventurer leading to disappointment and ruin," yet now forty millions sterling worth of commodities pass between India or China and Europe by this "African ditch," while 74 per cent. of the traffic sails under the British flag. The East is thus opening out to Europe and America; the Mediterranean countries, and Italy especially, are brought into contact with India. London has lost by being no longer the only warehouse for goods from the East; Genoa is rapidly obtaining the position she had before

* See the Appendix for a *precis* of Dr. Schuyler's views on Turkestan.

† See a Russian work, "Desyet lět Reform," ten years of reform in Russia, 1861-1871, by Golovatchevs, which shows the immense gulf between the Russia of Nicholas and of Alexander, and the mighty impetus given in the present reign to all kinds of reforms.

discovery of the Cape route, and Venice may ...gh it regain some of her lost glories. ...a contrast to the isolation of India in the ...f the East India Company and the inter-...
...e opening of the Suez Canal directed the ...tion of Russia to the Indian trade. Prince ...choff and General Ignatieff urged the ...an merchants at Odessa to take advantage of ...pportunity presented. In consequence, two ...s of the Russian Steam Navigation Com-...y were despatched to India to collect sta-...; they were well received, and on their ...n they held at St. Petersburg an exhibition ...ssian products, which attracted considerable ...tion; they sent steamers, but the trade was a ...owing to foreign competition.

...A'S CENTRAL ASIA AND CHINA RAIL A RIVAL SCHEME TO THE SUEZ CANAL.

...ile Germany and Italy are rivals in trade to ...nd—the former in particular, German mer-...s competing successfully with English in ...ta, Bombay, and China—Russia is coming ...d with another grand scheme of com-...n, and as the Suez Canal is super-...g the Cape route, so Russia sets up a ... to the Suez Canal, and is going back to ...l lines by which, ere Turkish barbarism had ...ted the fairest regions, Constantinople and ... were connected by a line of caravan routes ...me along Mongolia, the Oxus, the Caucasus, ...e Black Sea, making Constantinople the centre ...vergence and distribution to Central Europe ...e shores of the Mediterranean. The great ...nic race will by this new route be afforded a ...field in those regions, for ages given over to ...m fanaticism and Chinese immobility; the ...road which will unite the Baltic to the ...c will also bring Russia into contact with the ...-Saxon race, which, filling up the solitudes of ...merican Continent, will meet on the Pacific ..., to which they will be joined by the Dominion ...Californian railways, that will link the Pacific ...e Atlantic, and while 100,000,000 of the Slav ...will occupy Eastern Europe and the plains ...a. Coleridge's dream of America will be ...d, "100,000,000 freed men living there ... the laws of Alfred, speaking the language of ...speare and of Milton," having the old ...ry on the East, but Australia, India, the ...n Empire, and China on the West.

...sia has immense territories on the Amur, a ...ry as large as France, but now nearly useless ...mmercial or colonial purposes, owing to the ...lty and dearness of communication. It must ...dded on to Russia by the rail, and gives Russia ...p stake in the Chinese Empire.

...e project to connect Pekin and Petersburg ...ail is not a visionary one, for a communication ...m China and the Western World from the ... ancient times was maintained by Armenians, ...ists, and Persians.* There were two caravan ... across Central Asia, one by Bokhara and ...kand, over the Terek pass to Kashgar; the other leading up the valley of the Oxus, by Balkh and Faizabad, in Badakshan, by several routes to the table land of Pamir, and so on through Kashgar to Hasni and Hankow.

The Romans* were acquainted with the geography of Khiva and Bokhara, and there was a trade in silk between China and Rome in the days of Augustus, carried on to Pekin through Central Asia by way of Asoph, and Astrakhan. It took eight months going and returning, and was quite secure even for single travellers with a couple of interpreters and a servant. The country must have been subsequently consolidated when Jenghis Khan founded an empire that extended from China to Russia, through which the Mongolian wave of conquest rolled along to Western and Southern Asia, from the Yellow Sea to the Danube, and when even Breslau and Hungary were attacked.

THE RUSSIAN MOVE TOWARDS KASHGAR IN CONNECTION WITH THE RUSSO-CHINESE RAILROAD.

The Russian movements to the north-east of Kashgar have been going on steadily for years;† it has appeared to many a mystery why Russia has spent so much time and money in such apparently barren conquests; but the following will be the solution, as the conquest of the Caucasus has opened out the trade route to Persia and ultimately to India, so will the territorial acquisitions north of Kashgar and Yarkund lead to the great trade and caravan route to China, traversed for 2,000 years, on which a rail will ultimately be placed. The subject has been much discussed in the Russian journals, and an expedition has been sent out to survey the route.

The caravans from India to China always halted at Kashgar, and were there reorganised. In 1403 Bernard Goez, the Jesuit traveller, found Kashgar to be a mart of great note; here, as it is to the present day, all the roads, from the Khanates of Central Asia, converge; from thence they continued on the traffic route to China. Baron Richtofen has written‡ on the facilities for constructing a railway between Kuldja and the centre of China, through a country with easy gradients and supplied with coal; the coal exists abundantly along the trade road from Kansu through the fertile oasis of Hami to Barkul, along a steppe-like country, studded with wells, to Kuldja,§ a town annexed to Russia in 1872; from Kansu through Shenshi or Honan to Singafu, the gate to Central Asia, and great capital of North-West China, with its population of 1,000,000, the Lower Hoango-Ho, and Yangst, the railroad would have a cheap and abundant support; its construction, with scarcely any large river to cross except the Upper Hoango-Ho, and no mountain range to pass over, would be comparatively cheap. To the north, where the Hoango-

...this "Cathay and the Way Thither," written by Col. Yule, ... full details of all the intercourse and travel across ...ia, previous to the discovery of the Cape of Good Hope. ... is a noble specimen of an Anglo-Indian's labour in de-... experience gained in India to the working out social ...y problems.

* See "The Indian Travels of Apollonius and the Indian Embassies to Rome," by Priaulx.

† See a valuable report by Baron Kaulbars on the Thien Shan region, just published in Russian.

‡ "Geographical Magazine," July 1, 1874, pp. 144, and the "Proceedings of the Berlin Geographical Society," April 11, 1874.

§ The distance from Kulja to Singanfu is 2,245 miles, over which a wheeled car or waggon can be drawn. Hami is an *entrepot* for Yarkund and its dependencies; for promoting the traffic of Uliutsai and Kobdo, a line of trade stations is springing up along the northern slope of the Tien-Shan from Kulja, which is situated in a very rich and fertile valley. A branch railway can be made to join on with the Indian and with the proposed Siberian and Semipolatensk lines.

Ho breaks out from its mountain cradle, between the Pamir range and the Altai mountains, which edge the southern coasts of Lake Baikul, there is a natural pass from the most ancient times, as Humboldt shows, and numberless migrations have been made through it in the direction of the Caspian Sea; it was the only caravan route, and was followed by the celebrated traveller Hiouen Thsiang. The railroad from Hami and Kansu will bridge over those deserts and steppes of Central Asia which have kept races apart for thousands of years, and have contributed powerfully to the long isolation of the Chinese.

Thus while Peter the Great's object was to extend Russian trade from the Baltic to the Black and Caspian Seas, and so on to India, his successor aims at a higher flight, to link the Baltic to the Pacific by the iron horse. This may restore Constantinople to some of its palmy days, when it was the centre of trade between Europe and Asia.

While England proposes opening out a new and short route south-west between China and India *via* Burma, Russia is penetrating China from the north-west, through Siberia as well as Central Asia; thus the vast abyss between Chinese and European civilisation will be bridged over, and Western ideas will flow into the very centre of China from both Russian and English founts. The solitudes of Russia may hereafter be populated with Chinese emigrants who might do in Siberia what they are doing in California, as they are industrious, practical, and particularly suited for agriculture.

How then, these two great Empires of England and Russia can be in contact without collision is the great problem of the future; their shock would be an irreparable injury to Christian civilisation in the East, as well as to the cause of religion, humanity, and trade in both countries, while the savage tribes of the desert, the bigoted Moslem and idolatrous fanatics, would exult seeing two Christian Empires destroying each other.

The Siberian and Pacific Railway.

The Amur district, respecting which so much was hoped, has proved an utter failure, either as regards commerce or colonisation, mainly because it is not connected overland with Russia; the Siberian rail would be its salvation, and trade would spring up along the Pacific seaboard. What the overland route is to India, the overland must be, *cæteris paribus*, to the Amur.

But the great impulse for the Siberian railroad comes from the tea merchants of Moscow. The statistics of the fair at Nijni show that the trade overland from Pekin, *viâ* Siberia to Russia, is on the decline, and, notwithstanding the high protective duty, cannot stand the competition with the Russian Steam Navigation Company which brings the tea direct by sea from Hankow to Odessa; from Odessa it is sent to Nijni, and sold for less than the land-borne tea. It is only the high-priced fine sorts that can stand the competition; the coarse sorts, taking a twelvemonth or more in their overland transit, have to give way to the sea-borne tea, which comes in six weeks from China to Odessa.* The only chance is the Siberian rail, which will reduce the time of transit from twelve month[s] [to a] fortnight.

* The import of sea-borne tea into Russia, was legalised only in 1862.

There is much discussion as to the line; the [line] which finds most favour is to go from Nijni [to] Ekaterinburg by Tiumen across the Uralian mo[un]tains to Omsk, Tomsk, Irkutsk, Kiachta, and on to Pekin; it goes, however, over a thi[nly] populated country (Siberia has only six inhabit[ants] to a square mile), has to cross many large riv[ers], and little coal is to be found; and when a [line] shall connect the tea districts of Central C[hina] with Russia, *viâ* Mongolia and Central Asia, [the] tea trade may take the latter route in prefe[rence] to the one by Northern China and Siberia.

Trade to India via Russia in the Mi[ddle] Ages.

In Russia I found a deep and practical inte[rest in] the scheme of making a railroad to India. [To] the military the reason was strategic, as [they] would by railroads be able to mass a large [body] of troops within a week's march of India; [to] the politician it was considered a warnin[g to] England to mind her own affairs at home, an[d not] to interfere with Russia on the Eastern que[stion]; with merchants, it was looked forward [to as] leading the trade which passed into Europ[e from] India in the middle ages, *via* the Oxu[s], Caspian, the Caucasus, and Black Sea, to [its] its former channel; while a rail to Tashkend w[ould] consolidate their Central Asian conquests, [and] form subsequently a part of the India line.

In ancient times the goods of the East [found] their way to Europe through the Caucasus. [Strabo] states they were sent from Balkh down [the] Oxus, thence to the Caspian; crossing it, [they] were sent up by the Kur and by a land jou[rney of] five days to the Rion, then down to the Black [Sea]. In the middle ages the line of route betwe[en India] and China was via Badakshan and Kashgar, [the] way also for Buddhist pilgrims. The K[...] served to the Greeks and Genoese as an empo[rium] for the commerce of India until Jenghis Khan [and] the Turks destroyed it, and its ruin was comp[leted] by the discovery of the Cape route. In the m[iddle] ages Persia received its goods from Indi[a by] camels, which came from the banks of the I[ndus] to the Oxus, then down that river to the Ca[spian], and so on to Constantinople, the centre of comm[erce] between Europe and Asia. In 1716 two J[...] arrived at Astrakhan from India on their w[ay to] Rome. In 1470 Nikitin, a Russian, visited [the] Deccan and Golconda for the purpose of comm[erce]. He proceeded down the Volga to the Caspi[an at] Astrakhan, where he was robbed and made pri[soner] by the Tartars, who were masters of that cou[ntry]. Through the intercession of the Russian ambass[ador] he was released. He proceeded to Baku, [and] across the Caspian to Bokhara, at that time [the] emporium of Eastern commerce; thence to [the] north-west of Persia, abounding in wealthy c[ities], on to Ormus, and so to the South of Bombay.* [In] 1558 an agent from Russia settled in a port o[f the] Persian Gulf for the purpose of trading [with] India. In 1590 merchants from the Levant p[ene]trated into India with a similar object. [...] years after the Dutch came, and soon after [the] French.

* See memoirs of Nikitin, in the Hakluyt society's publ[ications].

trade between India and Russia was one of projects of Peter the Great. During his residence in Holland, he saw the wealth that flowed that country from the East India trade. Peter what few of his contemporaries did, the advantages of the Indian trade with Russia, and with view of promoting it, he even contemplated turning the Oxus to its old bed. Had the expedition he organised under Tcherkaski to Khiva not failed, Russia might have last century conquered North of India, and the Slav and Saxon race have been brought into collision—for two European powers could not peacefully occupy that country jointly. Peter, however, cherished the enthusiastically, and he sent embassies to and Persia in relation to it. In the early of the reign of Peter, Russian traders were ..., according to Sir J. McNeil, in India, and ... agent had penetrated to the coast of ...gzebe.

...r despatched an expedition to take possession of Yarkund, and connect it with the ..., while he directed Prince Bekovitch, ..., to enter into direct communication the Great Mogul, and open out a trade between the Caspian Sea and India, but the ... and his party were massacred, and Russia, ...tened, turned her attention to the West; ... in 1722 Peter foresaw that the Kirghis Steppe ... gate through which the conquest of Central ... must be made, a beginning was not made ... years after, until 1833. However, at the ...ncement of this century, various merchants ...nted a tolerably active trade between India Russia across the plains of Tartary, and a ... trader, in 1815, published at St. Petersburg an account of his return journey from India ...ria.

RAIL FROM RUSSIA TOWARDS INDIA VIA TIFLIS, TEHRAN, HERAT.

... may appear now in the category of im...les; so did the Suez Canal once, so did the ... St. Francisco to New York, over moun... 7,000 feet high, and through an immense desert. But they are *faits accomplis*. ... pushes westward, over sandy wastes, im... by much the same causes as lead Russia east ...necessity of a wide seaboard exists for both, the same indomitable perseverance which ... the Caucasus will lead to this.

...ail to Tashkend, to form part of a line to ... is an absolute necessity for Russia, as at ... it takes two years to march a body of ... from the Volga to Turkestan; with a railway ... be the work of a couple of days. As early as ... Vigne, the traveller, discussed the question ...ailway between India and London, *via* Russia. ..., however, having finished that grand work, ... Canal, next directed his attention to the ... a railway from Orenburg to Tashkend, from ... across the Hindu Kush to Peshawur. His ... was received enthusiastically in Russia, but ... favour from the English Government. ... of Lesseps visited India to collect the ... relating to this railway.

...a, recently defeated in the proposed rail ... Peshawur line, has worked away quietly in ... direction, and while England and the ... Embassy in Persia slept over it. Russia worked her diplomatic machinery, and has gained a signal victory. Baron Reuter's railway concession has been cancelled by the Shah, who, seeing England took the matter up coldly, has made the concession of a railway from Julpha to Tehran to General Falkenhage, a Russian, while the Russian Government has conceded a line from Tiflis to Julpha. Lord Derby has strenuously protested, but diplomacy came too late. This line will give Russia a firm grasp on Persia and the nomadic tribes, which are such obstacles to traffic, and will ultimately extend her power from Tehran to the borders of India *via* Herat, Kandahar, the Bolan Pass.

The rail now being made from Rostof in South Russia to Vladicaucus, in the Caucasus, will soon be completed, and will join the Tiflis one; thus, while Rostof is connected with the network of railways in South Russia, and so with Austria, Germany, and Constantinople, Tiflis is to be connected with Tehran, and so on to Meshed, Herat, Kandahar, and the Bolan Pass to India. The Persian railway system will thus be the link between Russia on the one side and India on the other. A branch is designed from Tehran to Resht, a commercial port on the Caspian, and a future one is contemplated to Bushir, so as to tap the trade on the Persian Gulf. It may make Bushir a second Alexandria, the emporium for some of the Indian trade and for that which will flow along the new line of rail.

It is singular this rail proposes to go not far from the route sketched out by Peter the Great. He was anxious that the English should commence a trade through Russia to the East, and in 1734 an English merchant of St. Petersburg took up the plan *via* Astrabad, Meshed, and Herat to India; but in 1746 the Russian Government, afraid of the English intriguing with Persia, prohibited the British Caspian trade, while Russia herself, absorbed in European politics, forgot the East.

The trade of England through Trebizond and Erzerum to Persia, is now taking the Tiflis route, as the Turks refused to make a good road between Trebizond and Erzerum, while the Russians afford every facility and protection on the Tiflis line. Tabriz is on the projected railway, a most important place, giving access to a populous country. Manchester goods and cloths to the value of one million sterling are imported into it, and are exported from thence to Central Persia, Khorasan, the shores of the Caspian, and even to Khiva.

THE EUPHRATES VALLEY RAILWAY VERSUS THE TIFLIS AND TEHRAN RAILWAY.

The concession by the Shah of the Tiflis and Tehran railway line, in its influence, strategically and commercially over the Euphrates Valley and Persia, as well as over the Turkish provinces, is an enormous advantage for Russia, while on the other hand very great engineering and financial difficulties are connected with the proposed English line from India through Asia Minor to Constantinople, 2,500 miles in length. The Tiflis-Tehran rail will be fourteen degrees of longitude nearer to India than the English one projected to Constantinople, while the latter will be outflanked strategically by the Tiflis and Tehran railway.

Russia has just raised a loan of fifteen millions

sterling, eight millions of which was raised in the English market, to complete her lines of communication between the East and West, principally the Tiflis-Tehran and Siberian lines, and to bring Asia into direct overland connection with Europe.

The Russian Advance in its Social Aspects.

The term social, like civilising, is very wide in its meaning. When we speak of social science or of society, it includes in fact all civilised influences not directly connected with the domain of theology and politics. But in discussing this we must not limit social civilisation to one type, the Anglo-Saxon, as if all wisdom was with them; like the Greeks, who reckoned all out of their sphere as barbarians, or like the Hindu idea of *Mlechas*.

Russia as Slav* or Semi-Oriental.

The European world has hitherto been mainly occupied with the doings of the Latin and Teutonic races, but a new race is coming on the stage that has hitherto been little known, and is destined certainly to exert a mighty influence in the East, more than in Europe—the Slavonic which has a plastic and assimilating spirit. The Slav populations of Bohemia, of the Danubian Provinces and Austria, are stirred to their utmost depths by their necessary antagonism with the German or Teutonic element in Austria, and they are drawn to Russia by sympathy of race, of religion, and the mighty bond of a common language.

The Slavs, of whom Russia is the head, are semi-oriental in their feelings and institutions, well symbolised by the double-headed eagle pointing east and west. Hence one of the main causes of the antagonism springing up in Russia with the Germans of that country (who, though so long settled there, are to theRussians aliens in language, religion, and race), and among the Bohemians in Austria with the Germans; what the Saxon is to the Celt, the German is to the Slav—hateful and hating. The Slavs, forming one-fourth of the population of Europe, extending from the Adriatic to the Pacific, are coming to the front, presenting a new literature, new institutions, and new forms of thought, quite different from the Anglo-Saxon, Teutonic, or Latin type. Their numbers are—Russian Slavs 60, Poles 7, Tcheques 5, others Slovaques, 2, Bulgarians 6, Servians 6; total 86.

While the Anglo-Saxon race, increasing from $2\frac{1}{2}$ millions in Edward the Third's time, to 66 millions under Queen Victoria, has effected a mighty work in the old and new world, it has partially broken down in its treatment of aboriginal or eastern races, as we see in the case of the North American Indians, and the aborigines of the colonies. India is in some respects a noble exception, through the excellent system laid down by the East India Company, which raised up a class of officials, semi-oriental in feeling, combining the best qualities of the eastern and western worlds, and whose rule in India was admirable. Alas, they are, as a class, being superseded by competition wallahs, who, with some noble exceptions, have little sympathy with the country, and little Oriental training,

* This word is sometimes misprinted with an e at the end, as if slave—an epithet little applicable to Russia since the days of Serf Emancipation.

while the influx of barristers into India is giv
us English law with a minimum of justice, equ
is sacrificed for legal technicalities and quibb
The English notions of law and landlordism h
been a fatal gift from England to India.

Russia, in her rising Asiatic empire, has
qualification which she possesses as a Slav coun
a sympathy with Oriental races. Nothing str
me more when I was in Russia than the Orie
type of the people impressed in their dom
life, manners, and institutions, and so qualif
them for their future *role* in Asia.* The T
occupation of Russia has also impressed
Oriental type deeper in Russia, while she is b
in close contact with her 7,500,000 Mussul
1,250,000 idolatrous, and 600,000 Armenian
jects.

The Latin races of France, Spain, and Italy
had their palmy days, while the Slav race,
was one of the last to enter Europe from the
is now rising up for a future career. On the
hand, the tendencies in England, leading t
mocracy, are to revive the pure Saxon or
Oriental element; this made Lord Metcalfe
day declare if India is lost, it will be lost
House of Commons.

The Slav race is now put side by side w
Anglo-Saxon, Teutonic, and Latin races
interesting contest between the 86,000,0
vonic speaking people, and the 80,
English speaking people, among the latter
cluded the Americans, who, whatever their
pathies with Russia may be, are sprung
English loins, using Shakespeare's tongu
guided by Alfred's laws.

While the Philo-Slavs, the national p
Russia, aim at developing the Slavic race
ing to Slavonic, not Teutonic models, th
Slavs aim at welding all under one political
ment, merging their nationality and indiv
in the political unity of the race. The Slav
Danube, however, though sympathising ful
the literary, religious, and social Philo-S
Russia, are not very anxious for political
tion into Russia and her bureaucratic sy
the same principle as England and America,
having great sympathy in language, literatu
religion, would not like to be under one
ment.

The Russian Church, the genuine expre
Slav thought, is well adapted to influe
Eastern mind, and it has numerous adher
Mauraviev, her historian, eloquently state

> "The Russian Church may count her children
> shores of the Adriatic to the bays of the Eastern
> the coast of America; from the ice-fields which gi
> the Solovetsky Monastery, on its savage islet in th
> to the heart of the Arabian and Egyptian dese
> verge of which stands the Lavra monastery of S
> church has had for three centuries to buffet with
> of Tartar slavery—she emerged with her faith unw

As England, unfortunately for herself, is
ing more and more anti-oriental in her adm
tion of the East, less sympathising in her
crammed civilians, so Russia is on the o
tack, as Gerebzof remarks:—"Russia's imit
the West has been fatal to her developmen

There is a great future for the Russian

* See "Atkinson's Art Tour in Northern Capitals," o
Tendencies of the New School of Painting in Russia."

[lit]erature, not only among the Slav race, but [in] Asia, where it may become the *lingua franca* [of Ea]stern and Central Asia, and be to those [reg]ions what the English is in Southern Asia. Many [of the] tajeks or mercantile class in Bokhara are ac[quaint]ed with Russian, and serve as interpreters. It [is bein]g immensely developed now in Russia, and [from its] close affinity with the Sanskrit it will be easy [of mas]tery by those who speak Sanskrit-derived [langu]ages.

[RUSSIA]'S EFFECT ON MUHAMMADAN CIVILISATION.

[Whe]n one considers the stronghold that Mu[hamm]adan civilisation, in connection with its [religi]ous system, has maintained in the East, [whethe]r we look at Turkey, Persia, or India, [and th]e obstacles it presents to modern civilisa[tion] and commerce, the forecast of Sir H. [Edwa]rds, an able Indian administrator, made at [Peshaw]ar the year of the mutiny may become [true]—"That it seemed the destiny of Muhammad[anism] in Asia, to be rolled up between the ad[vancin]g tides of Russian and English dominion." [It is s]ingular that at this very time, Muham[madan]ism, whether in Turkey, Eastern Hindustan, [or Per]sia, is attemping a revival, putting out violent, [and] spasmodic efforts towards regaining the [tempor]al power, and striving in every way to re[gain l]ost [grou]nt. The Babis Musulman reformers in [Persia] were almost exterminated by a persecu[tion une]qualled in modern times. In various cases [they] had been pierced in various parts of their [bodies], into which lighted candles were placed and [left] to burn down to the flesh. This occurred [some] years ago in the City of Teheran. In [Kashmir] 50,000 pairs of eyes were extracted. Had [Christi]an powers exerted their influence this might [have b]een stopped. The two great Christian [powers] of Asia, England and Russia, are, however, [sappin]g the vitals of the Moslem States. Vam[bery, n]o friend to Russian policy, says on this :—

"[The] Russian successes in Central Asia have dealt Islam [the grea]test blow it has ever received from Christen[dom in] the course of this thousand years struggle." Dr. [Schuyler] states:—"In Turkestan the Russians have forbid [the der]vishes to appear in the cities, on the ground of their [being dist]urbers of the public peace; they were in the habit [of doing] this, by their cries and sermons directed against the [Russians], of exciting the mob in the bazaars. The aboli[tion of] the native functionaries who compelled the perform[ance of] regular religious rites, and of a stated attend[ance at] the mosques, has allowed much indifference and [scepticis]m to creep in; the young will grow up with [sce]ptical notions. Even the Mussulman clergy [have ap]plied to the Russians to prohibit certain practices [on this g]round, but the Russians have refused to interfere. [Formerly] the Kazis or Mahommedan judges are allowed [to remai]n, but they were made elective by delegates from the [people], and their importance in the eyes of the natives [has muc]h diminished."

[What] a contrast to former days, when at Kaffa, [in the] Krimea, 300,000 Russians were collected in [some ye]ars to be sold as slaves to the merchants at [Consta]ntinople.

[The] Turks, entering Europe on horseback, [burnin]g and ravaging, have for ages desolated [the fai]rest regions of Asia, in Bokhara they [destroy]ed the cultivation of centuries and plunged [the pe]ople into a depth of barbarism in which [all rem]embrance of their past greatness was [efface]d—they are now, just retribution! to be [swept aw]ay themselves. As Lamartine said, many [years ag]o, the Turks are only encamped in Europe.

The recent combination of Russia, Austria, and Germany may hasten the doom of Turkey; while England maintains very properly an attitude of indifference to a country hopeless of reform, plunging more and more into debts which can never be paid, while the moral and material improvement of the country has been neglected. I refer to Turkey here because her and Persia's subjection to an European Power would lead to the opening out of roads and the development of commerce to a prodigious extent; but with their effete native government it is impossible. Since the Turks invaded Bactria two centuries B.C., what have they done for civilisation? have they not justified the Georgian proverb, "He who trusts to a Turk leans on a wave." The *Quarterly Review* for 1874 contains an article very significant on this subject; it advocates leaving Turkey to Russia. English opinion since the Krimean war has undergone a great revolution, and people are disgusted with the utter failure of Turkey to restore religious liberty or promote moral or material improvement. How true the saying, "Where the Turk treads the grass grows not!" A few mounds of earth amid the monotonous landscape of the steppe mark the places around Merv, once the garden of Persia and the seat of a thriving industry, but rendered desolate by barbarous Turkish tribes.

The Turkish conquest of Constantinople stopped that flourishing trade so long carried on by the Genoese with the East and the Krimea. The flourishing seats of civilisation became reduced to a desert under Tartar sway. Odessa, now such an emporium, was in 1792 only a Tartar village in a desert.

The Crescent is doomed; Turkey, the sick man, is sick unto death; the Muhammadan wave which so long swept over the fairest regions of Asia is receding, and giving way in Central Asia before a Christian civilisation. The fact of Bokhara, the holy, the spiritual centre of Islamism, where half the land revenue is devoted to mosques and colleges—360 mosques and 100 colleges—being practically under the yoke of Russia, notwithstanding the spasmodic efforts of priests to shake off this yoke, has deeply impressed the Moslem mind. The Moslem power, which had trampled out Buddhism and Christianity in those once fair regions, is now meeting its fate, and no longer will oxhide whips be used in the streets to force people into the mosques, as was the case not long ago in Bokhara, Khiva, and Khoten; the blue laws of the Moslem are no longer in force.

How strange, as Vambery says, that Shehr Sabz, the birthplace of the mighty Timur, should be taken by a race far north, alien alike in language and religion and idea! that the cradle of the former conqueror of Moscow, who had slain and led into captivity thousands of Moscovites, should after a lapse of more than 500 years be by Moscovites sought out, conquered, and opened out to the knowledge of the civilised world. The Slavs posted on the East of Europe had to bear the shock of the Moslem wave during the long

* See the map in Yule's Kathay, showing the seats of Christian bishoprics in the middle ages. There were in the eight century bishoprics at Herat, Merv, Samarkand, Kashgar, Bokhara. In the fourth century Merv was made an archbishopric, and the Nestorians had flourishing churches in Central Asia until destroyed by Moslem intolerance; even in the fourteenth century there was a bishopric near Samarkand.

period the cross and the crescent were arrayed against each other. They shed more of their blood fighting against the Moslems than all the European nations put together, and now they have their revenge.

Effects on the Natives of India of the Russian Advance.

Our India Government will have hereafter to frame its Indian policy not as if the Himalayas limited it, but must take into account India's neighbourhood to Russia, with all its disturbing effects on the native mind. Russia's position on the frontiers of Afghanistan is, *de facto*, a menace to India, even acquitting Russia of all ulterior designs on India; the fact of neighbourhood is sufficient, it is like a spark on inflammable materials, and there are many agents who know how to fan the flame. We must adopt, in the face of this, a more definite home policy. We must not uphold feudalism either in land or with princes in contrast with Russian democracy and tenant right. We must not aim at ruling India from a Saxon stand-point while Russia takes the Oriental one for her Asiatic dominions; in a word, we must govern India more on the great basis laid down by the East India Company in its best days—a restored Haileybury for civilians, to render them better adapted to rule Oriental races than the present class of competition wallahs is; we want for the natives justice, not English forms of law and English lawyers, whose success is the ruin of the Hindus; India requires a Dickens to write an Indian "Bleak House."

Native chiefs, however, will try to play off England against Russia; they will cling to the strongest power. The Indian Moslems, more then 40,000,000 in number, are bitterly hostile, and understand their old policy, "to set the Christian dogs to worry and devour one another." All who love change and have nothing to lose, the priests, nobility, and mob, and those who love to fish in troubled waters, will prick up their ears on every current of Bazaar news regarding the Russ, of whom so many entertain such an exaggerated idea, and particularly since the fall of Khiva, which has struck dismay into the Moslem mind, persuaded that the Russ are invincible, and that their invasion of India may happen some ten years hence.

The approach of Russia to India—the apparent inactivity of the Indian Government shrinking from adopting a firm but conciliatory policy—have had a disturbing effect on the natives of India, tending to diminish English *prestige*, to lessen faith in the permanence of British rule, and to give vent to all the local elements of discontent in India. The natives know that India has been invaded thirty times, and that the cry of the loot of India would raise tens of thousands of hardy troops in Central Asia to join in the spoil. The Government, in its relation with the natives of India, will have to consider their measures, not only in reference to India, but also to Russia.

Some natives of India, forgetful of the evils from which British rule rescued them, look with a favourable eye on Russia, as if her *regime* were superior to English; we hope the day is coming when Russian rule may equal English, but certainly it is not so at present; but let the natives study what it is among the Tartars in in the Caucasus, or as given in the re of Schuyler, the American attaché,* the Russians have made little progre ing the people to their rule, that assimilate what they have swallowe are but a garrison amid a hostile po that commerce has declined.†

One effect on India of the proxim will be English institutions will be trial; to rule India in the future we the native population with us, and we must become more oriental. Indi and must not be worried with all fangled notions imported brand new land with the London cockney sta on them.‡

But unfortunately the tendency education in India has been to provi in Bengal, far more candidates than th tions for; many of these men are unemp literary loafers they are consquently ve would look on any wind blowing as f even though it blew from Siberia; th of a false Government educational the Government in language whic learned at the Government expense.

Lord Napier, the Commander-in- some remarks applicable to this class

> "The benefits which we conferred on th which we relieved from oppression and mi away with the people of those days; the pr only consider their present restraints and imposed on them, and the more educated and for a larger share of places of influence and they now possess."

Schuyler in his report on Turkes similar remark with reference to the "the inhabitants are now beginning evils which they suffered from the K thinking more of the evils which the the Russian officials."

Anglo-Indians must Study

India is brought within the perple the Eastern question, which involves interests of Europe and Asia, and the which cannot be far distant. By pressu Asia and the frontiers of India, Rus the political contest in Constantino make the shortest way to Constantin Persia.

The Anglo-Indian, whose mind beyond the Himalayas, must study th pire rising beyond, destined to equal or Greek dominion in their palmiest d tending now its influence down bazaars of India; he must rouse hims vestigate the causes which propel forward, and its consequences to Indi

* See Appendix.

† Hutton in his work on Central Asia, says " succeeded in India in producing patriots, we have towards producing parrots." A remarkable statem the Russian *Dyelo* some years ago relating to the actions, and immoralities among Russian function tan; the fact is, the country is regarded as a B the best men of Russia do not go there; pe adventurer class of India of last century chiefly go

‡ Bazaar reports about Russia have been rife in In people untutored will believe anything, such as that are wanted for the foundation of a bridge, the bl was required to restore the Governor-General to pri

90
100
FROM RUSSIA.
Central China.
towards India
Asia.
M
ULIASUTA
Kutchun
Barkul
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Desert
M
SHAN
MOUNTS
Lassa
90

he is brought in contact with the first instalment of Russian travellers in India, and their numbers will increase, as out of the 200,000 Russians that go annually on foreign travel, some will surely direct their steps to the East, particularly now as the Krimea, connected by rail with Russia, is become a favourite place, and will serve as a starting point for Suez, six days' journey from Odessa, or Russian travellers can cross the Caspian to Persia, and go down the Persian Gulf, or by the Bolan Pass to India.

In the altered state of things with Russia as a neighbour, it is as incumbent on Anglo-Indians to study Russia in its history, development, and political influence, as to study India, and not only to study, but to visit it. St. Petersburg is only three and a half days, and Moscow four days from London.

Russia teaches India.

Russia has learned much from England, and nowhere do there exist more fervent admirers of English institutions and literature than in Russia.

India, on the other hand, may learn something from Russian history and example—the danger of varnishing the upper classes, and leaving the masses neglected; the importance of fostering a native literature; the evils of a servile imitation of foreigners; the great importance of reviving the old village municipalities; the advantages of colonies in Asia; the evils of caste and rank exclusiveness; and the importance of tenant right.

Sympathy for Russia.

While England takes all necessary steps for securing peace and progress in her Indian empire, and of protecting it against all foreign disturbing influences, let her extend the right hand of sympathy to Russia in her civilising work in Asia, slow though it be, for Russia herself has many reforms to make at home. There is room for both. Even Vambery, hostile as he is to Russia, says "the interests of civilisation make us wish the most entire success to Russia in Central Asia"—in the face of Hindu fanaticism, Chinese immobility, Moslem hate, let us rise above mere national jealousies.

Russian conquests have gone no farther than Indian annexations, and both have been beneficial to the natives. Similar causes in the natural expansion of their respective empires, mercantile enterprise, and the decrepidness of native States have led both Empires one south and the other north. Happily, the English press takes a fairer and more considerate view of Russia, her reforms, and defects, than used to be the case. What a contrast in the tone of of the press on the late visit of the Czar to England with that of former days! Polish Fenianism no longer biases English opinion on Russia.

England would have had far more influence in Russia than she has, or ought to have, had she while censuring Russian defects, which the Russians themselves most fully acknowledge, also sympathised with the efforts made in Russia to remove these defects.

Let Russian progress be viewed with no unfriendly feeling, let the advance of Russia be hailed as the pioneer of ultimate progress, material and moral, as Russia herself advances in the career of reform, sealing the doom of the Crescent and trampling down Asiatic feudalism.

England, with 250,000,000 British subjects in India, and Russia, embracing one-seventh of the habitable globe, have an ample sphere without interfering with one another; they might run in parallel lines without intersecting; even a little friendly rivalry might do good; one power left to itself is apt to stagnate; it requires a little competition to rouse it. We believe, with the exception of the military class, a large party in Russia are in favour of friendly terms with England. They might help each other in the warfare against barbarism; in which the interests of Christianity and civilisation are deeply involved. If Russia can stir up revolt in India, England can do the same in Central Asia, which as Schuyler's report shows, is not in a very contented state.

Unfortunately the friends to a peace movement in England and India have thought to forward it by a drifting policy, leaving the vessel to steer among quicksands and rocks, without a watch a-head. Let us take a lesson from the past. Had Russia understood the mind of England, and had England then known the proper policy to pursue towards Russia, as she does now, the Krimean war would not have taken place.

The Russian Language ought to be Studied.

The Russian press has teemed with articles on the Central Asian question in its relations to India, but they have been as a sealed book to Englishmen, owing to their ignorance of the language; while there are more than 50,000 Russians who can read English, there are not perhaps more than a dozen Englishmen in England who can read Russian, and possibly two in India!

The study of the Russian language and people is of supreme and vital importance to England's empire in the East. Our principle of non-intervention keeps us aloof from Continental complications; but England, as Disraeli has pithily said, is more an Asiatic empire than an European, hence our relations with Russia in the East are becoming closer every year.

Along the line of her trade and conquests, even now amid the din of Tartar music, the words of command may be heard in Russ. How strange it sounds in Schuyler's report that in Samarkand the commander of the city, a Musulman, has opened a school for teaching the children of the city the Russian language.

Diplomacy.

An enlightened diplomacy, not that of meddling and muddling, is a friend to peace, as the world's history shows; not so the shifting, changing policy of England in the East, dependent on the Ministry of the day, elected by constituencies utterly ignorant of everything relating to Eastern policy. Had the East India Company not been a united body, uncontrolled by individual traders, the British Empire in the East would have been a myth.

The astuteness of Russian diplomacy has done more for her than the battle-field. On the other hand, England has lost in bad diplomacy what she has otherwise gained; her diplomatists and con-

suls, as a rule, know little of the languages or opinions of the people they are posted to.

The Federal Unity of the British Empire.

Is England, as some would wish her to be—the island of Great Britain and anarchical Ireland—is she to sink to the level of Holland or Carthage, "*Une nation des boutiquiers*," as Napoleon termed it? Is the Empire on which the sun never sets, with all its civilising influences, to be reduced to a petty island, or is she to continue as the head of a great civilising confederacy, with her base on the ocean, embracing the Dominion of Canada on the one side, Australia on the other, and India in the centre, her power being ships, colonies, and commerce? Happily the current of public opinion, while holding to non-intervention on the Continent, no longer sets towards the disintegration or the dissolution of the British Empire. India, as an important dependency, has a deep stake in this, and feels that the federal unity of the British Empire is just as important to England, as the federal unity of the United States was to the Americans.

The great empire rising in Australia, with its enormous trade, cannot be a matter of indifference to the Anglo-Indian, as constituting a member of the British Empire, a probable future support and buttress to the great Indian dependency.

The idea of Empire is not one of mere political power, or that India should be the milch cow of Manchester. No, it embraces the far higher scope of spreading Christian civilisation, and training to self-government the 250,000,000 British subjects that owe allegiance to the Empress Queen. England has this Indian Empire, and she cannot now shake off her obligations there. She cannot isolate herself. Even Stuart Mill admits the use of the Empire in adding to England's moral influence and weight in the counsels of the world.

We might take a leaf out of Russia's book, who employs in high office men of any race or creed. Scotchmen, Germans, Armenians, and Tartars figure in her list of employés.

The projected visit of the Prince of Wales to India will have an important effect in increasing the sympathy between England and India, and giving a reality to the idea of the federation of the Empire. The Prince lately spoke of his contemplated visit as "the dream of his life," and of India as "the pride of England, which has filled so prominent a place in history."

Queries in Conclusion.

I close this brief view of a great subject with a few points for consideration:—

1. Russia is advancing in Asia as a Slav, *i.e.*, semi-Oriental Power. Should not England then judge Indian matters more from an Oriental, and not merely from an insular stand-point?

2. While maintaining a watchful, active policy for the defence of her Indian Empire, should not England sympathise more with Russia's progress in the East, as the advanced wave of civilisation and the uprooter of Asiatic feudalism and priestcraft?

3. Should not the idea be impressed strongly on the public mind, that England represents not Great Britain, but the Greater Britain embracing the Dominion of Canada and Australia, and the great Indian Dependency with its 250,000,000 people?

4. In the prospect ere long of the Russian Empire running conterminous with our Indian frontier, should not steps be taken in England to form a better acquaintance with the rise and progress of the Russian people, and the Slavonic race?

APPENDIX.

Dr. Schuyler's Report.

Dr. Schuyler's report was written for the American Government, and met with their approbation, as also with that of many Russians who wished, as reformers, to know the real state of things. One Russian journal translated it, and for so doing was suspended for three months, while Dr. Schuyler, it is said, has been recalled, at the request of the Russian Government. It is not written from an English stand-point, for he states, "On the whole, the Russian influences is beneficial in Central Asia, not only to the inhabitants but to the world, and it certainly is greatly for our (American) interest that a counterpoise should exist there against the extension of English dominion in Asia." He states there are dangers menacing the good relations between the two Empires, from English policy in Kashgar, and especially in connection with the Turkomans. The Governor-General of Orenburg told Dr. Schuyler "it will be necessary for the Russians to have expeditions against the Turkomans for many years. It will be a second Caucasus, and in the end we shall find ourselves obliged to take Merv, which would immediately lead to complications with England." Dr. Schuyler met at Samarkand Abdul Raman Khan, the deposed Afghan prince, who said "Shire Ali was detested by the Afghans for his complaisance to England, who would willingly join a foreign power in an attack on English domination in India."

Good Effects of Russian Rule.

"Sanitary measures in the cities have been taken by the Russians. Hospitals have been established, physicians appointed to be consulted by the natives, and during the cholera times many persons gave their whole time to an organised work of disinfection and preventing the spread of the disease, with excellent results. These things the natives begin to appreciate. So far as the more material interests of the country are concerned, the Russians have endeavoured to do well. The roads are being greatly improved (which seems a little strange when good roads are so almost unknown in Russia itself), bridges are being constructed over the chief streams, and canals are being projected for the purpose of irrigation. Every man's life is his own. The price of labour has doubled. The mercantile class gain by contracts necessary for the sustenance of the Russian army."

Dr. Schuyler states that "many regulations were made by the Russian Government in the interests of the natives," but like laws in Russia itself and in India, broke down through the want of suitable administration.

Expense of the Administration.

"The cost of supporting the troops is enormous, far greater than was anticipated in this fertile land. The cost of flour in Tashkend, in any province of European Russia would be considered a famine price, the maintenance of the cavalry is still dearer; the price of beef and mutton would be dear, even when cattle breeding was unknown. The 36,000 soldiers in Turkestan cost yearly a large sum to the Government; the expenses of the transport of the troops themselves, and the cost of bringing to them articles of uniform and of equipment made in Russia are very great. It will be very long before Central Asia, as a property, will be the slightest value to Russia, and unless great changes of administra-

...are made, it will also be very long before it even ...s for the expenses which are necessary to keep it up.

"The local revenue amounts to only 1,328,200 roubles; ...these the personal taxes are 566,000 roubles, the road ...is 154,000 roubles, the tax on land and its products ...,000 roubles, indirect taxes 224,000 roubles, tea im-...rted from India 10,000 roubles, excise on liquors ...,000 roubles, postal revenue 65,300 roubles.

"In 1872 the expenditure amounted to 7,600,800 ...bles; of this nearly 5,000,000 was for the army, ...,000 for partial expenses, 26,000 for surveying, ...,000 for geological and economical investigation, and ...r schools 12,000. It is evident that Turkestan is not, ...d will not be for some time to come a self-sustaining ...ovince."

Trade not Flourishing.

"For industry and commerce the Russian administra-...n has done comparatively little. Commercial treaties ...ve been made, but slight pains have as yet been taken ...ensure the enforcement of their stipulations; foreign ...mmerce has not greatly increased. Various projects ...ve been proposed for starting factories for cotton ...inning and the fabrication of silk, and the Govern-...ent, in some cases, has lent material assistance to ...ese and other projects; but, with the exception of a ...lk spinning establishment at Khodjend belonging to a ...oscow company, nothing now exists. The Bazar of ...okhara is the trade centre of the whole of Central ...sia, and unless Russian commerce is subject to few ...strictions, and makes greater efforts, it will be entirely ...owded out of Bokhara by the English; for even now ...rge quantities of English wares are imported there by ...ay of Afghanistan."

"Nearly all the attempts in regard to irrigation have ...roved failures. Russian engineers have yet to learn ...om the natives. Buildings were erected by Colonel ...lukofsky at Tashkend for a great fair on the plain of ...ijni, at a cost to Government of 400,000 roubles. It ...has proved a failure, though the bazaar was closed in ...the city to compel the natives to attend the fair, while ...they were fined for non-attendance, and were even sent ...there under a guard of Cossaks. It is found almost im-...possible to develop the mineral wealth. The coal which ...was found near Khodjend costs almost too much to be ...used for fuel in Tashkend, on account of the high price ...of transport."

The Russian Officials Ignorant of the Central Asia Languages.

"Few of the officials who come to the country have a knowledge of the native languages, and the administra-...tion is consequently obliged to use as interpreters either natives who barely understand Russian, Cossaks who have a very rough knowledge of the native languages, or Tartars, who are in general the most honest or best of interpreters. The badness of the interpreters is not only a source of great trouble and confusion in dealing with the natives, but has led to some most ridiculous and even critical mistakes."

Dr. Schuyler refers to the neglect by the Russian ad-...ministration of schools, which "might raise up a class of interpreters acquainted with both the vernaculars and Russian. As far as education is concerned the Russians have done almost nothing."

Many Russian Officials Corrupt.

The reformers in Russia itself have been manfully and successfully struggling with the evils of bureaucracy and bribery—the inheritance of the despotic *regime* of former days; we need not be surprised, therefore, that these prevail in Central Asia. Dr. Schuyler states, "The officials who flock to Tashkend are in general a very bad material of which to make good instruments. In some cases men come to Tashkend on account of the increased pay, and the shorter time which it is necessary to serve before arriving at a pension; others come hoping to find an opportunity of enriching themselves. In most cases they come or are sent there, because they are over-burdened with debts, or because, from various scandals, they find it impossible to live in other parts of the empire. There are very few who come to Central Asia because they think it is the place to make a briliant career. Army men finding themselves there by acci-dent have made such a career, but no civilians have yet done so. So long as Tashkend is looked on in the nature of a penal colony, or a house of correction, it will be impossible to induce the best men to come there, or to persuade the men who are there to put themselves to the best use. However, in the Semerecht Province there is much less corruption, the Governor knows the country and the Kirghis language, and there is a better judgment in selecting the employés. The regulations* which went into force in 1867 were designed in the interests of the natives, and were calculated to give them a good government. Any failures in the working of these regulations were probably at first owing to the ignorance of the country and of the language by the Russian officials, who were chosen among the officers even without regard to their special qualifications. In time it was found that the position of the Russians gave officials a possibility of making money for themselves, and of satisfying their pleasures, at the expense of the natives, without subjecting themselves to any severe censure. The most glaring acts of maladministration have been committed by the district prefects or commanders, who, removed to a certain extent from the observation and control of the centre of the administration, and falling soon into the ways and methods of former Central Asiatic Governments, abuse their powers and consider themselves as almost irresponsible."

Dr. Schuyler gives some instances illustrating the corruption of the employés:—"One prefect levied in one year 90,000 roubles of illegal taxes, all of which he spent, besides other Government money, and yet he resided within five miles of the house of the Governor-General, and was known to be living in a style, with frequent dinners, suppers, and gambling parties, entirely im-possible on his salary of 2,400 roubles a year. Among other things, savings funds had been instituted for the benefit of the population; this money, some 22,000 roubles, had been used in fitting up the house of the pre-fect. Money was taken from the natives at all times and under all pretences, and a grossly illegal order was issued forbidding all persons to cross the river Syr Daria at any other place than at the points specified in the order, threatening persons who did so with being sent to Siberia. The points specified were places belonging to the friends of the prefect. The prefect was not punished for this, but simply appointed to another locality. Other persons have in like manner been removed from one post for maladministration and immediately given another. Any persons who endeavoured to enlighten the public as to the state of affairs were immediately punished. The commandant of the district of Uratube was removed for having sent a letter to St. Petersburg for publication, stating the truth about the disaffection and riots at Khod-jend, alleging they were caused by the excessive taxation, which was not what the Russians had at first promised and not by the vaccination measures, as had been at first given out. Similar instances are numerous."

The prefects in some cases resort to torture to extort confession from innocent parties, and a judge placed stolen property in a Kirghis chief's tent and then ac-cused him of the robbery. The Kirghis furnished 14,000 camels for the Khivan expedition; they were promised 50 roubles for each camel that died; nearly all died, but they got no money, the prefects compelling the owners to state they made them a present to Go-vernment. "The effects of such proceedings is to make

* This refers to the excellent plan introduced by General Kauf-man of governing the people in civil and political matters by ad-ministrators and elders (aksakals or grey beards) chosen by the people themselves; judges were also elected by the people to decide according to tribal and national traditions—much on the system introduced into Russia itself.

the natives thoroughly displeased with the workings of the Russian courts and administration."

Discontent at Russian Rule.

"That discontent exists can be seen by intercourse with the natives, and it is evident also from one or two facts. In 1872, for instance, there was a great disturbance in Khodjent, which necessitated the action of the troops, but it was put down, and the ringleaders were executed. The disturbances were supposed to be against the order for vaccination, this being thought to be a process for stamping men as recruits for the army. The chief cause, however, was found in the general discontent with the taxes, which had been raised instead of lowered, as the Russians had promised, and were then higher than in former times. In the same year an attack was made on the station of Kansu, on the road between Tashkend and Khodjend. One officer was killed, and the station was destroyed. It was found to be the work of a political conspiracy, in which many prominent natives of Tashkend had been asked to take part. During the early spring of 1873 most of the Kirghis inhabiting the district of Tchemkend left the country, preferring the sands of the Kizylkum desert to being under Russian rule. The people are beginning to forget the evils which they suffered from the Khan, and are thinking more of the evils which they suffer from the Russian officials; they are discontented with the impositions practised by the officials, and with the sudden and violent changes in taxation and administration."

DISCUSSION.

Dr. Leitner said the paper contained a number of very interesting points, but on some matters further details and historical evidence were necessary—for instance, as to the trade routes which existed in former times between Pekin and Constantinople. No doubt there was a great deal of ignorance in England with regard to Central Asian matters, but that ignorance was fast being dispelled by means of such works as that recently published by Sir Henry Rawlinson. What would be the nature of the Russian advance Mr. Long had not perfectly satisfied him. It seemed to him that although he began rather as a Russophobist, he ended by recommending sympathy and conjoint action with Russia; and although the existence of commerce in Central Asia had been mentioned, and certain social features in Bokhara had been alluded to, he did not think sufficient information had been given regarding their effect on the commerce and the social problems of India. In his view it would be desirable to know what articles of trade would be introduced into Central Asia, how far those would affect British trade carried from India to Central Asia, and how far the commercial development generally of India would be affected by the proximity of Russia. With regard also to the social aspect of the question, it would be important to know in what precise respects the semi-oriental power of Russia had hit upon that peculiar orientalism which in Mr. Long's opinion was suited to India, and how far England could derive a lesson or a warning from it. On this point questions of intercourse between the rulers and the ruled, of marriage, education, and numerous other details, would have to be considered, as well as the results of Russian rule in Trans-Caucasia, the Crimea, and elsewhere; further details on these points would have been valuable, though the subject of Central Asia was so very vast a one it was not fair to expect anyone to go into the whole of it in a lecture. Still enough ought to be said to warrant the hopes raised in their minds, hopes that had been raised by the title of the paper, as to the particular bearing which the present action of Russia might be expected to have on English and Indian interests. It was a question whether Russia was not pursuing a false policy, and really hampering her own trade by monopolies or prohibitive tariffs instead of eliciting an anxiety in the people for greater comfort by putting greater luxuries within their reach at a cheap rate, and unless the benevolent views of the Emperor of Russia, probably the most enlightened man in the Empire in the English sense of the term, prevailed (and in Central Asia his representatives did pretty much as they liked), he thought commerce would abandon all the routes it had previously followed, and would throw itself into the course opened up by the wisdom of the English Government by their newly formed relations with Yarkand. At the same time, the proper use of Russian and Central Asian patterns, he hoped, would revive the peculiar taste for colour in India which owed so much to Central Asian inspiration. Anyone who would compare the peculiar combinations of colours in Central Asian patterns with those of India, would find there were points of similarity which had almost ceased with the introduction of new fabrics from Europe, but which he hoped would again revive, for although there had been latterly a tendency in Central Asian works to deepen the stripes so as to overlay the contiguous ones, there was everything to be hoped for from the wonderful freshness of colour which would still be preserved in Central Asia. As regards the introduction of articles of commerce, if the other feudatories followed the example set by the Maharajah of Cashmere, in abolishing transit duties, the markets would be opened up to Indian and English commerce, and the results would be very considerable. They would, no doubt, be exposed to the competition of Russian goods (such as a strong kind of sailcloth), and it would be interesting to know the prices of various goods coming from different quarters and meeting in Central Asia. Mr. Long had rendered a great service by pointing out the fact that there were a number of passes leading easily into India. One in particular, the Ish Kuman Pass, in the direction from Ghilgit, was an easy one, and there was not the least doubt that India was accessible from many points, so that the fate of the empire, both as the centre of future civilisation as well as of political power, did not lie so much in the inaccessibility of the passes or in the maintenance of military power, as in the strengthening from within of English administration, by impressing on the native mind the superiority of British justice. With due deference to those great men whose swords had done so much for England, he thought it was not the 60,000 and odd bayonets which were keeping possession of India, but the belief which those excellent and docile, although brave races, held as to the superiority of English justice, and it was of the utmost importance that this idea should not be in any way shaken. Every Oriental could understand the dealings of a Pharoah or a despot who only consulted his own will, and he also understood the opposite line pursued by Naushirwan, the Persian monarch, who was renowned for his administration of justice. They could understand either one thing or the other, but it was no use attempting to combine the two. The Orientalism of Russia had given them at the present time only one side, that which had turned out the Tartars from the Crimea, so that throughout Bulgaria men, calling themselves chieftains, were begging for their bread. The policy he hoped the present enlightened Emperor would overthrow, but if Russia represented the Pharaoh, it should be England's part to represent Naushirwan, or all that was best and most just, and not attempt a foolish course of steering between the two systems, which could only end in a quagmire, because the natives would most assuredly see through it. With reference to the social aspects of the question it appeared, in Schuyler's work, that they had opened a *café chantant* at Bokhara, and so on, and that he almost doubted whether Vambery could have been there or have passed, as he undoubtedly did, through the dangers he described. There was always a tendency amongst the *faineants* of different races to join with each other in their amusements, and the political

value of joint amusement could not be ignored; but he hoped, in India, it would take the form of a more sympathetic social intercourse, without those adjuncts which were found so pleasant in Bokhara. The most important lesson for England to learn was to cultivate social intercourse with the natives by the encouragement of sympathy; for, however good and well-intentioned our rule might have been, it had been considerably wanting in that particular, and because it had been so wanting, the British Government had, on numerous occasions, been deprived of most important information, because it was sympathy alone which created confidence, and only through confidence could information be obtained. Dr. Long had made some reflections on the competitive system, but he believed if it were not overridden with rules and regulations, and one man were not made to do ten men's work, the present civilians would probably find the leisure for the cultivation of sympathy with the natives which was so very important. He had had forty of these young men under his instruction while at King's College, and they did not seem to be either much better or much worse than their predecessors. In conclusion, he reiterated his conviction that winning the sympathies and affections of the natives would form the greatest bulwark of the English power against any encroachments either political, commercial, or social.

Mr. Tayler said he had listened with the greatest possible interest to Mr. Long's paper, although he had scarcely been able quite to follow him through all the long names and numerous places marked as routes on the map. What appeared to him to be the real benefit of a discussion of that kind was that public attention would be directed to the fact that Russia was advancing steadily on the frontiers of India. That was a question in which it was of the utmost possible importance that public attention should be aroused, because, taking a deep interest in India, and looking to the future stability of our empire there as one of the greatest blessings the world could attain, he felt that if England went on in the miserable fools' paradise, or, as it was foolishly called, "masterly inactivity," at present pursued, a crisis must ensue before long. India was acknowledged to be the brightest jewel in Queen Victoria's crown. We possessed a great country, and whether or not we had succeeded in securing the affections of the people, as to which there might be grave doubts, the approach of Russia was a most critical event. Many persons thought we should be acting unwisely to take any notice of this approach, and some like Dr. Long had spoken about sympathy with civilisation. But what did civilisation mean?—the destruction of the barbarian. In the Christian sense that might be a very praiseworthy and benevolent thing, but probably the Mohammedan and barbarian would take a different view of it. He considered it an entirely utopian and optimist view to think that India and England ever could advance as Russia was advancing, connected by a tie of benevolence, embracing one another in a sort of common bond of civilisation. Such a thing could never be. Sentiment was one thing and business was another, and a study of history would not show that nations had ever been actuated either by charitable or benevolent subjects, or by a sympathetic attraction to one another. They had fought out their quarrels to the death, and after one had conquered then they joined hands in civilisation, or whatever they might like to call it. Russia professed in the march to Khiva that she was only going to punish a few individuals who had insulted her, but a friend of his said at the time that if she once got to Khiva she would never return, and so the event proved. That, therefore, showed a deliberate intention of Russia to approach near enough to India to put our empire in jeopardy. He had had the pleasure lately of reading a remarkable work published by a member of the Indian Council, and saw the proposal there made that the time had arrived for England to take a decided step; that the present movement of Russia with regard to the Turcomans was but preparatory to the occupation of that important position, which would give her a command and position with regard to India, and that if she did that England should make at once a counter move, and occupy Herat. There were two different opinions held on this subject; one school were in favour of remaining on our own frontier at Peshawur, and alleged that the Russians as they advanced would be further and further away from their centre of communication, and would become weaker and weaker, so that they would meet us at our strongest point. But it had been well pointed out that danger was not always in front. It was not so long since they had heard of a Chief Justice and Viceroy stabbed from behind, and the same thing might happen again. How could they be possibly sure that these princes and peoples, although nominally loyal to England, were really so? Would any one venture to say, if they found reason to admire Russian activity and enterprise more than English inactivity, that they would not desert England in the hour of need; and supposing Russia were to advance close upon the borders of Afghanistan were they certain of the Amir of Cabul? Was he a friend of ours or not; and what about his son? There might be a conflict of interests, and who could say which side these princes would espouse. All these questions were greatly affected by the character of the English administration. He had had experience for thirty-eight years in every branch of the administration, not only as an official, but for ten years as a non-official behind the *purdah* (the curtain), as it was called, and he believed his experience of the ten years was infinitely more valuable than all the rest of his service, because he then came into familiar communication with the natives, and heard their genuine sentiments. Thus he found the very man who six months before had flattered him and praised everything which was done, when he gave him his real opinion, showed that his feelings were those of dissatisfaction, in some instances of contempt, and in many of indignation. One remark of Dr. Leitner's he most thoroughly agreed with, that in all our dealings we never had secured the sympathy or heartfelt affection of any one class of the natives of India. At one time, the Bengal Government forbad the complimentary presents of oranges and raisins which were usual on Christmas day, in order to avoid all fear of authority being corrupted. This seemed a trivial thing to mention, but he believed these sort of things were more at the bottom of the estrangement between the people and the authorities than anything else. This absurd restriction arose from it having been supposed some years ago that an officer had received a bribe put into the pulp of a shaddock, and from this trivial cause originated the extraordinary rule, and much consequent bitter feeling. He could speak for himself, and many public officers would corroborate him, that a man sitting as a judge was actually afraid to have an interview with a native gentleman, for fear it should be said unholy influence was exercised, and the consequence was that when a native was admitted to an interview his uncomfortable attitude and constrained bearing constituted it the most painful farce ever exhibited. How this was to be cured it was difficult to say. Competition was universally admitted to be the only safe criterion of efficiency, but the way that competition had been abused by the miserable system of cramming was, no doubt, a terrible blunder. He knew no one who more critically examined and tested the character and attributes of a gentleman than a native of India, and it was not cramming a head with knowledge only which would provide what was requisite; beyond that a certain amount of physical and moral qualities were of the utmost importance, and this the cramming system had overlooked. With regard to the native princes of India, although they stood by us in the rebellion of 1857, it was a serious question whether they would do so in a similar crisis;

and connected with this question was the important and interesting one of the mode in which justice was administered to them. This was a topic on which he had been agitating for the last six or seven years, as he considered it of extreme importance that princes, when accused of any crime, should be entitled to a public investigation. It so happened that an application of this kind had recently occurred, which made him rather chary of speaking upon it, but he had abundant means of knowing that one of the things which had caused more dissatisfaction, more disloyalty and suspicion than anything else in India, was the fact that the princes of India and the feudatories connected with England by treaty, and therefore entitled to every consideration, if they were accused of a crime, were debarred the privilege which an old woman in Calcutta would be entitled to if accused of a petty theft, that of confronting the witnesses, and putting forward their defence in the best manner their means could procure. If this state of things were thoroughly remedied, he believed it would go far to establish a truer feeling of loyalty, sympathy, and good feeling on the part of the native princes and their subjects towards us, both in peace time and in time of war and need.

Mr. Collett asked if he had rightly understood Mr. Tayler to advocate the taking possession of some place beyond our own dominion.

Mr. Tayler said he decidedly meant to express his entire approbation of the proposal made by Sir Henry Rawlinson, that if Russia ventured to take possession of Merv, England should at once take possession of Herat.

Mr. Haliburton thought that in considering the remedy for the evils which were undoubtedly impending in the East, it would be well to ask whether England ought not to set her house in order; whether the empire should not look forward to the great struggles which await her; and whether she should not attempt to organise those powers which undoubtedly existed amongst the English-speaking race, arising from the loyal and military spirit which seemed to revive among Englishmen who had left England and gone to distant countries. If he could only speak of Englishmen throughout the empire as possessing the same spirit as that he had witnessed in England, he believed the day would not be far distant when it would be impossible to find men who would fight England's battles in India and arrest the progress of Russia in Europe; but he could not help seeing that the character of Englishmen changed when they left England, and seemed to regain the old English character, which was so prominent in the days of Queen Elizabeth, when the foundation of the Indian as well as the Colonial Empire was laid. Those men seemed to be of different spirit from the Englishmen of the present day, but if you went abroad you found this to be the case, that the Darwinian theory was correct with men as with animals; that the artificial type disappeared, and the original form was resumed. On Sable Island, near which Sir Humphrey Gilbert was wrecked, he had seen wild ponies, descendants of English chargers which had swam ashore. They were no longer the English horse. They were the wild horse of Tartary. In the same way the military spirit which seemed to have been lost in England re-appeared in the colonies. The people of Canada are pronounced by Marshall to be one of the most military people in the world; it was not from being trained to war, but simply from the re-appearing of the old English feeling which had been deadened by perhaps a little excessive civilisation at home. If the feeling of loyalty and military spirit so prevalent in colonists were properly fostered, it would be an universal source of power, which would at some future day enable England to hold its own in Europe and throughout the world. Canada sent 20,000 men into the Northern army of the United States, and also sent a regiment to the Crimean war, and would have sent ten, if that feeling had been properly encouraged. He had given expression to these sentiments in the *Standard*, and had been sneered at by some writers, but he was glad to find that the Canadian papers re-echoed his statement as really representing Colonial feeling. What would be the state of India if an European war arose, and the Suez Canal got into the hands of a foreign power? She would then have to depend on Australia and the Cape, and a few regiments from those colonies might save India just as a few regiments sent by accident to the East were probably the means of saving her within the last ten years. If England were to organise an imperial reserve in the colonies, and pay them for their extra drill, so as to compensate them for their loss of time, an efficient force of 100,000 men could easily be raised, who would, in event of any great emergency be ready to take their place side by side with Englishmen, to fight the battles of the Empire.

Mr. Collett said he was reluctant to say anything apparently opposed to gentlemen from India, but there was one thing which gentlemen from India always forgot. They were well acquainted with the progress of Russia in Central Asia, but not with the progress of Russia in the British Government. He did not mean at this moment, because the leaders of the present Government had refused to join the Emperor of Russia's Peace Congress, but it was the boast of Lord Granville and Lord Clarendon that there was nothing on which England and Russia were separated throughout the world, except the question of the boundary of Afghanistan, and having declared that they would have an open space between the two countries, they agreed to exactly the reverse. In 1837 the policy was adopted now proposed, of taking Herat, and we went into Afghanistan and took possession of a country which did not belong to us and was occupied by our friends, justifying that invasion by forged dispatches, which had since been published, showing the passages which were inserted and those which had been omitted. In 1854, when we were supposed to be at war with Russia, a declaration was published in the *Gazette*, the authorship of which had never been acknowledged, agreeing that, during that war, we would abolish the practice of seizing enemies' goods in neutral vessels, the consequence of which was that the Russian fleets were not required to act against us, and the English and French fleets were entirely useless, the trade being carried on both by ourselves as well as neutrals. The end of it was that we made a treaty by which the Turkish vessels were kept out of the Black Sea, and Russia, who did not observe that treaty, got possession of Circassia. Even if England were to take possession of any place in the neighbourhood of India—he would say nothing about the injustice of it, being utterly contrary to the law of nations—but what reason was there to suppose that the English Government, in doing such a thing, would oppose Russia. Only once, namely in 1800, had there been a really warlike position between England and Russia, and then Russia was brought to her knees in about four months without any military expedition at all, or any naval operation on her shores, simply by seizing Russian trade wherever it was to be found in the Baltic. Therefore if England really wanted to assume a warlike attitude towards Russia, the only proper way to do so was to declare invalid the Declaration of Paris, which was originally signed without authority by Lord Clarendon and Lord Cowley, had never been authorised or ratified, and was simply in law a piece of waste paper.

Mr. Raees Uddin Ahmed, as a native of India, said he would endeavour to give the meeting some idea of what the feelings of Indians were, because English gentlemen could hardly be expected to be able to do so. It had been generally considered in Europe that the object of Russia in Central Asia was benevolence and civilisation,

that this he did not agree with. In the 19th century commerce was considered the best means of cultivating international intercourse; but, if he was rightly informed by the English press, Russia had closed every country she had taken possession of to all foreign commerce, so that she could not be considered as assisting civilisation, but rather as doing her best to check it. Russia from beginning to end cultivated ambitious designs, and he wondered that Englishmen did not see this more plainly. Her object, no doubt, was to take India, and she aspired in the end to the sovereignty of the world. This was shown by her previous operations against Turkey and Sweden, and her present designs in Central Asia. He therefore considered it was the duty of the English nation and Government to take a bold step to check Russian ambition and not to trust in her benevolence. He was very sceptical with regard to benevolent impulses towards people thousands of miles off. With regard to the policy to be adopted by the British Government, it might be divided into two heads, that towards British subjects and towards her neighbours and native princes. In the first place, he should say that he did not look upon the English nation as perfect, but, at the same time, with all her defects, he considered the English nation the most noble and glorious in the world. Up to the present time, however, she had denied to her native subjects those rights which they ought to possess, if only by the fact of their birth, a share in the administration of their own country. The Civil Service competitive system was practically closed to natives, although it was theoretically open. But he had reason to believe it was going to be even still more closed against them, because the noble Marquis, who was now Secretary of State for India, expressed in Parliament, during the Liberal administration, the opinion that it was very dangerous to give the natives any commission in the Civil Service of India, saying that the best way of giving the natives a share was in the Governments of the Native States. He might as well have advocated the guaranteeing of the integrity of Turkey, or the protection of Belgium, because the native princes had nothing to do with British subjects; they had their own subjects, and it was their duty to bestow offices in their own country upon their own subjects. Again, the military service was closed to natives, and even in the army medical service, a native, in spite of all his abilities, was not considered competent to feel the pulse of an European soldier. With respect to the administration of justice, with every respect to the law courts and the Legislative Council, they were sometimes found to be seriously wanting in the ordinary principles of humanity, of which he could give instances if time allowed. As to the policy pursued towards native princes, it must be remembered that unless these princes and British subjects co-operated it would be impossible to resist any invasion, because a rebellion in the interior would counteract all efforts on the frontier. The best way to check Russian, or any other aggression, was to cultivate the friendship of the natives, and win their affection by justice and consideration.

Dr. Burn did not feel the same dread with regard to the approach of Russia as had been expressed by some gentlemen. He had considered this question a long time in India, but he really could not see that Russia had any intention of attacking India. She had a Government full of energy, and, like all other countries of Europe with a similar organisation, was somewhat ambitious. England had been the same; had taken possession of India, and had large colonies all over the world wherein to employ her active young men. Our Continental neighbours, on the other hand, were cooped up in such a way that their ambition could not be exercised so easily, though their military spirit was much greater than our own. In his opinion, the best plan for the protection of India would be, for England to put aside any desire to fight and quarrel with Russia, and allow and invite her to advance towards the East, because her civilising power among Mohammedan tribes would be an advantage rather than the contrary; he believed her object was entirely to go towards China, which was a country far more worthy of her ambition than India, and far more easily accessible. It was too late to-night to go at length into this question, but he desired to protest against a feeling being aroused that Russia had designs upon India.

H. H. Sekunder Khan said he had not intended to take part in the discussion, but reference having been made to the present Amir of Cabul he could not help doing so. The Amir was spoken of as unfriendly to England, but he was not so. He could not and did not forget that England had given him many lakhs of rupees and many stands of arms, and Russia had never given him anything. But, at the same time, he felt that these presents were given him to help England as well as himself against Russia. And he could not altogether be friendly with England so long as she persisted in encouraging his rebel son, and in not recognising his favourite and obedient son, Abdulla Jan, as his designated successor; just as she persisted in encouraging his rebellious brothers, and refrained till she could no longer help herself from recognising Shere Ali, as the rightful successor of his father, Dost Mahomad. It was this sort of policy which made them think in the East, as was said in the time of Lord Lawrence's Government, that England wanted to pull everywhere, but to be responsible for help nowhere. But the Amir sent every letter he received from the Russian Government straight in original to the Viceroy of India. What more could he want? He naturally knew pretty well the feelings of his native country—Afghanistan; he had lived four years in Russia, and got to know something of her policy, and he had now been three years in England. He contended that Afghanistan was the only safe ally for England, and would fight bravely from motives of religion and patriotism to preserve her independence against the ambitious designs of Russia. The natives of India could not be depended upon as the allies of England in the event of war with Russia. What did Sir Henry Rawlinson and Sir Richard Temple say? That there were four classes irreconcilable to the British Government in India: 1st, the priesthood; second, the civil and military classes; third, the native chiefs and princes; and, fourth, all the blackguards of India. Why, who is there then left to be friends? Poor menial servants, barbers, and such like! A gentleman talked of sending thousands of men from Canada to India to fight against Russia; just as if Russia would not take care that Canada would in such a war have to keep every man at home to preserve herself from the United States, who would not be likely to lose such an opportunity! But let England send an English army to combine with an Afghan army, they could finish the matter at once; though if once Russia got into Afghanistan matters might be past remedying.

The Chairman, in summing up the discussion, said it was impossible to travel over so wide a field of speculation; but he regretted that Mr. Long, from considerations of time, had omitted some of the practical details which would have made his paper more explicit. He referred particularly to the details of the customary trade routes through Central Asia, and the lines of railway which he intimated Russia intended to substitute for those routes. As to the question of the moral ascendancy or social influence which Russia would be able to exercise in those countries, he did not quite understand in what respect Mr. Long considered Russia peculiarly able to reconcile, conciliate, civilise, and assimilate those races; in what particulars she was superior to ourselves as a governor of Asiatic races; or in what way he considered that our Government should assume a more oriental, or semi-Asiatic attitude in its relations with its Eastern subjects.

Mr. Long said these points would be found set out in detail in the paper as printed in full.

The Chairman continuing, said he had been personally acquainted both with Russia and India, and if he had thought there were any danger of this discussion being conducted in a spirit of rancorous hostility towards Russia, it would have been inconsistent with his personal sentiments to take the chair. He felt, however, that the subject was safe in the hands of Mr. Long, whose acquaintance he had made some years ago at St. Petersburg, and renewed in Calcutta. Mr. Long took the deepest interest in the social condition of the Indian races, and at the same time had conceived a great sympathy for the Russian people, and had studied their rural institutions more deeply probably than any other Englishman. He to some extent shared this duality of sympathies, for he must avow a strong sympathy for the Government and people of Russia, in whom he recognised a great number of interesting qualities, and whose destiny in the future was no doubt very important. On the other hand his experience of official life led him to take the deepest interest in the English administration of India, and of the social condition of the races there subjected to our sway. He hoped, therefore, that he was temperate and impartial in expressing his opinion on the great problem at issue between the English Government and that of Russia. In the first place it was most desirable that the English should thoroughly realise that the advance of Russia was a constant and progressive movement in Central Asia. That progress was an ancient historical progress, which had depended upon various influences, indicated by Mr. Long, partly on ambitious plans, sketched out by the Government, partly on the religious impulses and enthusiasm of the Russian people, and their natural hostility to the Moslem partly on commercial ambition and the desire to procure an extensive field for manufactures and trade, and partly on that indefinable force, which might be called the expansive force of nations—that force which led all great political bodies which were impregnated with strong vitality, and with a sense of a powerful progressive future, to encroach on the weaker nature, a course of which our own country offered in its history most unmistakable evidence. The whole of these influences were combining to push the Russian Government further in Central Asia, and two reasons at the present moment intensified this movement. One was the cessation of Russian aggression in European Turkey, brought about by the events connected with the Crimean war, and the other the accomplished conquest of the Caucasus, the expansive forces of Russia having for a long time been almost entirely occupied in those two fields of action. Now, however, the whole of these forces, political, religious, commercial, and national, were let loose on Central Asia, and so far from being astonished that they had made great advances, he really thought those advances had been of a very moderate and temperate character. His first political recollection of this subject extended to the time of the Persian attack on Herat, alleged to be supported by Russia. Thirty-eight years had since elapsed, but Afghanistan still retained its integrity, and Persia and Russia had really made no impression at all upon Herat, whilst the field in Central Asia, upon which England could really exercise its power and control, was up to the present time intact. In considering the moral and political character of the Khanates to the north of Afghanistan, he did not think any of them were of such a character as that they could be constituted our active or passive allies. It was idle to talk of an alliance with Bokhara or Khiva; there was only one power in Central Asia within our control which we could depend upon, namely, Afghanistan. It had been proposed by some able writers on this subject that the English Government should take a more active attitude with reference to the occupation of Afghanistan, or some point in it. But he confessed he did not admit the necessity for such a policy at the present time. It appeared to him that all our Government had to do was to make it perfectly understood that they regarded Afghanistan as the exclusive scene and theatre of English influence and power, and that, without trenching on its internal government or national independence, we must guarantee absolutely, its integrity with reference to external adversaries, making it understood that we would not tolerate any participation of political influence in Afghanistan, or any aggression on her boundaries which England herself had defined, or should define. He believed that if the English Government made this policy perfectly plain there would be no danger of Russian aggression in that quarter, and that our relations with that power would be more clear and more satisfactory than they had been. The argument had been put forward that we might maintain very good relations with Russia if brought into immediate contact with her. That might be so; we might have a defined frontier on the North, and Russia might approach the verge of that, and the two countries might remain on good terms, as was the case with Canada and the United States; but he deprecated the use of that argument, and doubted the advisability of such a course. England and Russia might remain on good terms if we were thus placed face to face, but the difficulty would be much greater than at present, and it would probably lead to a greatly increased expenditure for military purposes along the frontier. He understood Mr. Long to state that the nearest Russian post was not more than 250 miles from Peshawur, but if that were so his information was entirely erroneous. He did not think that any Russian military party south of Bokhara or Samarkand had ever come within 450 or 500 miles of Peshawur, and he certainly thought the further off they were the better. The immediate proximity of Russia would oblige us to maintain a large force to fortify the frontier, and to employ in military preparation a great deal of money, which was expended at the present time in social and industrial works for the Indian people; whilst he had no doubt that the presence of Russia would exercise a disturbing force on the native people and native courts within our borders. Indeed he could hardly think it possible, if such a state of things arose, to permit the maintenance of anything like a powerful native Government, independent court, or native army in India, and thus we should have to change the whole course of our policy, a thing much to be deprecated. The question had been mooted during the discussion of the internal government of India, but that subject was so vast that he must be excused venturing upon it at that late hour. He concluded by moving a vote of thanks to Mr. Long.

The motion was carried unanimously.

Mr. Hyde Clarke being restricted from speaking by the length of the discussion, writes:—The semi-Oriental character of the Russians marked by Mr. Long is true, but its application to Orientals is deserving of consideration, particularly in reference to the Mussulmans. Formerly, like ourselves, the Russians administered Mussulman laws, and did not interfere with local institutions, and this certainly enabled them to decimate their Mussulman subjects. They are now introducing Russian law and institutions, and proselytising, and thereby their hold on the Mussulman and other tribes is slackened. The measure of the irritatives can hardly be estimated by the emigration of Krim Tartars, Nogais, and Circassians, for it is wide-spread throughout Caucasia and Turkestan. While this diminishes the risk of sympathy and alliance between Indian Mussulmans and Russia, it does support the expediency of more sympathetic treatment of our Mussulman population. Russia, with great qualities, is semi-Oriental, chiefly in her barbarities, and her conduct is destructive as much to civilisation as to barbarism. The prosecution of the policy of opening trade routes to Central Asia is imperative, and particularly is

...ance to China, for trade is our chief means of resist... Russian monopoly. The railway communication ... India should be more intelligently aided by our ...rnment. The line through Constantinople and ... Minor is making slow progress left to the ...led energies of the Turkish Government, ...it is most essential it should be prosecuted ... more vigour. With regard to Persia, it is ...expedient that we should promote railways ...uth Persia. There is still time to strengthen our...s to the south of the Russian border. One im...ant part of the general policy is that advocated by ...Long, and to which we have often called the atten... of the Indian Section, the promoters of the hill ...ements in the Himalayas especially. These, which ...ow so slowly growing, may become barriers against ...ession from either side. The adjustment of the ...ions with Cashmere requires serious attention, as ... those with Nepaul and Thibet. The policy re...d to by Mr. Haliburton, of treating India as an ...gral part of the empire, should be upheld; but in ...ection our alliance with our own people in the United ...s is no less to be cultivated. Let us on the one ... interest the people of the United States in India, ...on the other let the politicians of India understand ...they can rely on the support and alliance of a great ...ia, and may look forward, fearless of the changes of ...arous invaders, to enjoyment of that greatest ...sure of freedom under English institutions which ...world now witnesses on both shores of the Atlantic.

MISCELLANEOUS.

SIGNALLING ON RAILWAYS.

...n Monday, the 7th inst., a model of Sir David ...mons' method of signalling on railways was exhi...d in the Society's Great Room. The object of the ...tion is to enable trains in motion on a line to com...icate with stations, and to be warned of the presence ...ains before or behind them. For this purpose a ...t insulated rail is laid down between the ordinary ... and on this a wheel, carried by the engine, runs ...to keep up electrical communication between the ...and a machine or battery on the engine. The line ...g divided into short lengths, the engine driver is ...enabled to receive information at once of the pre...e of a second train on the same length, and appa...s may also be arranged by which the steam can be ...matically cut off and the breaks applied. The ...ths are arranged so as to "overlap" for some ...ance, and thus enable the train, when near the end ...e length, to communicate at once with the lengths ...ront and that behind, and for this purpose there are ... wheels on the engine which are brought into action ...ately. For sidings there are special arrangements ...which the battery can be thrown out of contact to ...t a train; at other times they are protected by a ...lar arrangement to that above described.

...rom Japan news comes that the Japanese Go...nment are taking steps for establishing blast furnaces. ... iron hitherto manufactured in Japan has been made, from ...ron sands which occur in the islands of Yesso, by a sort ...lomery process, and these iron sands have lately been ...ribed in the report of Mr. B. S. Lyman, the geologist ... mining engineer to the Government of Japan, as consist... of two varieties, the one easily smelted and pure, whilst ... other is difficult to smelt, and supposed to contain ...nium.

...he Secretary of the London Patents Agents' ...mittee is Mr. C. Graham Carttar, and not, as printed ... week, "Carlton."

MATERIAL FOR CASTS.

The following memorandum has been received from the Science and Art Department of the Committee of Council on Education, South Kensington:—

May, 1875.

SIR,—I am directed by the Lords of the Committee of Council on Education to inform you that the Prussian Government has offered two prizes of the value of about £150 (3,000 marks) and £500 (10,000 marks), respectively, for the discovery of a new method of cleansing plaster casts, statues, &c., and for the invention of a new material possessing the advantages of plaster, but which will not deteriorate by repeated washings.

I am to invite your attention, therefore, to the enclosed translation of the paper which the Prussian Ministers of Education and Public Works have issued on the subject, and to beg you to be good enough to make the matter known among persons likely to be interested.—I have the honour to be, sir, your obedient servant, NORMAN MACLEOD.

The Secretary, Society for the Encouragement of Arts, Manufactures, and Commerce.

Prizes for the Discovery of a New Method of Preserving Plaster Casts from Deterioration by Repeated Washings.

On the suggestion of the undersigned Ministers, a Committee of Archæologists, Directors of Art Museums, Artists, &c., was formed in April, 1874, to consider the management and preservation of plaster casts.

This Committee has acknowledged that in large and much visited collections, casts cannot be kept clean without periodically repeated washings, and that all methods, hitherto known, to prepare the casts for cleansing have but imperfectly served their purpose. The delicacy of the form or the colour of the plaster is liable by these methods to become more or less injured, while its surface is not rendered better able to resist the influence of the washings.

This might, however, be avoided, if casts could be made of a material that would allow washing, without having been previously saturated.

The Committee, therefore, considered it desirable to offer prizes; firstly, for the discovery of a new method of preparing plaster casts for periodically repeated washings; and, secondly, for the invention of a new material for making casts of Art-works which would not require a preparation of the casts for cleansing.

The undersigned Ministers have adopted these views, and decided upon issuing the following two offers of prizes:—

FIRST PRIZE.

A prize of 3,000 marks (about £150) is offered for a method which will give the plaster casts the power of resisting periodically repeated washings, without injuring in the least the delicacy of the form, or the tint of the plaster.

SPECIAL CONDITIONS.

(*a*.) The method must be applicable in equal degrees to all kinds of plaster occurring in trade, and must not diminish the hardness of the cast.

(*b*.) In order to entirely preserve the delicacy of the form, those materials are absolutely excluded which do not soak into the plaster.

(*c*.) It is not necessary to preserve the original colour of the plaster; a yellowish tint, or any warmer tint may be allowed; but the evenness of the colour is at any rate indispensable.

(*d*.) Plaster casts prepared according to the method must stand repeated washings with soap and lukewarm water.

(*e*.) The method must be applicable to plaster casts of any size and shape.

(*f*.) Competitors for this prize are to prove the

practicability of their respective methods by sending samples, and, if desired, by preparing casts placed at their disposal.

Second Prize.

A prize of 10,000 marks (about £500) is offered for a material for making casts of Art-works, possessing the advantages of plaster, but which, without any special preparation, will not deteriorate by periodically repeated washings.

Special Conditions.

(*a*.) The new material must easily allow casting in original moulds, without their becoming more injured than with plaster, and it must re-produce the mould as exactly as plaster.

(*b*.) It is not required that the material should have the colour of plaster; a yellowish tint, or any warmer tint, may be allowed; but the evenness of the colour is indispensable.

(*c*.) The solidity of the material must not be less than that of plaster, so that it may be used for the largest casts.

(*d*.) Casts made of this material must stand repeated washings with soap and lukewarm water.

(*e*.) The price of the material must not considerably exceed that of plaster; and the price of the moulds for casting must likewise not considerably differ from that of plaster moulds.

(*f*.) Competitors are to prove the practicability of their material by sending samples in applied and unapplied states, and also to give proof, if required, by the actual execution of casts.

General Conditions referring to Both of these Prizes.

The undersigned Ministers reserve to themselves the nomination of a Committee of Experts, in order to examine the consignments which may be received.

Competitors are to send with their consignments sealed envelopes, provided with mottoes, and containing the names of the senders. On the outside of these envelopes, also, is to be written the address to which the returned samples, or any communications, are to be sent.

The consignments which have been found to correspond with the conditions stated above, will become the property of the Government, and the names of the successful competitors will be published. The remaining consignments will be returned to the addresses given on the envelopes.

Competitors are to forward their consignments to the Royal Prussian Ministry of Public Worship, Instruction, and Health (Königl. Preussisches Ministerium der geistlichen, Unterrichts, und Medicinal Angelegenheiten), not later than 31st December, 1875.

Signed—

The Royal Prussian Ministers:

Of Public Worship, Instruction, and Health,
Falk.

Of Trade, Industry, and Public Works,
Achenbach.

The number of acres of colonial wheat under culture in all the Australian colonies last year was over 1,500,000 acres, and the produce 18,000,000 bushels. South Australia and Victoria are the largest wheat-producing colonies, the former producing six to eight million bushels, and the latter about five million. New Zealand ranks next for about three million, and New South Wales follows with two and a-half to three million.

The speed of trains in Germany is given by a recent report as follows:—Greatest speed per hour, including stops for express and fast trains, 34 miles; for ordinary passenger trains, 25. Slowest speed were for express and fast trains 21 miles per hour; ordinary passenger trains, 16 miles. Average speeds per hour, for express and fast trains, 28 miles; for ordinary passenger trains, 21 miles.

THE NAVIGATION OF THE OXUS.

The following account of the navigation of the Oxus has been sent by M. Vambéry to the *Augsburg Ga- zette*:—

Whoever has navigated the Amu-derja, has any time on its banks, or knows anything of its character, must be aware that the climate and the nature of the soil in Central Asia have from time immemorial exercised a main influence on this principal river of Central Asia. This influence will always exist; neither is it possible to apply to the Oxus the theories which are applicable to other bodies of running water. In fact, from the point where it bears the name of Amu (that is to say, from the Khanate of Kunduz) to its mouths, the Oxus is bounded by a and uninterrupted sandy steppe; whence it follows that nowhere can there be a uniform depth, the right being always deeper than the left. In the second the river always draws along with it a quantity of such as is found in no other river. This quantity increases in proportion as the Oxus nears the sea of Thus, a pitcher of water at Kerki becoms —that is to say the sand forms a deposit at the —in much less time than at Chanka; and, enough, the same proportion exists between the taken from the river and from the canals.

At Kerki, the crossing only occupies three even under the most unfavourable while at Chanka, from six to eight hours are for the passage. Moreover, at the principal leaving Codscha, Sali, Kerki, &c., no pilot can be who can, from year to year, turn to account the experience he has gained as to the navigation currents of the river; in like manner, no sailor able to predict, notwithstanding his knowledge river, how much time will be required to stream.

The change begins each year towards the second month of spring, when the snow melts mountains. Then the water rises several feet space of an hour; islands are formed and the currents change their direction; and the undergo such changes at many points as to be [illegible] nisable. In past ages there have been, it is well inundations which have engulphed whole districts towns and villages; even now large portions of banks are drawn in by the river, and M. Vambéry himself witness of a phenomenon of this nature from the mouth of the Schurachau canal; all of a a large mass of earth many yards long fell into the with a dreadful noise and became engulfed. account, when the water is high the natives approach the banks with the greatest care; and they evince considerable fear of the river, land route, although much longer.

When but little snow falls in the winter, the are in a great difficulty, because they do not whether, in the ensuing summer, there will be water to permit of navigation being carried on; on account of the great heat, the level of the becomes lowered much more rapidly than that of rivers, and the rapid evaporation of its waters is a of much astonishment to travellers.

A commission, to which Major Wood is attached, been nominated, under the direction of Colonel to study this matter on the spot, and their report give the information as to whether the Oxus is or not in the modern sense of the word, that is for commerce and the transport of all commodities.

The acclimatisation of trout in Tasmania certified by an official report, which states that in [illegible] total distribution of 4,050 trout ova was made from the that country to the neighbouring colonies; 800 of these were sea trout, and the rest brown trout.

FOREIGN COMMERCIAL ESTABLISHMENTS IN SYRIA.

The first Europeans who traded regularly with Syria in modern times, and who possessed factories in the land for the purposes of their trade, were the French and Venetians. In the early infancy of this trade, which was at the sixteenth century, and, indeed for many years afterwards, the Island of Cyprus formed the emporium of European commerce in the far Levant, and became the depôt of European and Eastern merchandise, whence supplies were forwarded to the mainland, or to Europe, as occasion required. The few ships then bound to Syria from Europe called at the island to refresh their crews, to refit, and to learn the latest news from the coast, and the state of the country. Again, on their return voyage, they made Cyprus their point of departure, calling in to complete their cargoes, and for provisions. Descendants of the old European factors are still numerous in the island, but the trade has departed long since, and flowed into other channels. The creation of the English and Dutch Levant companies led to the establishment of important factories of these nations at Aleppo, with branches at Tripoli, Beyrout, Sidon, and Acre, and much competition ensued. Broadcloths, colonials, and piece-stuffs formed the bulk of the importations from Europe, whilst the most important articles of export were silks, carpets, rhubarb, galls, spices, and many articles of Indian trade, which found their way to Syria overland, and cotton yarn, grey and Turkey red, spun in the country, and sent to Europe, and afterwards re-imported in the shape of manufactures. Vice-Consul [illegible] mentions it as a curious fact in connection with this last article of yarn, that the native manufacturers of Damascus, Hamah, &c., are at the present moment purchasing largely of British spun yarn for the manufacture of their native stuffs.

Towards the close of the last century, owing to facilities of communication, expansion of trade and competition, the business of these foreign factories largely diminished, and finally became extinct. About the year 1801, Napoleon I. made efforts to monopolise Egyptian trade by the creation of a factory at Sidon, with special advantages to the adventurers. This, however, from a variety of causes, did not prove a success, and the only vestige of that attempt is a large khan in a ruinous condition. Between the decadence of the English and other specially favoured trading adventurers, and the time of the Egyptian occupation, Syria was supplied with British and other European manufactures from the Continental depôts of Leghorn, Marseilles, Genoa, &c. The foreign commercial establishments in Syria were confined to a few houses of Italian and Levantine origin, the remains of the Levant Company's servants. English houses had long been broken up and their members gone home. With the Egyptian occupation, and the encouragement and the facilities offered by that Government to the establishments of foreign merchants in the country, English and French houses were opened at Aleppo, several in Beyrout, and two or three in Tarsus and Damascus, and the year 1833 witnessed the first direct trade with England. In 1840, the attention of the French silk manufacturers was attracted to the Lebanon, and the introduction of an improved system of reeling led to the establishment of silk factories by Frenchmen, and to the beginning of the present large export trade in silk, in the advantage of which the natives have so largely partaken. Between 1840 and 1850, Swiss and German industry, by imitating the native fabrics of the country, led to the opening of Syrian houses of commerce, and to those large importations of cheap prints and muslins which have so much injured the native manufactures, and led almost to their extinction. Native competition and other causes have gradually driven from the field the English houses of Aleppo, Damascus, and Tarsus. Those of Beyrout still remain, but in diminished number and extent of operations; and the prophecy of one of the largest native importers of British manufactures, that ten years hence there will not be a single English house in the trade, seems likely to be fulfilled.

While thus British and other European nationalities generally appear to be yielding the field to the native trader, one element alone seems to thrive, and the number of their establishments to increase throughout the land—the Swiss and Germans. Frugal, saving, and persevering, keeping up no appearance, they seem well able and determined to hold their own. They are chiefly commission agents, possessing little or no capital but their industry, and are generally connected with home manufacturers. Their houses are on the increase at Beyrout, Aleppo, and Damascus; and as native Syrian enterprise has not yet succeeded in making itself a home in their manufacturing centres, the Swiss and German commercial element will doubtless engross, before very long, a considerable portion of the foreign import trade of Syria.

OBITUARY.

Thomas Lawton.—The death of Mr. Lawton took place on the 1st inst. He was the agent and visitor of the Lancashire and Cheshire Union of Mechanics' Institutes, and as such worked energetically to assist the educational labours of the Society. From the time when this union became connected with the Society Mr. Lawton continued to take the greatest interest in the Society's scheme of examinations, and it is not too much to say that the success which has attended them in the North of England, is very largely due to the unwearied and active care which he devoted to them. He was also secretary to the Local Committee for the Government Science Examinations, and was nominated in recent years by the Manchester School Board and appointed by the Education Department.

Thomas Webster, Q.C., F.R.S.—The death of Mr. Webster was announced on Thursday, the 3rd inst. It was quite sudden, the deceased having been engaged in court on that very day. He was the eldest son of the Rev. Thomas Webster, vicar of Oakington, in the county of Cambridge. He was born on the 16th of October, 1810, and was educated at the Charterhouse. Thence he proceeded to Trinity College, Cambridge, and graduated as 14th Wrangler in 1832. He was for several years secretary to the Institution of Civil Engineers. In 1839 he resigned this post, but continued as honorary secretary till 1841, in which year he was called to the Bar at Lincoln's-inn, and joined the Northern Circuit. His scientific knowledge brought him into notice in connection with patent cases, in which he soon acquired a very large practice. In 1851, during the preparations for the Great Exhibition, Mr. Webster was appointed, in conjunction with Mr. Le Neve Foster, to act for the Attorney-General in examining and registering the inventions exhibited, which were then provisionally protected during the continuance of the exhibition by a special Act. This led the way to the Patent-law Amendment Act of 1852, in the preparation of which he contributed great assistance. In 1865 Mr. Webster was appointed one of her Majesty's Counsel He was elected a Fellow of the Royal Society in 1847. In addition to an extensive patent practice, Mr. Webster was much employed at the Parliamentary bar. He was also the author of several works, both legal and scientific. His "Reports and Notes of Cases on Letters Patent for Inventions" may perhaps be considered as his chief legal work, as it still remains a standard work of reference on the subject. In all proposals for Patent-law reform Mr. Webster took a keen and active interest

he was a member of most of the various committees which have from time to time been organised for this purpose. At the recent Vienna Exhibition he was one of the leading members of the International Patent Congress, and he was appointed by the British Commissioner to draw up a report thereon. His connection with this Society was long and intimate. He joined it in 1838, when it was at a very low ebb, and it was mainly through his exertions that it was resuscitated. He continued as a member of the governing body and vice-president of the Society for a considerable time, and since his first joining down to the time of his death, he never ceased to co-operate heartily in the work of the Society. On several occasions he contributed papers to the evening meetings, among other subjects on "Patent Laws," "Technical Education," "Property in Designs," &c. He frequently took part in the discussions, and on several occasions took the chair.

GENERAL NOTES.

Philadelphia Exhibition.—Among the other departments of the exhibition, that devoted to agriculture is intended to be a prominent one. A special building will be allotted to it, and preparations are being made for including in it exhibits of every sort bearing on the subject. Besides agricultural products and implements, it is intended to show live stock, poultry, fruits and flowers, and fish. It is stated that ample provision will be made for the proper exhibition of all these various objects. A memorial signed by 29 power-loom carpet manufacturing firms, and representing four-fifths of the entire Brussels carpet manufacturers of the United Kingdom, has just been forwarded from Kidderminster in answer to the invitation from the English Commission to those firms who have usually exhibited their productions representing the carpet industries at previous international exhibitions. The following paragraph contains the substance of the communication—"That in view of the heavy duties now levied by the United States on the importation of carpets produced in this country—an additional ten per cent. having recently been re-imposed—the manufacturers fail to see any advantage in responding to the invitations requesting them to become exhibitors in Philadelphia in 1876, and they respectfully submit that international exhibitions are incompatible with tariffs of a prohibitory character."

Testing Metals.—The board appointed by the President of the United States to make tests of metals, asks for tenders for the construction of a machine suitable and convenient for subjecting to either tension or compression specimens of iron, steel, or other metals of all lengths up to 45 ft., and of any width up 30 in. The machine must have a maximum testing capacity of 800,000 lbs., and be capable of accurately measuring strains. The machine is to be furnished with all necessary tools and driving machinery, and with holding down bolts ready for erection. It must be delivered within five months from the date of contrast. It will be further demanded that the machine shall be taken back in part payment for a machine of 2,000,000 lbs. testing capacity at an early date, which may be specified in the proposals, and upon terms which may be stated in full. Satisfactory guarantees will be required, and a penalty of 100 dols. per day in case of non-fulfilment of contract. Applications should be made to Professor Thurton, Yale College, U.S.

The Bessemer.—The contractors for the building of the *Bessemer* steamer, Earle's Shipbuilding and Engineering Company (Limited), Hull, took her out on Saturday, the 5th inst., to make their final trial of the engines. Among the party on board were Admiral Sir Spencer Robinson, K.C.B., Mr. Reed, C.B., M.P., Admiral Chamberlain, Captain Davis, managing director of the Bessemer Company, and Mr. F. Elgar, manager of Earle's Company. The vessel was under the command of Captain Pittock, and, leaving Dover Harbour about 11 o'clock, steamed straight out into the Channel, where her speed was measured over three runs of half an hour each. Although tested under ordinary conditions, with common coal and her own stokers, the speed attained was 15½ knots, or about 18 miles an hour. The steering qualities of the steamer were then tried by measuring the diameter of the circle in which she turned and the time she took in turning through the various points of the compass. The result was reported as satisfactory, as she turned very quickly for such a long craft. Her draught of water was 8ft. 5½ in. The engines worked exceedingly well throughout the day and indicated nearly 5,000-horse power, which is in excess of what was expected and of what the builders had contracted for. There was but little wind or sea, so that no opportunity was afforded for testing the steadiness of the vessel. The *Bessemer* saloon was kept fixed during the trip.

The Patents for Inventions Bill.—At a meeting of the London Association of Foremen Engineers and Draughtsmen, held at the Cannon-street Hotel, on Saturday, the 5th inst., under the presidency of Mr. Joseph Newton, it was proposed by Mr. Lloyd Wise, seconded by Mr. William Smith, and unanimously resolved:—1. That, in the event of its being determined to provide for the preliminary examination of applications for Letters Patent, such examination should be confined to the questions whether the invention is for any manner of manufacture, whether the specification is clear, and whether the invention appears open to objection on the ground of want of novelty as far as can be ascertained by such examination as prescribed of former specifications and other documents and publications in the Patent-office. 2. That adverse judgment of the examiners should not constitute a veto upon the grant of a patent. 3. That, inasmuch as the publication of reports of examiners would, in many cases, operate unjustly against the patentee, such reports should not be made public, provided that the applicant inserts in his specification an acknowledgment of the existence of the prior matter the examiners may have found and called attention to, and a specific statement of what he nevertheless claims.

MEETINGS FOR THE ENSUING WEEK.

MON. ...Royal United Service Institution, Whitehall-yard, 8½ p.m. 1. Mr. W. F. Dignum, "Proposed New Position for Ship's Side Lights." 2. Mr. Samuel Goode, "Mance's Heliograph, or Sun Telegraph."
Royal Geographical, Burlington-gardens, W., 8½ p.m. Admiral Sir F. Leopold McClintock, "Arctic Sledge Travelling."
Social Science Association. Law Amendment Society (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Sir Edward S. Creasy, "The Facility of Administering Law which includes Equity."

TUES. ...Birkbeck Scientific Society, Southampton-buildings, W.C. Mr. E. W. Craig, "The Science of Sunlight."
Statistical, Somerset House-terrace, W.C., 7¾ p.m. Mr. Thomas A. Welton, "The Effects of Migrations upon Death-rates."
Zoological, 11, Hanover-square, W., 8½ p.m.

WED. ...Meteorological, 25, Great George-street, S.W., 7 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THURS... Royal, Burlington House. W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Dr. McIntosh, "*Valencinia Armandi*, a new Nemertean." 2. Prof. Lankester, "The Anatomy of the *Amphioxus*." 3. Mr. A. G. Butler, "The Sub-families *Antichlorinæ* and *Charideinæ*."
Chemical, Burlington House, W., 8 p.m. 1. Mr. M. Pattinson Muir, "Nitrosyl bromide and sulphur bromide." 2. R. Warrington, "Notes on the chemistry of tartaric and citric acids." 3. "The action of nitric acid on mercury, copper, &c., especially in the presence of metallic nitrates." 4. Dr. Gladstone and Mr. Tribe, "Decomposition of water by the joint action of bromide and chloride, including instances of reverse action." 5. Professor Mallet, "Achrematite, a new molybdo-arseniate of lead," and "New reactions of tungsten." 6. Mr. E. W. Prevost, "The action of chloride of acetamide."
Zoological, 11, Hanover-square, W., 4 p.m.
Numismatic, 13, Gate-street, W.C., 7 p.m. Annual Meeting.
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

FRI.......Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7½ p.m. Annual Meeting.
Philological, University College, W.C., 8 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Classification of Plants."

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FRIDAY, JUNE 18, 1875.

[Co]mmunications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

[PR]OCEEDINGS OF THE SOCIETY.

EXTINCTION OF FIRES IN SHIPS.

[T]he Fothergill Gold Medal is offered for an [ef]fective means of preventing and extinguishing [fire]s on board ship. Communications, illustrated if [nee]d be by models or working drawings, must be [sen]t to the Society not later than the 31st of [Dec]ember, 1875. The Council reserve to them[sel]ves the right of withholding the Medal offered, [if], in the opinion of the judges, none of the [com]munications sent in competition are deserving [of] reward.

CONFERENCE OF INSTITUTIONS.

[T]he Twenty-fourth Annual Conference between [the] Council of the Society and the representatives [of] Institutions in Union will take place at the [Soc]iety's House, on Friday, June 25th. The [cha]ir will be taken at 12 o'clock, by Major-General [E]ARDLEY-WILMOT, R.A., F.R.S., Chairman of [Co]uncil.

[Se]cretaries of Institutions and Local Boards are [re]quested to send, *immediately*, the names of the [rep]resentatives appointed to attend the Con[fere]nce; and early notice should be given of any [sub]jects which Institutions or Local Boards may [des]ire their representatives to introduce to the [no]tice of the Conference.

[N]ATIONAL TRAINING SCHOOL FOR MUSIC.

A Conference convened by his Royal Highness [th]e Prince of Wales, as president of the Society [of] Arts, was held on Tuesday last, at Marlborough [H]ouse, for the purpose of establishing free scholar[sh]ips for metropolitan students in the National [Tr]aining School of Music, Kensington. His Royal [Hi]ghness the PRINCE of WALES occupied the [ch]air, supported by the Duke of Edinburgh, [P]rince Christian, the Duke of Teck, the Arch[bi]shops of Canterbury and York, the Lord Mayor [an]d Sheriffs, and Lord Hampton.

The following received invitations to attend the [Co]nference, but some were unable to be present:—

The Archbishops of Canterbury and York and the Bishop of London.

As representing the Corporation of the City of London:—The Right Hon. the Lord Mayor, Alderman Sir B. Phillips, Alderman Sir F. W. Truscott, Alderman Finnis, Alderman Cotton, M.P.; Sheriff Ellis, Sheriff Shaw, Mr. Councillor Taylor, Mr. Councillor Isaacs, Mr. Councillor Bath, Mr. Councillor Lintott, Mr. Councillor Taylor, Mr. Councillor Bedford, Mr. Councillor Wood, Mr. Councillor Fry, the Recorder, and the Town Clerk.

As representing the City Companies:—The Masters and Prime-Wardens of the Goldsmiths, Fishmongers, Drapers, Spectacle-makers, Vintners, Clothworkers, Coachmakers, Grocers, Haberdashers, Mercers, Merchant Tailors, Salters, Stationers, Weavers, Leathersellers, Turners, Saddlers, Coopers, Curriers, Carpenters, and Ironmongers.

The Governor and Deputy-Governor of the Bank of England, and the Chairman and Deputy-Chairman of the London School Board; the Head Masters of the Merchant Taylors, St. Paul's, Christ's Hospital, and City of London Schools; Mr. S. Morley, M.P.; Mr. W. B. Waterlow, Sir John Bennett, Mr. C. Morley, Messrs. Huth, Baring, Rothschild, Heath, and Goschen.

The Parliamentary representatives of the home counties, the City, and Metropolitan boroughs:—Col. Loyd Lindsay, R. Benyon, J. Walter, T. C. Baring, Col. Makins, J. Round, Col. Ruggles Brise, Sir H. Selwin-Ibbetson, Bart., Lord Eustace Cecil, W. T. McCullagh Torrens, Sir A. Lusk, Bart., J. Holms, E. L. Pemberton, Sir W. Knatchbull, Bart., W. Hart Dyke, Viscount Holmsdale, Sir C. Mills, Bart., J. G. Talbot, Alderman Sir J. C. Lawrence, Bart., Alderman W. McArthur, Alderman W. J. R. Cotton, P. Twells, Right Hon. J. G. Hubbard, Sir C. Dilke, Bart., W. Gordon, Right Hon. G. J. Goschen, Right Hon. R. Lowe, W. Fawcett, Sir Thomas Chambers, Lord George Hamilton, Octavius E. Coope, J. Locke, Col. Marcus Beresford, James Watney, Wm. Grantham, Sir H. W. Peek, Bart., Sir Richd. Baggally, George Cubitt, Lee Steere, Capt. C. T. Ritchie, J. D'A. Samuda, W. H. Smith, Sir Charles Russell, Bart., T. W. Boord, Right Hon. W. E. Gladstone, W. Forsyth.

As representing the Council of the Royal Albert Hall:—The Earl of Rosse, Major Donnelly, R.E., Warren De la Rue, Lyon Playfair, M.P., E. Thomas, Dr. Mouat, Dyer Edwards, H. C. Rothery, Lord Feversham, Sir Thomas Biddulph, Sir John Hawkshaw, Wentworth Cole (assist. sec.).

As representing localities which have appointed committees to endow scholarships, viz., Liverpool, Manchester, Birmingham, Leeds, Bradford, Halifax, Nottingham, &c.:—Mr. W. J. Beale, Mr. C. Harding, Mr. R. Peyton, Birmingham; Mr. H. Averdieck, Bradford; Sir J. Whitworth, Mr. H. Cheetham, Mr. E. S. Heywood, Manchester; Mr. I. Leslie, Mr. L. J. Crossley, Halifax; Mr. A. J. Kurlz, Mr. B. Rathbone, Liverpool; Mr. Albert Grey, Northumberland; Mr. T. Starey, Nottingham; Mr. G. Wedgwood, Staffordshire; Mr. R. B. Turner, Leeds.

The Council of the Society of Arts:—*Vice-Presidents*—F. A. Abel, T. Brassey, M.P., Andrew Cassels, E. Chadwick, C.B., Sir Henry Cole, K.C.B., Sir Daniel Cooper, Bart., W. F. Cowper-Temple, Major-General F. Eardley-Wilmot, R.A., C. J. Freake, Captain D. Galton, C.B., Wm. Hawes, Admiral Ommanney, Admiral Lord Clarence Paget, Major-General Sir H. Rawlinson, S. Redgrave, Rev. W. Rogers, Seymour Teulon, E. Carleton Tufnell. *Council*—G. C. T. Bartley, Sir G. Campbell, M.P., Lord A. Churchill, Hyde Clarke, Colonel A. Angus Croll, James Heywood, E. Lawrence, Robert Rawlinson, C.B., E. J. Reed, C.B., M.P., C. W. Siemens, Lieutenant-Colonel A. Strange, T. R. Tufnell, E. Brooke, John Murray, I. Gerstenberg, J. O. Chadwick, P. Le Neve Foster (Secretary).

Society of Arts Musical Committee:—E. A. Bowring, C.B., F. Clay, A. S. Cole, Lord Hampton, Sir J. Haring-

ton, Bart., H. A. Hunt, C.B., Lord Henry G. Lennox, M.P., Frank Morrison, Major-General H. Y. D. Scott, R.E., C.B., C. Wren Hoskyns, Sir Wm. Anderson.

Together with the following noblemen and gentlemen interested in the subject:—Duke of Richmond, Duke of Westminster, Marquis of Lansdowne, Marquis of Ripon, Earl of Carnarvon, Earl Granville, Sir Titus Salt, Bart., Sir William Armstrong, C.B., Viscount Sandon, M.P., Sir Francis Sandford, Major Carpenter, J. Morant, L. S. Benson.

The Prince of Wales said—In opening the proceedings of to-day, I shall have but few words to say, but I must express my gratitude at seeing so large an attendance on the present occasion. It looks well for the object which we have in view, namely, to do all we can to further musical education in this country; to do all we can to render it a really great national undertaking. I will now call upon my brother, the Duke of Edinburgh, to move the first resolution.

The Duke of Edinburgh then rose and said—In introducing the resolution which has been placed in my hands to propose to you, I shall ask you to listen to a few words which I have to say, dealing with the history of this movement from its first commencement. For this purpose I shall have to go back many years—as far, indeed, as 1854, at which time the Royal Academy of Music first made a request to the Commissioners of 1851 to grant a site upon their estate at South Kensington for a building in which the Academy could continue its labours. The negociations with regard to that matter were not successful, and all action ceased then until the year 1865. In that year the Society of Arts appointed a committee, composed of sixteen gentlemen, to consider and report upon the state of musical education in this country. Of that committee the Prince of Wales consented to act as Chairman, and it met several times, and made two reports; and those reports have been published by the Society of Arts. They explain what had so far been done in the matter, and they were issued after a careful consideration of all the methods of instruction and management at the institutions in Paris, Munich, Vienna, Prague, Leipsic, Milan, Berlin, Brussels, and Liége, and after receiving a great deal of additional information from witnesses who were the principal musical men in this country. One of the principal points which was established by this committee was the necessity of forming free scholarships, which were to be competed for in open competition, so as to obtain in this manner the best talent which could be obtained in this country, the successful competitors to have their musical education free in cases where they were unable to pay for that education themselves. Negociations with the Royal Academy continued steadily during the time of Lord Wilton and the late Sir George Clerk, but they were interrupted by the death of Sir George Clerk, and were not resumed until 1872, when I myself joined the committee, which was established in 1865. Negociations were then reopened with the Royal Academy with the view of their coming, as was originally intended, to the estate at South Kensington. Those negociations were carried on with Lord Dudley, the president of the Royal Academy, and he and the other members of that institution came down to view the ground and premises at the Albert Hall. It was, however, decided by them that they did not desire to leave their present premises. I believe the settlement came from the late Sir Sterndale Bennett, the Principal of the Academy, and they preferred to remain in their present building in Tenterden-street, and not to come down to the Albert Hall. It being then found that there was no possibility of a union between the institution which the Society of Arts desired to establish and the Royal Academy of Music, the Society of Arts thereupon turned their attention to the building and establishing of a new Institution on the principle that I have already explained—that of free scholarships. It is for that purpose that this meeting has been convened by the Prince of Wales to-day to interest gentlemen connected with the City of London and the metropolitan district in founding scholarships in this great city. In the meantime operations have been carried on, and the pulse has been felt, if I may use the term, of all the principal towns in England, with very fair promise of successful results, so that it now only remains for London to do the same, and we may hope that by the end of this year we may be able to open this new Institution with every promise of great success. The foundation stone of the building was laid in 1873, and at the time when it was decided to build the new school of music, a most liberal member of the Council—Mr. C. J. Freake—offered to build the premises entirely at his own risk, and on that point, before I proceed further, I think my brother has a communication to make to the meeting.

The Prince of Wales—I think it will be as well to interrupt for one moment, for I am sure it would be gratifying to the meeting here to-day if I were to read to them a letter which I received yesterday evening from Mr. Freake, of the contents of which I had no idea until I opened it. It is dated the 14th of June, from Cromwell-house, and is as follows:—

"Sir,—Fearing that I may be prevented by indisposition from attending the meeting to-morrow, I beg to state that it was my original intention to have given the use of the building now in course of completion for a training school of music for a period of five years, but it is with sincere pleasure and gratification that I now write to request the honour of your gracious acceptance of it as a free gift to the country for the cultivation and development of an art with which you, sir, and the Duke of Edinburgh, are known to have, like your illustrious father, the late Prince Consort, so much sympathy and interest. The Prince Consort's name awakens reverence and gratitude for the beneficial influence his high intellectual attainments and his excellence must have exercised in England. To it may be traced the important place music now fills amongst us—a place which has become so important that the nation need regret no pains bestowed upon its cultivation. I will only heartily wish the institution every success now that it is so happily inaugurated by your Royal Highness's kindness and support; and, in conclusion, I feel much pleasure in presenting to the school, in the name of Mrs. Freake, a scholarship.—I am, your Royal Highness's obedient servant,

C. J. Freake."

The Duke of Edinburgh—I think from the encouragement which has been given by the letter which has just been read from Mr. Freake, we may consider that at any rate this meeting will have borne already most excellent fruit. As I mentioned before, it has been convened for the purpose of interesting the City of London and the metropolitan district in the organisation of scholarships in a national institution, to enable the school to start with a reasonable anticipation of success. The school will have ample accommodation for 300 students, and that is the number we hope to have under education at all times. It has been announced within the last few days that by the end of the present year there will be at least 50, and that will enable the school to open with a fair share of success. But there is ample time for other scholarships to be founded in order that the institution may be able to engage a permanent staff of the most able professors, so that it may be carried on in the best manner. It now remains for me to read the resolution, which runs thus:—

"That it is desirable that a General Committee should be formed to establish Free Musical Scholarships in the City of London and the Metropolitan district, and that the following be requested to act on it, viz., the Right Hon. the Lord Mayor, the Aldermen, the Sheriffs, and the representatives of the Corporation and the City Companies, the Archbishop of Canterbury, the Deans of St. Paul's and Westminster, the Governor and Deputy-Governor of the

f England, the Chairman of Lloyds, and the merchants of City of London who are present on this occasion, with power to their number, and that the Lord Mayor be requested to that such committee do meet at the Guildhall or the Mansion ."

he **Archbishop of Canterbury** said—I have great sure in seconding the resolution, principally on unt of my ignorance of the subject. But perhaps ially I am entitled as much as any one to urge upon meeting the propriety of supporting this resolution h his Royal Highness has laid before you. As nted with an important position in the Church of land I cannot but recognise how very important it religious progress in this country that the science usic should be properly cultivated. Speaking also greatly interested in education in the country, officially and personally, I fully recognise how important it is for education that the science of music ld be properly cultivated. The progress which has made in this country in this matter during the last years is surprising, but still I think all who know of the subject will allow that we still require to great efforts in this direction. I might perhaps ure to suggest on this occasion that there is a source which we might look for some assistance in as in the other great educational movements which been so much talked of during the last few ths, and to which I may, perhaps, direct the attenof those who are present. There has been a comon, as your Royal Highness is aware, for investig the funds at the command of the universities. universities have always conferred degrees in music, professors of music are appointed to assist in the otion of musical science. If there is to be any taken in the redistribution of those funds, so as to them more available for the general education of untry, I think it would be only right that some n of those funds should be turned towards the otion of the great object for which your Royal ness has convened this meeting. As to myself, have told you how incompetent I feel to say hing which will throw light on this great substill I have some connection with it, and in a lar way, in so far as, in common with universities, I have the power, in virtue the office which I hold, of conferring the e of doctor of music, and I have been puzzled to tain the persons who were fit to hold the office. I in one or two instances when I have been called to confer a degree, found those who are interested in matter—the heads of the profession—ready to conduct an examination as would enable a proper selection e made for this honour. I trust that this meeting, h has been inaugurated by your Royal Highness, at which you have been able to promise so munit a donation on the part of our fellow-townsman Freake, will produce good fruits, and that the prowhich has been made in musical education in past will be but the beginning of that far greater prothat will be made in years to come.

he **Prince of Wales**—Before I put the resolution I leave to call upon any gentleman who wishes to make remark or to ask for any explanation on the subject of scholarships.

t. **Alderman Cotton**—On behalf of the company I esent—the Haberdashers—I beg leave to say that we not quite aware what it was that you required at hands, and I attended here to-day to hear your es. I now have no doubt that so far as our pany is concerned we shall have great pleasure in avouring to carry them out.

he **Master of the Mercers' Company** said that a communication from the Society of Arts had been received them on the 17th January, 1872, and the Court had ed a resolution that in the event of the National aining School for Music being founded, they would vote an annual grant of £50 during pleasure for one scholarship, to be called the Mercers' Musical Scholarship.

Alderman Sir Thomas Dakin, on behalf of the Fishmongers' Company, said that, recognising the importance of the movement, they intended to institute two scholarships.

The Master of the Vintners' Company made a similar announcement.

The **Lord Mayor** said—I see on the agenda paper that I am down to reply to the proposition that has just been carried, but I think as I see myself surrounded by so many of my brethren of the Court of Aldermen and the Common Council, and also by the representatives of the City Companies, I need not hesitate to assure your Royal Highness that it will afford them and me very great pleasure to give our best consideration to this important subject. For myself, remembering what your Royal Highnesses have said as to what has been done in other parts, and also that letter of my friend Mr. Freake—and I know him to be a most generous man in every respect—it will be a great encouragement to me to convene a meeting at an early day, and I am sure I shall be supported on that occasion by a very influential gathering of my fellow citizens. They, knowing your Royal Highnesses' very laudable desire for the attainment of this object, and remembering that it is one in which your illustrious father felt a deep interest, will not allow anything to stand in the way of responding to your wishes. I have a resolution to propose, namely:—

"That this meeting cordially thanks his Royal Highness the Prince of Wales for holding this Conference and presiding over it."

The words of that resolution are sufficient to commend it to your acceptance, feeling, as we must all feel, that thanks are due to his Royal Highness for taking so much interest in this, which is a matter of interest to the country at large. Although I am not much acquainted with music, yet I feel that if this college is properly and liberally instituted and supported, it may in time be made to conduce to the happiness of almost every family in this country. Everyone must at one time or other have felt the necessity for some proper amusement, and I am sure there is nothing that would so much tend to popularise the very best kind of amusement—that which can be enjoyed in the family circle—as one or two members of the household being acquainted with music. It would, in more than one sense, promote harmony. I am convinced, therefore, that all here will join in thanking your Royal Highness, and also the Duke of Edinburgh, for the interest you have taken in this matter.

The Archbishop of York said—I am permitted the privilege of seconding the resolution so ably moved by the Lord Mayor, but I do not think I need do more than say that it has in past times been the privilege of kings and princes to support the arts in their various countries; and our own Royal Family have shown themselves conspicuous in their love of art and their wish to do everything which might promote it. With regard to the art of music, I must say that the position it has held in the education of the country has been somewhat of a disgrace to us in the past. We have no doubt, as the Archbishop of Canterbury has said, a faculty of music in the universities, but there was no teaching of music, and it was as it were thrust into a corner, and it existed as a mere name. Now music has come forward in this metropolis in its right position; it will have a good school in which it may be taught, and there will be, I am sure before long, ample endowments, so that I hope his Royal Highness the Prince of Wales will be able to look back on this meeting with great satisfaction as placing one of the noblest of the arts in its fit position in one of the chief cities of the world.

The Archbishop of Canterbury put the resolution, which was carried unanimously.

The Prince of Wales—I beg to thank the Lord Mayor and the Archbishop of York for the kind way in which they proposed and seconded this resolution, and you, my lords and gentlemen, for the way in which you have received it. I need not assure the gentlemen here present that I would not have called this meeting unless I had taken a great interest in the subject; but I must say I think the initiative in this matter is due to my brother, who has taken the deepest interest in music since his childhood. I think we have reason to congratulate ourselves on the success which has so far attended this meeting. I am glad to have the opportunity of returning thanks to the Lord Mayor and to those gentlemen who represent the great City Companies for their co-operation in this scheme. I feel sure that this meeting will be the commencement of what I trust will be hereafter a great success, that the love of music which is so great now throughout the country will soon be vastly increased, and that those who now are fond of music will be able to secure a good musical education for their children and their grandchildren. In conclusion I am anxious to move a resolution which will be the last one to-day, but it is one which I feel sure you will all support most cordially, and that is a vote of thanks on our part to Mr. Freake for the handsome and liberal manner in which he has so kindly gratified us by presenting to us this building for a National Training School for Music. It was very kind and most liberal on his part to say that we should have it rent free for five years, and no one here could conceive that he would have made us a present of it. I am anxious, therefore, that we should record on this occasion our unanimous vote of thanks to him for his magnificent liberality and the interest he has taken in the welfare of that we have so much at heart.

The Duke of Edinburgh—I have the greatest pleasure in seconding the resolution, which requires no words of mine to ensure its cordial reception by this meeting. The munificence of Mr. Freake is such that his act speaks for itself, and I leave the resolution confidently in your hands.

The Archbishop of Canterbury put the resolution to the meeting, which was carried, and the proceedings then terminated.

The Duke of Edinburgh presided on Wednesday at a meeting of the Committee of Management, in the Prince's Room of the Royal Albert Hall. There were present—Prince Christian, K.G., Lord Clarence Paget, K.C.B., Sir William Anderson, K.C.B., Sir Henry Cole, K.C.B., Major-General F. Eardley-Wilmot, R.A., F.R.S. and Mr. Alan Cole, Honorary Secretary. Mr. A. G. Kurtz, from Liverpool; Mr. H. Averdieck, from Bradford; Mr. Richard Peyton, and Mr. Charles Harding, from Birmingham; with Mr. P. le Neve Foster, Secretary to the Society of Arts, and Mr. Lionel Benson, attended.

The appointment of Examiners to examine into the progress and working of the School was considered, and the following professional gentlemen were appointed:—Sir Michael Costa, Sir Julius Benedict, Sir George Elvey, Mr. Charles Hallé, Professor Ella, and Mr. John Hullah, who will also advise the Committee of Management in its work of organisation. The committee proceeded to inspect the building. In Mr. Freake's unavoidable absence, through indisposition, Lieut. H. H. Cole, R.E., the architect, Mr. F. W. Moody, and Mr. Waller conducted their Royal Highnesses and the Committee over the works, which are complete with the exception of a few interior fittings and exterior decoration. The outside is being decorated in an Italian style, executed in "Sgraffitto," from designs by Mr. F. W. Moody. A conference of representatives of provincial centres, each of which guarantees ten scholarships, is to be held shortly to further advance the arrangement necessary in appointing the staff for carrying out the work of the school.

CONVERSAZIONE.

The Society's Conversazione will be held on Friday, June 25th, at South Kensington Museum, by permission of the Lords of the Committee of Council on Education. Cards have been issued.

The following are the arrangements for the evening:—

1. A vocal concert, consisting of glees by the London Glee and Madrigal Union, directed by Mr. Land, will be given from 9 to 11 o'clock with intervals, in the Lecture Theatre; and the Council request that as the theatre will only hold seven hundred persons, the audience will change at every interval, to enable the greatest number to have the pleasure of listening to the concert.

A promenade concert will also be given by the band of the Grenadier Guards in the north court.

A programme of the vocal and instrumental music which will be performed is given below.

2. The Raphael Cartoons, the Sheepshanks' and the National Gallery's Picture Galleries will be open.

3. The courts and corridors of the ground floor, including the new architectural court, will be open. The seats will be chiefly in the north court. The reception will be held in the south court by Major-General F. Eardley Wilmot, R.A., F.R.S., Chairman, and other members of the Council.

4. Refreshments will be supplied as usual, in the refreshment rooms in the central corridor of the museum, at 9 o'clock. Ices, wines, &c., can be purchased.

5. Ladies' cloaks and gentlemen's coats will be taken charge of.

Hats cannot be received.

The following is the programme of music to be performed in the North Court by the Grenadier Guards Band (conductor, Mr. Dan Godfrey):—

Overture	"La Sirène"	Auber.
Valse	"Copenhagen"	Gung'l.
Selection	"Reminiscences of Mozart"	Mozart.
	Cornet, Mr. Ellis. Euphonium, Mr. Siddons. Petite Clarinette, Mr. Mann.	
Valse	"Manolo"	Waldteufel.
Aria	"Cujus Animam"	Rossini.
	Cornet, Mr. W. Ellis.	
Fantasia	"Les Prés St. Gervais"	Lecocq.
Pot-Pourri	"England" (On Old English Melodies)	Godfrey.
Valse	"Isidora"	Godfrey.
Glee	"The Chough and Crow"	Sir H. Bishop.
Fantasia	"Il Talismano"	Balfe.
Galop	"Schlaraffen"	Calbulka.

The following glees will be sung at intervals during the evening in the Lecture Theatre by the London Glee and Madrigal Union (Miss J… Wells, Mr. Baxter, Mr. Coates, Mr. Land, and Mr. Lawler), under the direction of Mr. Land:—

From 9 to 9.30.

Madrigal (five voices)	"Now is the month of Maying" (A.D. 1590)	Thomas Morley.
Glee (male voices)	"When the wind blows in the sweet rose tree"	W. Horsley, M.B.
Four-Part Song	"When the west"	Mendelssohn.
Glee (male voices)	"Haste, ye soft gales"	G. W. Martin.
Glee	"The Spring, the pleasant Spring"	R. Spofforth.

From 9.45 to 10.15.

Glee	"See the chariot"	W. Horsley, M.B.
Glee (male voices)	"How sweet, how fresh"	S. Paxton.
Prize Glee	"To my Lute"	Robert Cooke.
Madrigal	"Who shall win my lady fair"	R. L. Pearsall.

From 10.30 to 10.45.

Glee	"The Fisherman's Good-night"	Sir H. Bishop.
Humorous Part Song	"The Three Chafers"	Truhn.
Madrigal	"Down in a flow'ry vale" (A.D. 1541)	Festa.

GENERAL EXAMINATIONS, 1875.

PRIZES AND CERTIFICATES AWARDED TO CANDIDATES.

PRIZES.

His Royal Highness the Prince Consort's Prize of Twenty-Five Guineas to

No. 811—Henry Beer, aged 24, of the City of London College, clerk, who has obtained the following First-class Certificates during the specified period:—

1873. Logic.
„ Political Economy.
„ English Language, with the First Prize of £5.
1874. Theory of Music.
1875. Arithmetic
„ Book-keeping.

The Council Prize (for Female Candidates) of Ten Guineas to

No. 226—Mary Elizabeth Rudd, aged 19, of the Carlisle Mechanics' Institution (no occupation stated), who has obtained the following First-class Certificates during the specified period:—

1874. English Language, with the Prize of £2 for Females.
1875. Theory of Music.

Arithmetic	1st Prize	£5	To No. 844—Frederick Finter, 16, City of London College, Civil Service.
	2nd Prize	3	„ 764—Philip Sharpe, 22, Birkbeck Literary and Scientific Institution, clerk.
	Females' Prize	2	„ 234—Mary Lattimer, 16, Carlisle Mechanics' Institution (no occupation).
Book-keeping	1st Prize	5	„ 1081—John Ingham, 24, Manchester Mechanics' Institution, clerk.
	2nd Prize	3	„ 1083—William Jackson, 18, Manchester Mechanics' Institution, clerk.
			* *No Prize for Females awarded.*
Gardening	..	..	† *No Prizes were awarded in this subject.*
Political Economy	1st Prize	5	„ 683—Alfred Carter, 23, Birkbeck Literary and Scientific Institution, clerk.
	2nd Prize	3	„ 779—George Hickman, 25, Birkbeck Literary and Scientific Institution, Inland Revenue officer.
			‡ *The additional Prizes in this subject were not awarded.*
Commercial History and Geography	1st Prize	5	„ 1051—James Roscoe, 18, Manchester Mechanics' Institution, clerk.
	2nd Prize	3	„ 827—William A. Casson, 21, City of London College, clerk.
English Language—	1st Prize	5	„ 902—William H. Wright, 20, City of London College, clerk.
	2nd Prize	3	„ 86—John J. Frye, 24, Ashford Mechanics' Institution, reporter.
			* *No Prize for Females awarded.*
French	1st Prize	5	„ 30—Marion M. Murray, 18, Aberdeen Mechanics' Institution (no occupation stated).
	2nd Prize	3	„ 375—James Dawson, 19, Glasgow Athenæum, clerk.
	Females' Prize	2	„ 30—Marion M. Murray, 18, Aberdeen Mechanics' Institution (no occupation stated).
German	1st Prize	5	„ 758—Henry Henderson, 18, Birkbeck Literary and Scientific Institution, clerk.
	2nd Prize	3	„ 858—Gustave Loly, 17, City of London College, clerk.
	Females' Prize	2	„ 922—Clara Hatfield, 21, Royal Polytechnic College (no occupation).
Italian	..	..	† *No Prizes were awarded in this subject.*

* No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.
† No First-class Certificates were given in this subject.
‡ No other First-class Certificates were given in this subject.

Spanish	1st Prize......	£5	„	325—William Reid, 21, Glasgow Anderson's Univers Popular Evening Classes, warehouseman.
	2nd Prize	3	„	390—Thomas M. McKinlay, 18, Glasgow Athenæum, clerk.
				* *No Prize for Females awarded.*
Theory of Music ..	1st Prize......	5	„	443—Daniel McGhie, 32, Glasgow Mechanics' Institution, clerk.
	2nd Prize	3	„	316—William Millar, 21, Glasgow Anderson's Univers Popular Evening Classes, architect.
	Females' Prize	2	„	769—Louise Dickes, 30, Birkbeck Literary and Scientif Institution (no occupation stated).

* No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.

The additional Prizes offered by Mrs. Harry Chester in Political Economy have not been awarde

The Prizes offered by the Council for Writing from Dictation have been awarded as follows:—

1st Prize of £3 to No. 864—William G. Newton, 16, City of London College, Civil Service.
2nd „ 2 „ 827—William A. Casson, 21, City of London College, clerk.
3rd „ 1 „ 871—Edmond J. Riley, 16, City of London College, clerk.

The Prizes offered by the Council for Writing and Manuscript Printing have been awarded follows :—

1st Prize of £3 to No. 910—John G. Freeman, 28, Royal Polytechnic College, warehouseman.
2nd „ 2 „ 1081—John Ingham, 24, Manchester Mechanics' Institution, clerk.
3rd „ 1 „ 316—William Millar, 21, Glasgow Anderson's University Popular Evening Class architect.

The Prizes offered by the Council for the four best specimens of Handwriting, as shown in any the Papers worked in any subject, have been awarded as follows :—

1st Prize of £5 to No. 705—George W. Sellar, 18, Birkbeck Literary and Scientific Institution, clerk.
2nd „ 3 „ 770—Charles Wright, 17, Birkbeck Literary and Scientific Institution, Civil Servi
3rd „ 2 „ 844—Frederick Finter, 16, City of London College, Civil Service.
4th „ 1 „ 864—William G. Newton, 16, City of London College, Civil Service.

VIVA-VOCE EXAMINATION IN MODERN LANGUAGES.

The vivâ-voce examination in Modern Languages, as proposed in the memorandum furnished by Mr. Hyde Clarke, Member of the Council, has been held this year, at one Institution, the subje taken being French, and the Local Examiners having reported the following as havi satisfactorily passed, the Council have awarded them Certificates of "Proficiency":—

No. 1056—Thomas W. Davies, 21, Manchester Mechanics' Institution, clerk.
„ 1075—Henry Hartley, 27, Manchester Mechanics' Institution, cashier.

CERTIFICATES.

The following is an Alphabetical List of the Candidates who have obtained Certificates :—

The number following the name gives the age of the Candidate.

(1st) after a subject signifies a First-class Certificate.
(2d) „ „ Second-class „
(3d) „ „ Third-class „

The occupations stated are either present or proposed.

126—Aaron, Rose, 18, Birmingham and Mid. Inst., (no occupation)—French (1st)
461—Aaron, William B., 23, Halifax W.M. Coll., woolsorter—Bkpg. (3d)
805—Abbott, Henry, 23, City of London Coll., clerk—Bkpg. (1st)
261—Adam, John A., 23, Glasgow Anderson's Univ. Pop. Evg. Classes, bank agent—Th. of Music (1st)
1237—Adams, Henry, 17, Sheffield Ch. of Eng. Inst., teacher—Arith. (2d)
1141—Adams, Martha, 34, Penzance, schoolmistress—Eng. Lang. (3d)
127—Adams, Martha A., 16, Birmingham and Mid. Inst. (no occupation)—French (3d)
649—Adcock, Thomas, 27, Leicester W.M. Coll., teacher—Arith. (3d); French (1st)
1073—Addison, Joseph, 18, Manchester M.I., clerk—Bkpg. (3d)
462—Ainley, Edward, 19, Halifax W.M. Coll., draper's assistant—Bkpg. (3d)
128—Aldrich, Alice E., 19, Birmingham and Mid. Inst., (no occupation)—German (3d); French (2d)
1033—Allan, Frank, 21, Manchester M.I., clerk—Bkpg. (3d)
1048—Allan, Thomas, 19, Manchester M.I., clerk—Bkpg. (2d)
1378—Allen, Eliza M., 30, Quebec Inst., governess—German (3d)
1379—Allen, Matilda F., 39, Quebec Inst., governess—German (1st); French (1st); Eng. Lang. (2d)

28—Allen, William G., 16, Pembroke Dock M.I.; shipwright's apprentice—Arith. (1st.)
06—Allsop, Peter J., 20, City of London Coll., clerk—Bkpg. (3d)
58—Alston, Thomas, 17, Manchester M.I., mechanic—Arith. (2d)
07—Althans, George A., 17, City of London Coll., clerk—Arith. (3d); French (3d); Bkpg. (3d)
58—Anderson, Fred, 17, Hull Young People's Chr. and Lit. Inst., clerk—Arith. (3d)
6—Anderson, John, 17, Aberdeen M.I., clerk—Eng. Lang. (2d)
25—Anderson, John S. K., 16, Aberdeen M.I., clerk—Eng. Lang. (2d)
31—Anderson, William G., 18, Aberdeen M.I., clerk—French (3d)
62—Andrew, John, 21, Glasgow Anderson's Univ. Pop. Evg. Classes, stationer—Th. of Music (3d)
46—Andrew, Noah, 21, Manchester M.I., clerk—Bkpg. (2d)
57—Andrew, Walter, 18, Freetown Working Men's Inst., Glossop, clerk—Bkpg. (3d)
53—Andrews, Annie, 18, Hull Young People's Chr. and Lit. Inst. (no occupation)—Eng. Lang. (3d)
63—Angus, William S., 25, Glasgow Anderson's Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)
04—Anholm, August S., 16, Hull Young People's Chr. and Lit. Inst., teacher—Arith. (3d); Eng. Lang. (3d)
2—Annan, John, 18, Glasgow Ath., clerk—French (3d); Bkpg. (2d)
28—Annis, William, 20, Leicester W.M. Coll., iron-monger—Eng. Lang. (3d); French (3d)
88—Arden, Richard P., 17, Bolton Ch. Inst., corn merchant's assistant—Arith. (2d); Th. of Music (1st); Eng. Lang. (3d)
34—Armstrong, James, 20, Carlisle M.I. (no occupation)—Arith. (1st)
45—Armstrong, John B., 16, Carlisle M.I. (no occupation—Arith. (2d)
32—Armstrong, Thomas, 17, Carlisle M.I. (no occupation)—Arith. (3d)
64—Arnold, Henry, 19, Salford W.M. Coll., clerk—Bkpg. (2d)
18—Asher, Alexander, 17, Aberdeen M.I., stone cutter—Arith. (2d)
65—Ashton, Joseph, 16, Salford W.M. Coll., engraver—Arith. (3d)
67—Ashworth, James, 18, Bacup M.I., teacher—Arith. (2d); Eng. Lang. (3d)
674—Arundale, Francesca E., 27, Birkbeck Lit. and Sci. Inst., teacher—German (2d)
656—Atkinson, James, 21, Salford W.M. Coll., joiner—Arith. (3d)

904—Bailey, Isaac, 28, Manchester M.I., warehouse-man—French (3d)
544—Bailey, William, 18, Hull Young People's Chr. and Lit. Inst., printer—Bkpg. (2d).
958—Bain, George W., 19, Liverpool Inst., teacher—Arith. (3d)
344—Baird, Alexander, 18, Dundee Young Men's Chr. Assoc., clerk—French (3d)
129—Baker, William M., 16, Birmingham and Mid. Inst., clerk—German (3d); French (3d)
676—Balchin, William F., 17, Hull Young People's Chr. and Lit. Inst., gunmaker's apprentice—Bkpg. (3d)
193—Balshaw, James, 18, Bolton M.I., clerk—Arith. (3d)
590—Banyard, William F., 18, Ipswich W.M. Coll., clerk—Bkpg. (3d)
653—Barclay, Thomas P., 22, Leicester W.M. Coll., framework-knitter—Eng. Lang. (2d)
190—Barlow, James, 18, Bolton Ch. Inst., teacher—Arith. (3d)
810—Barnes, Lawrence L., 18, City of London Coll., clerk—Arith. (3d); English Lang. (2d); French (3d)
79—Barnett, William J., 18, Ashford M.I., black-smith—Arith. (2d)
35—Barron, James, 20, Aberdeen M.I., warehouse-man—Arith. (3d); Eng. Lang. (2d)
1003—Barry, John, 19, Manchester M.I., clerk—French (3d)
1043—Barry, Thomas, 22, Manchester M.I., clerk—German (3d); French (2d; Bkpg. (2d)
1371—Bartle, Harry, 19, Wakefield M.I., clerk—Arith. (3d)
1057—Bateman, Alfred G., 17, Manchester M.I., clerk—Arith. (2d); English Lang. (3d).
130—Bates, George W., 20, Birmingham and Mid. Inst., organist—Th. of Music (1st)
985—Bath, Caroline L., 18, King's Lynn Ath. (no occupation stated)—Bkpg. (3d)
984—Bath, Emily B., 20, King's Lynn Ath. (no occupation)—Bkpg. (3d)
545—Battarbee, Robert H., 16, Hull Young People's Chr. and Lit. Inst., assistant in shop—Bkpg. (3d)
786—Batty, Edward J., 17, Birkbeck Lit. and Sci. Inst., teacher—Arith. (3d)
1096—Baxter, Fred, 17, Mossley M.I., tailor—Bkpg. (2d)
4—Baxter, James, 16, Aberdeen M.I., clerk—Eng. Lang. (1st)
1053—Bedford, William, 25, Manchester M.I., black-smith's foreman—Arith. (1st)
811—Beer, Henry, 24, City of London Coll., clerk—Arith. (1st); Bkpg. (1st); and the Prince Consort's Prize of Twenty-five Guineas
77—Bell, George, 23, Aldershot and Farnham District Board, soldier—Arith. (3d)
265—Bell, John, 21, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (1st)
812—Benn, William R., 20, City of London Coll., clerk—German (2d)
813—Bennett, Cecil J., 19, City of London Coll., clerk—Commercial German (1st); Bkpg. (3d)
814—Bennett, Ernest, 18, City of London Coll., clerk—Bkpg. (3d)
815—Bennett, Horatio H., 20, City of London Coll., clerk—Commercial German (1st); Bkpg. (3d)
699—Bennett, Richard W., 22, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d)
905—Berridge, Arthur, 19, Kentish-town Lit. Inst., dental modeller—Th. of Music (1st)
1094—Berry, John J., 19, Mossley M.I., cotton piecer—Bkpg. (3d)
506—Best, Joseph H., 17, Huddersfield M.I., clerk—Bkpg. (3d)
366—Beveridge, Robert C., 18, Glasgow Ath., clerk—German (3d); French (3d)
612—Bevins, William, 33, Leicester W.M. Coll., model maker—Bkpg. (3d)
131—Beynon, Frances M., 20, Birmingham and Mid. Inst., teacher—French (3d)
816—Biden, Lewis M., 18, City of London Coll., clerk—Arith. (2d)
954—Biggs, Emily S., 17, Lichfield W.M. Assoc. (no occupation stated)—Arith. (3d); Eng. Lang. (3d)
817—Biggs, George H., 20, City of London Coll., assistant foreman—Arith. (2d); Bkpg. (3d)
1222—Billam, Wilfred, 16, Sheffield Ch. of Eng. Inst., teacher—Arith. (1st)
124—Bingham, Edward, 29, Belfast Working Men's Inst., teacher—Arith. (1st)
1084—Bond, George, 20, Manchester M.I., book-keeper—French (3d)
1080—Booth, Edwin, 31, Manchester M.I., customs' officer—Arith. (2d)
1235—Booth, George, 23, Sheffield Ch. of Eng. Inst., file smith—Arith (2d); Th. of Music (2d)

1055—Booth, James, 21, Manchester M.I., book-keeper—Pol. Econ. (2d)

266—Bothwell, Thomas, 20, Glasgow Anderson's Univ. Pop. Evg. Classes, twister—Th. of Music (3d)

704—Bothwell, William M., 36, Birkbeck Lit. and Sci. Inst., district-visitor—Th. of Music (3d)

925—Bourne, Frederick, 23, Royal Polytechnic Coll., clerk—Bkpg. (3d)

267—Bowie, James, 30, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)

21—Bowie, William, 25, Aberdeen M.I., clerk—Th. of Music (2d)

455—Bowler, Joseph P., 18, Freetown Working Men's Inst., Glossop, teacher—Arith. (3d)

381—Boyd, Robert A., 24, Glasgow Ath., clerk—French (3d)

125—Boyle, Samuel, 25, Belfast Working Men's Inst., clerk—Arith. (1st)

1135—Bradbury, John, 16, Penzance, printer—Arith. (3d)

1132—Bradbury, Samuel, 16, Penzance, teacher—Arith. (3d)

1029—Bradley, John, 20, Manchester M.I., clerk—Bkpg. (1st)

460—Bramhall, John, 18, Freetown Working Men's Inst., Glossop, clerk—Arith. (3d)

819—Branch, Harry, 26, City of London Coll., teacher—Th. of Music (2d)

409—Brand, David, 20, Glasgow Ath., gilder—Eng. Lang. (2d)

250—Bransfield, Richard J., 17, Cork Catholic Young Men's Soc., accountant—Arith. (2d); Bkpg. (3d)

1167—Brassington, Edward, 17, Salford W.M. Coll., clerk—Arith. (2d)

58—Brebner, George, 20, Aberdeen M.I., student—German (2d)

60—Brebner, Jane, 18, Aberdeen M.I. (no occupation)—French (2d)

59—Brebner, William, 19, Aberdeen M.I., architect's apprentice—French (2d)

1137—Brewer, John C., 19, Penzance, tin-plate worker Arith. (3d)

1108—Brierley, James H., 19, Oldham Lyceum, weaver—Th. of Music (2d)

90—Briggs, John T., 18, Bacup M.I. (no occupation stated)—Arith. (3d)

820—Brighton, George, 25, City of London Coll., in Civil Service—French (3d)

957—Briscoe, Joseph T., 18, Liverpool Inst., architect's assistant—Arith. (2d); Eng. Lang. (3d)

982—Bristow, Charles, 24, King's Lynn Ath., clerk—Bkpg. (1st)

1240—Brittain, George S., 22, Sheffield Young Men's Chr. Assoc., clerk—Bkpg. (3d)

464—Broadbent, John, 19, Halifax W.M. Coll., warp-dresser—Arith. (2d)

522—Brocklehurst, Thomas, 22, Hull Ch. Inst., clerk—Bkpg (3d)

686—Brook, Frederick H., 20, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Commercial Hist. (1st); Pol. Econ. (2d); Bkpg. (1st)

1118—Brooks, John H., 20, Oldham Lyceum, clerk—Arith. (2d)

1012—Brooks, William J., 17, Manchester M.I., draughtsman—Arith. (3d)

1166—Broom, James W., 21, Salford W.M. Coll., warehouseman—Bkpg. (2d)

1038—Broomhall, T. H., 17, Manchester M.I., clerk—Bkpg. (2d)

268—Brow, William, 23, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)

182—Brown, Anne I., 22, Birmingham and Mid. Inst., teacher—Eng. Lang. (2d)

495—Brown, George E., 18, Hertford, teacher—Arith. (2d); Eng. Lang. (3d)

907—Brown, Henry J., 18, Kentish-town Lit. Inst., clerk—Th. of Music (2d)

983—Brown, James, 27, King's Lynn Ath., clerk—Bkpg. (2d)

1170—Brown, James B., 18, Salford W.M. Coll., teacher—Arith. (2d)

271—Brown, William, 24, Glasgow Anderson Univ. Pop. Evg. Classes, warehouseman—Th. of Music (1st)

272—Brownlie, John, 32, Glasgow Anderson's Univ. Pop. Evg. Classes, labourer—Th. of Music (2d)

583*-Bruce, George, 37, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)

1220—Brunt, Henry, 18, Sheffield Ch. of Eng. Inst., teacher—Arith. (2d)

273—Bryan, Mary E., 25, Glasgow Anderson's Univ. Pop. Evg. Classes (no occupation)—French (3d)

183—Bryning, Robert, 34, Birmingham and Mid. Inst., book-keeper—French (3d)

15—Buchan, Helen Mc. L., 16, Aberdeen M.I., teacher—French (1st)

274—Buchanan, James, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Bkpg. (2d)

773—Buckbarrow, John E., 22, Birkbeck Lit. and Sci. Inst., warehouseman—Arith. (1st); Eng. Lang. (2d); French (3d)

821—Budd, Charles J., 20, City of London Coll., warehouseman—Bkpg. (3d)

822—Budd, William C., 24, City of London Coll., warehouseman—French (3d); Bkpg. (3d)

428—Bullock, Archibald, 27, Glasgow M.I., in Customs—Eng. Lang. (3d)

1107—Bumstead, Charles, 17, Oldham Lyceum, student—Th. of Music (2d)

986—Bunn, Frederick W., 22, King's Lynn Ath., upholsterer—Bkpg. (3d)

987—Bunn, Samuel H., 21, King's Lynn Ath., engine-fitter—Bkpg. (3d)

759—Burchatt, Edward C., 21, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)

828—Burke, Charles, 26, City of London Coll., clerk—Commercial German (1st); French (2d)

904*-Burnett, David, 24, City of London Coll., clerk—Bkpg. (1st)

824—Butler, James, 20, City of London Coll., chronometer maker's assistant—Arith. (2d)

825—Butler, Joseph, 22, City of London Coll., clerk—Bkpg. (3d)

1050—Butterworth, James, 22, Manchester M.I., clerk—French (2d); Arith. (2d); Bkpg. (2d)

740—Cable, James McC., 26, Birkbeck Lit. and Sci. Inst., draughtsman—Th. of Music (2d)

730—Cable, Robert McC., 19, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (3d)

39—Calder, David, 21, Aberdeen M.I., clerk—Commercial French (1st)

426—Campbell, Archibald, 17, Glasgow M.I. (no occupation stated)—Eng. Lang. (3d)

398—Campbell, Paul, 18, Glasgow Ath., warehouseman—Spanish (3d)

276—Carmichael, Peter, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, teacher—Th. of Music (2d)

826—Carson, John, 22, City of London Coll., clerk—Arith. (2d); Bkpg. (1st)

683—Carter, Alfred, 23, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Commercial Hist. (1st); Pol. Econ. (1st), with the First Prize of £5; Bkpg. (1st)

465—Carter, Hanson, 18, Halifax W.M. Coll., tin-plate worker—Bkpg (3d)

1077—Carter, M. A., 18, Manchester M.I., printer's apprentice—Bkpg. (2d)

827—Casson, William A., 21, City of London Coll., clerk—Arith. (1st); Commercial Hist. (1st) with the Second Prize of £3.; Pol. Econ. (3d); Bkpg. (2d); and the Second Prize of £3 for Writing from Dictation]

[illegible]1—Chadderton, John R., 18, Salford W.M. Coll., bookkeeper—Arith. (3d)
[illegible]—Challenger, William, 17, Sheffield Ch. of Eng. Inst., teacher—Arith. (2d)
[illegible]—Chapple, Louis, 27, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (3d)
[illegible]—Charles, Benjamin, 22, Wakefield M.I., clerk—Bkpg. (1st)
[illegible]7—Charlesworth, James, 24, Leicester W.M. Coll., teacher—Arith. (3d)
[illegible]—Chesman, Mary, 22, Hull Young People's Chr. and Lit. Inst. (no occupation stated)—Arith. (3d)
[illegible]—Chipchase, Thomas H., 20, City of London Coll., wholesale stationer's assistant—Arith. (2d)
[illegible]—Churchill, Joseph, 26, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (3d)
[illegible]—Clark, David J., 22, Glasgow M.I., compositor—Eng. Lang. (3d)
[illegible]7—Clark, Walter G., 23, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (1st)
[illegible]1—Clarke, Alfred, 28, Leicester W.M. Coll., dyer—Eng. Lang. (3d)
[illegible]—Clarke, Thomas R., 23, City of London Coll., clerk—Arith. (1st); Eng. Lang. (1st)
[illegible]8—Clarkson, William, 18, Sheffield Ch. of Eng. Inst., teacher—Arith. (3d)
[illegible]2—Clear, Thomas H., 19, Birkbeck Lit. and Sci. Inst., woollen draper—French (3d)
[illegible]—Clements, Hugh, 29, Walworth Lit. and Sci. Inst., clerk—Arith. (1st); Pol. Econ. (2d) Bkpg. (3d)
[illegible]3—Close, John, 18, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
[illegible]—Clouston, John, 31, Aberdeen M.I., Customs officer—French (3d)
[illegible]—Cockerline, Walter H., 18, Hull Ch. Inst., clerk—Bkpg. (1st)
[illegible]7—Cochran, John, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, book keeper—Bkpg. (2d)
[illegible]—Codd, Samuel C., 17, Ipswich W.M. Coll., clerk—Bkpg. (3d)
[illegible]—Coey, James, 19, Belfast Working Men's Inst., clerk—Arith. (2d)
[illegible]—Coffey, Edward, 19, Cork Catholic Young Men's Soc., accountant—Arith. (3d); Eng. Lang. (3d)
[illegible]—Cole, William G., 16, Pembroke Dock M.I., shipwright's apprentice—Arith. (1st)
[illegible]5—Collison, Mary S., 27, Birkbeck Lit. and Sci. Inst., teacher—Eng. Lang. (2d)
[illegible]35—Connan, John, 21, Hull Young People's Chr. and Lit. Inst., tea merchant's assistant—Eng. Lang. (3d)
[illegible]85—Conolly, John, 20, Manchester M.I., decorator—Bkpg. (2d)
[illegible]4—Conolly, William, 17, Manchester M.I., decorator—Bkpg. (3d)
[illegible]71—Conolly, William W., 22, Birkbeck Lit. and Sci. Inst., clerk—Eng. Lang. (2d); French (2d)
[illegible]—Cookes, Amy, 25, Birkbeck Lit. and Sci. Inst., (no occupation stated)—French (2d)
[illegible]174—Cookson, J. D., 17, Salford W.M. Coll. (no occupation stated)—Arith. (3d)
[illegible]285—Coombs, Henry R., 16, St. Stephen's (Westminster) Evg. Classes, teacher—Arith. (3d); Eng. Lang. (3d)
[illegible]—Cooper, Alice M., 19, Birmingham and Mid. Inst. (no occupation)—Th. of Music (1st)
[illegible]—Cooper, Charles W., 17, St. Stephen's (Westminster) Evg. Classes, teacher—Arith. (2d)
[illegible]77—Cooper, John, 19, Glasgow Ath., clerk—French (3d)
[illegible]85—Cooper, John W., 20, York Inst., joiner—Arith. (2d); Bkpg. (3d)
[illegible]—Cooper, Tom W., 17, Rugby, teacher—Arith. (3d); Eng. Lang. (3d)
[illegible]—Corner, Robert, 24, Hull Young People's Chr. and Lit. Inst., clerk—Commercial German (1st)

136—Cornish, Elizabeth M., 20, Birmingham and Mid. Inst., governess—Eng. Lang. (2d)
1333—Corr, James, 19, Dundee Young Men's Chr. Assoc., calenderer—Arith. (3d)
761—Coulter, George G., 20, Birkbeck Lit. and Sci. Inst., in Civil Service—Eng. Lang. (2d)
1386—Court, George, 16, St. Stephen's (Westminster) Evg. Classes, teacher—Eng. Lang. (3d); Arith. (3d)
832—Cowan, John, 34, City of London Coll., clerk—Bkpg. (3d)
1239—Coward, Henry, 25, Sheffield Ch. of England Inst., schoolmaster—Th. of Music (1st)
833—Cownley, Francis L., 22, City of London Coll. (no occupation stated)—German (2d)
834—Cox, John W., 21, City of London Coll., clerk—Bkpg. (3d)
753—Crabtree, Jean, 29, Birkbeck Lit. and Sci. Inst., governess—German (1st)
960—Craine, George, 20, Liverpool Inst., clerk—Pol. Econ (2d)
466—Craven, Enoch, 19, Halifax W.M. Coll., watchmaker—Bkpg. (2d)
1001—Creer, John J., 22, Manchester M.I., warehouseman—Bkpg. (1st)
606*-Cressey, Thomas, 17, Leeds Young Men's Chr. Assoc., pupil teacher—Eng. Lang. (3d)
95—Cropper, Abraham, 17, Bacup M.I., weaver—Arith. (3d)
617—Crosby, Ernest E., 18, Leicester W.M. Coll., draper—French (3d)
510—Crosland, Joe, 30, Huddersfield M.I., salesman—French (3d)
468—Crossley, James F., 17, Halifax W.M. Coll., bookkeeper—Bkpg. (3d)
1173—Crossley, Thomas, 18, Salford W.M. Coll., clerk—Arith. (2d); Bkpg. (2d)
1016—Crowe, George, 19, Manchester M.I., clerk—Bkpg. (2d)
835—Crowson, Samuel, 20, City of London Coll., clerk Arith. (2d); Bkpg. (2d)
469—Crowther, Edgar, 19, Halifax W.M. Coll., clerk—Arith. (3d)
29—Cruickshank, William, 21, Aberdeen M.I., engineer—Arith. (2d)
380—Crum, John, 23, Glasgow Ath., clerk—German (3d)
138—Crump, Sarah E., 24, Birmingham and Mid. Inst., governess—Italian (1st)
5—Cumming, James, 19, Aberdeen M.I., clerk—Eng. Lang. (2d)
1120—Cunningham, Thomas, 27, Paisley Artizans' Inst., tailor—Th. of Music (3d)
279—Cunningham, William R. S., 19, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—French (3d)
836—Curtis, Harry, 18, City of London Coll., clerk—Spanish (3d)
689—Curtis, John H., 26, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)
837—Cuthbertson, Robert A., 17, City of London Coll., clerk—French (2d)

44—Dale, Eliza S., 19, Aberdeen M.I., student—French (2d)
13—Dale, Robert, 17, Aberdeen M.I., student—French (2d)
516—Dales, John, 22, Hull Ch. Inst., clerk—Bkpg. (1st)
1332—Dallas, James, 19, Dundee Young Men's Chr. Assoc., mechanic—Arith (1st)
591—Damant, Thomas S., 19, Ipswich W.M. Coll., clerk—Bkpg. (1st)
1028—Daniels, Frederick W., 16, Manchester M.I., clerk—Bkpg. (2d)
515—Darneley, Edwy M., 19, Hull Ch. Inst., joiner—Bkpg. (3d)

1147—Davaine, Evodie, 17, Rugby (no occupation)—French (2d)
1056—Davies, Thomas W., 21, Manchester M.I., clerk—French (2d)
139—Davies, Walter W., 19, Birmingham and Mid. Inst., clerk—Spanish (2d); Commercial German (1st); Italian (3d); French (2d)
140—Davies, William, 22, Birmingham and Mid. Inst., ironmonger—Arith. (2d)
684—Dawe, John, 25, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
1000—Dawson, Charles, 23, Manchester M.I., clerk—French (3d)
375—Dawson, James, 19, Glasgow Ath., clerk—French (1st), with the Second Prize of £3.
281—Dawson, Robert, 24, Glasgow Anderson's Univ. Pop. Evg. Classes, letterpress printer—Th. of Music (2d)
1337—Dawson, William, 22, Dundee Young Men's Chr. Assoc., clerk—Bkpg. (3d)
588—Day, Walter, 18, Ipswich W.M. Coll., clerk—Bkpg. (3d)
838—Deacon, Lewis A., 18, City of London Coll., teacher—Arith. (3d); Eng. Lang. (2d)
532—Dealtry, Albert, 20, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
717—Denton, John, 30, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
792—Descours, Paul J., 18, Birkbeck Lit. and Sci. Inst., in Civil Service—Commercial Hist. (1st); Pol. Econ. (2d); Bkpg. (3d)
733—Dickes, Emma, 27, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Eng. Lang. (2d); French (2d)
769—Dickes, Louise, 30, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Th. of Music (1st), with the Prize of £2 for Females.
678—Dickes, Mary, 24, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Eng. Lang. (3d); French (3d)
1175—Dobson, Ralph W., 16, Salford W.M. Coll., clerk—Arith. (3d)
1025—Dobson, William, 18, Manchester M.I., clerk—Bkpg. (1st)
839—Docksey, Frederick, 21, City of London Coll., clerk—Spanish (1st)
19—Donald, Alexander, 17, Aberdeen M.I., stone-cutter—Eng. Lang. (3d)
514—Dossor, William C., 28, Hull Ch. Inst., clerk—Bkpg. (1st)
688—Dovey, Henry W., 22, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (2d)
527—Downs, James, 18, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
1142—Dovle, Annie, 22, Penzance, teacher—Eng. Lang. (2d)
655—Draycott, William F., 16, Leicester W.M. Coll., teacher—Arith. (2d); Eng. Lang. (2d)
988—Duffield, Lydia, 34, King's Lynn Ath. (no occupation stated)—Bkpg. (3d)
198—Duncan, Andrew B., 27, Broughty Ferry Young Men's Chr. Assoc., manufacturer—Th. of Music (3d)
12—Duncan, James, 17, Aberdeen M.I., stone cutter—Arith. (3d)
763—Dyer, Herbert, 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
942—Dyer, William A., 17, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (1st)

989—Eccles, James L., 22, King's Lynn Ath., clerk—Bkpg. (3d)
1281—Edgoose, Lucilla F., 19, York Inst., teacher—Th. of Music (1st)
1130—Edmonds, Andrew T., 20, Penzance, teacher—Eng. Lang. (2d)
1268—Edmonds, James H., 16, New Swindon, M.I., teacher—Arith. (3d)
1145—Edmunds, Eliza, 17, Rugby, teacher—Arith. (3d)
710—Edwards, John T., 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
654—Ellis, Charles J., 18, Leicester W.M. Coll., clerk—Arith. (3d)
841—Elwood, Elisha, 16, City of London Coll., clerk—Arith. (2d)
1288—Emmerson, James, 17, York Inst., clerk—Bkpg. (3d)
1213—Entwistle, Benjamin, 20, Stockport Sund. Sch. Soc., warehouseman—Arith. (3d)
1066—Entwisle, Peter, 18, Manchester M.I., warehouseman—French (3d)
283—Erskine, John, 24, Glasgow Anderson's Univ. Pop. Evg. Classes, stationer—Th. of Music (1st)
843—Esden, George A., 16, City of London Coll., clerk—Bkpg. (3d)
1148—Evans, Annie A. M., 18, Rugby, teacher—Arith. (3d)
85—Evans, Edward C., 18, Ashford M.I., teacher—Eng. Lang. (1st)
700—Evans, William, 21, Birkbeck Lit. and Sci. Inst., in Civil Service—Arith. (2d); Bkpg. (3d)
82—Evans, William H., 16, Ashford M.I., clerk—Arith. (2d)
652—Exton, Henry, 20, Leicester W.M. Coll., clicker—Eng. Lang. (3d)

141—Fairley, Thomas, 25, Birmingham and Mid. Inst., commission agent—French (2d)
76—Fenwick, George F., 22, Aldershot and Farnham District Board, soldier—Arith (3d)
284—Ferguson, Duncan, 25, Glasgow Anderson's Univ. Pop. Evg. Classes, teacher—Arith. (2d); Eng. Lang. (1st)
397—Ferguson, Hugh, 26, Glasgow Ath., clerk—French (3d)
286—Finlayson, Alexander, 31, Glasgow Anderson's Univ. Pop. Evg. Classes, steel-polisher—Th. of Music (2d)
844—Finter, Frederick, 16, City of London Coll., Civil Service—Arith. (1st), with the First Prize of £5; Bkpg. (1st), and the Third Prize of £2 for Handwriting.
782—Fish, William D., 22, Birkbeck Lit. and Sci. Inst., Civil Service—Eng. Lang. (1st)
511—Fisher, William H., 18, Hull Ch. Inst., clerk—Bkpg. (1st)
1390—Fitzgerald, Eleanor A., 17, St. Stephen's (Westminster) Evg. Classes, teacher—Eng. Lang. (3d)
1389—Fitzgerald, Fanny E., 20, St. Stephen's (Westminster) Evg. Classes, gold embroideress—French (3d)
142—Flavell, Amelia J., 17, Birmingham and Mid. Inst., teacher—Arith. (2d); Eng. Lang (1st); French (3d)
749—Flegg, Robert, 24, Birkbeck Lit. and Sci. Inst. clerk—Arith. (2d); Eng. Lang. (1st)
400—Fleming, William, 20, Glasgow Ath., clerk—French (3d)
287—Fleming, William M., 17, Glasgow Anderson's Univ. Pop. Evg. Classes, law apprentice—Arith. (3d); Bkpg. (3d)
1036—Fletcher, Henry, 16, Manchester M.I., clerk—Bkpg. (2d)
990—Flint, John, 32, King's Lynn Ath., Inland Revenue officer—Bkpg. (2d)
1119—Foote, Edward C., 17, Oldham Lyceum, surveyor—Arith. (1st)
61—Forbes, Alexander, 23, Aberdeen M.I., clerk—Eng. Lang. (2d)
34—Forbes, James, 30, Aberdeen M.I., compositor—Th. of Music (1st)
713—Ford, Joseph J., 20, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
471—Fossard, Alfred, 39, Halifax W.M. Coll., warehouseman—Bkpg. (3d)

935—Fossey, Mary, 27, Royal Polytechnic Coll., governess—Th. of Music (1st)
525—Foster, Alfred, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
1241—Foster, Frederick E., 18, Sheffield Young Men's Chr. Assoc., clerk—Arith. (3d); Bkpg. (3d)
1242—Foster, J. J., 20, Sheffield Young Men's Chr. Assoc., clerk—Bkpg. (2d)
606—Foster, William, 26, Leeds Young Men's Chr. Assoc., book-keeper—Bkpg. (1st)
38—Fotheringham, Thomas, 20, Aberdeen M.I., clerk—Bkpg. (1st)
1264—Fowles, Walter, 21, Sunderland Young Men's Chr. Assoc., engineer—Arith. (3d)
1110—Fox, George H., 23, Oldham Lyceum, mechanic—Th. of Music (3d)
1265—Fox, John, 30, New Swindon M.I., shop clerk—Bkpg. (3d)
288—Fraser, Peter P., 25, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
1261—Fraser, William T., 17, Sunderland Young Men's Chr. Association, teacher—Arith. (3d)
910—Freeman, John G., 28, Royal Polytechnic Coll., warehouseman—French (2d), and the First Prize of £3 for Writing and Manuscript Printing
908—Freeman, George D., 40, Royal Polytechnic Coll., teacher—Th. of Music (3d)
1049—Frethey, Henry T., 20, Manchester M.I. (no occupation stated)—Bkpg. (2d)
1310—Fry, Alfred, 34, Dublin, soldier—Arith. (3d)
756—Fry, James, 25, Birkbeck Lit. and Sci. Inst., writer—Bkpg. (2d)
86—Frye, John J., 24, Ashford M.I., reporter—Eng. Lang. (1st), with the Second Prize of £3
289—Fyfe, Alexander, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, shoe-cutter—Th. of Music (3d)

638—Gamble, John G., 20, Leicester W.M. Coll., clerk—Th. of Music (3d)
742—Gandy, John B. H., 27 Birkbeck Lit. and Sci. Inst., engineer—Th. of Music (2d)
673—Gardiner, Frederick, 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)
1373—Garnsworthy, Joseph, 21, Quebec Inst., clerk—Commercial Hist. (3d)
[illegible]87—Garrod, Philander N., 19, Ipswich W.M. Coll., clerk—Bkpg. (2d)
1099—Garstide, William A., 17, Mossley M.I., mill hand—Bkpg. (3d)
472—Gaunt, Joseph, 16, Halifax W.M. Coll., student—Eng. Lang. (3d)
739—Geddes, George, 25, Birkbeck Lit. and Sci. Inst., watchmaker—Th. of Music (1st)
40—Geddes, James L., 24, Aberdeen M.I., clerk—Eng. Lang. (3d)
259—Geddes-McIntosh, John, 20, Edinburgh Watt Inst., clerk—French (3d)
698—George, William E., 20, Birkbeck Lit. and Sci. Inst., clerk—Arith (1st)
1041—Gibbon, Robert, 20, Manchester M.I., salesman—Bkpg. (1st)
938—Gibbs, Alice, 22, Royal Polytechnic Coll. (no occupation)—Th. of Music (1st)
2—Gibson, William M., 20, Aberdeen M.I., engraver—Th. of Music (3d)
144—Gilbert, Emma J., 35, Birmingham and Mid. Inst., music teacher—Th. of Music (2d)
145—Gittins, Mary E., 20, Birmingham and Mid. Inst. (no occupation)—Th. of Music (1st)
146—Glanvill, Samuel, 24, Birmingham and Mid. Inst., clerk—French (3d)
778—Glencross, Ebenezer, 25, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Com. Hist. (1st)
52—Glennie, William, 17, Aberdeen M.I., clerk—Bkpg. (3d)
147—Glydon, Amy, 26, Birmingham and Mid. Inst., teacher—French (3d)
692—Godard, John G., 23, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); Bkpg. (3d)
1267—Goldie, Charles G., 16, New Swindon M.I., turner—Arith. (3d)
1115—Gomersall, William, 20, Oldham Lyceum, blacksmith—Arith. (3d)
1178—Gomersall, William, 17, Salford W.M. Coll., warehouse assistant—Bkpg. (2d)
148—Goode, Charles B., 17, Birmingham and Mid. Inst., clerk—French (3d)
149—Goodrick, John, 17, Birmingham and Mid. Inst. clerk—French (3d)
49—Gordon, Lewis, 38, Aberdeen M.I., policeman—French (3d)
294—Gowans, William, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, cloth salesmen—Th. of Music (2d)
221—Graham, George, 18, Carlisle M.I. (no occupation stated)—Arith. (2d)
962—Grant, William, 18, Liverpool Inst., joiner—Arith. (3d)
200—Gray, Baxter, 30, Broughty Ferry Young Men's Ch. Assoc., brewer—Th. of Music (2d)
846—Gray, Harry, 17, City of London Coll., clerk—French (3d)
292—Gray, William, 35, Glasgow Anderson's Univ. Pop. Evg. Classes, power loom tenter—Th. of Music (3d)
492—Green, Charles H., 19, Hanley Potteries Inst., correspondent—French (3d)
660*—Green, Henry, 20, Leicester W.M. Coll., engineer—Eng. Lang. (3d)
992—Green, Sophia D., 19, King's Lynn Ath., hosier's assistant—Bkpg. (3d)
991—Green, Thomas C., 20, King's Lynn Ath., clothier's assistant—Bkpg. (3d)
1376—Greenish, Emily C., 17, Quebec Inst., governess—Eng. Lang. (3d)
1177—Gregson, William, 18, Salford W.M. Coll., clerk—Arith. (3d)
1258—Greig, David J., 18, Sunderland Young Men's Chr. Assoc., teacher—Arith. (3d); Eng. Lang. (2d)
150—Grew, Frederick W., 19, Birmingham and Mid. Inst., lithographer—German (2d); French (3d); Bkpg. (2d)
293—Grigor, Alexander, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, stationer—Th. of Music (3d)
847—Groom, Charles, 19, City of London Coll., clerk—Bkpg. (3d)
681—Grove, James E., 30, Birkbeck Lit. and Sci. Inst., goldsmith—Th. of Music (1st)
151—Grundy, Harriette, 28, Birmingham and Mid. Inst., teacher—French (3d)
1076—Guilmette, Robertson, 20, Manchester M.I., clerk—Bkpg. (2d)
766—Gurrin, Thomas H., 26, Birkbeck Lit. and Sci. Inst., in Civil Service—Spanish (1st)

507—Haigh, Arthur H., 17, Huddersfield M.I., clerk—Arith. (3d); French (3d)
16—Hall, James, 16, Aberdeen M.I., writer—Eng. Lang. (3d)
697—Hallam, John, 24, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (3d)
1039—Halliwell, Francis T., 22, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)
596—Halls, Alexander, 16, Ipswich W.M. Coll., clerk—Bkpg. (3d)
214—Halstead, Alfred, 22, Burnley M.I., schoolmaster—Pol. Econ. (2d)
500—Halstead, Charles W., 19, Huddersfield M.I. (no occupation)—Eng. Lang. (3d)
517—Hammond, Charles F., 21, Hull Ch. Inst., clerk—Bkpg. (1st)

1180—Hancock, Lillias, 18, Salford W.M. Coll., teacher —Arith. (3d)
1127—Hancock, William G., 17, Pembroke Dock M.I., teacher—Arith. (1st); Eng. Lang. (1st)
1259—Handy, George, 16, Sunderland Young Men's Chr. Assoc., clerk—Arith. (3d); Eng. Lang. (3d)
414—Hanlon, John, 24, Glasgow Ath., newspaper reporter—French (1st)
396—Hardie, Francis W., 22, Glasgow Ath., clerk—Spanish (1st); Eng. Lang. (2d)
416—Hardie, H. D., 22, Glasgow Ath., clerk—Commercial German (1st); Bkpg. (3d)
712—Harding, Samuel W., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); Bkpg. (3d)
1293—Hardy, Anthony, 24, York Inst., warehouseman Bkpg. (3d)
848—Hargreaves, James G., 20, City of London Coll., in Civil Service—Bkpg. (1st)
1013—Hargreaves, John W., 16, Manchester M.I., office boy—Bkpg. (1st)
202—Hargreaves, Samuel, 20, Burnley M.I., weaver—Commercial Hist. (3d)
473—Harper, Thomas, 19, Halifax W.M. Coll., clerk—Eng. Lang. (2d)
1226—Harrington, Jackson, 17, Sheffield Ch. of Eng. Inst., teacher—Arith. (1st)
1286—Harrison, Joseph, 18, York Inst., clerk—Arith. (3d)
121—Harrison, Thomas, 17, Belfast W.M. Inst., teacher —Arith. (2d)
849—Harrold, John, 19, City of London Coll., clerk—French (3d)
1075—Hartley, Henry, 27, Manchester M.I., cashier—Arith. (3d); French (3d); Bkpg. (2d)
296—Hartoch, David, 19, Glasgow Anderson's Univ. Pop. Evg. Classes, commercial traveller—Th. of Music (1st)
850—Harvey, Francis, 35, City of London Coll., clerk —Bkpg. (1st)
752—Harvey, W. Alfred, 21, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Pol. Econ. (3d)
668—Haskins, Samuel, 26, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
491—Hassall, William W., 25, Hanley Potteries Inst., clerk—French (3d)
923—Hatfield, Ada H., 18, Royal Polytechnic Coll. (no occupation)—German (1st)
1321—Hatfield, Charles A., 23, Dudley M.I., clerk—Bkpg. (1st)
922—Hatfield, Clara, 21, Royal Polytechnic Coll. (no occupation)—German (1st), with the Prize of £2 for Females.
937—Hatfield, Rosa, 19, Royal Polytechnic Coll., (no occupation)—Arith. (3d)
104—Haworth, James, 16, Bacup M.I., clerk—Arith. (3d); Eng. Lang. (3d)
924—Haywood, Julia A. M., 17, Royal Polytechnic Coll., teacher—Eng. Lang. (3d)
1034—Heathcote, Arthur, 21, Manchester M.I., warehouseman—Arith. (3d); Bkpg. (3d)
741—Hellier, Lewis, 30, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (2d)
474—Helm, Samuel C., 17, Halifax W.M. Coll., clerk —Bkpg. (1st)
758—Henderson, Henry, 18, Birkbeck Lit. and Sci. Inst., clerk—German (1st), with the First Prize of £5.
295—Henderson, John, 33, Glasgow Anderson's Univ. Pop. Evg. Classes, brass-finisher—Th. of Music (2d)
382—Henderson, John, 23, Glasgow Ath., clerk—German (3d)
1391—Hendré, Francis H., 24, St. Stephen's (Westminster), Evg. Classes, clerk—Commercial German (1st); Commercial French (1st)
297—Hendry, John, 40, Glasgow Anderson's Univ. Pop. Evg. Classes (no occupation stated)—Th. of Music (3d)
774—Hennequin, Léonié A. H., 27, Birkbeck Lit. and Sci. Inst., teacher—Eng. Lang. (3d)
298—Henry, John, 40, Glasgow Anderson's Univ. Pop. Evg. Classes, beamer—Th. of Music (2d)
676—Herbert, Alice M., 26, Birkbeck Lit. and Sci. Inst., music teacher—Th. of Music (2d)
1035—Hetherington, George I., 20, Manchester M.I., clerk—Bkpg. (3d)
793—Hewitt, Joseph, 28, Birkbeck Lit. and Sci. Inst., goldsmith—Th. of Music (1st)
578—Hewson, Ellerby, 35, Hull Young People's Chr. Lit. Inst., joiner—Bkpg. (3d)
454—Heys, Abel, 18, Freetown W.M. Inst., Glossop, at print works—Arith. (3d)
779—Hickman, George, 25, Birkbeck Lit. and Sci. Inst., Inland Revenue officer—Pol. Econ. (1st), with the Second Prize of £3
1229—Hides, Albert V., 18, Sheffield Ch. of Eng. Inst., clerk—Bkpg. (3d)
851—Hill, Arthur, 21, City of London Coll., in Civil Service—Arith (2d); Bkpg (3d)
1362—Hill, Howard, 20, Dundee Young Men's Chr. Assoc., clerk—Spanish (2d)
1270—Hill, William O., 17, New Swindon M.I., teacher —Arith. (2d); Th. of Music (3d)
509—Hinchliffe, John W., 19, Huddersfield M.I. warehouseman—Bkpg. (3d)
695—Hind, Charles, 43, Birkbeck Lit. and Sci. Inst., warehouseman—Pol. Econ. (2d)
106—Hindle, Abraham, 16, Bacup M.I., clerk—Arith. (2d)
1252—Hinds, James, 18, Stourbridge Assoc. Institute, clerk—Arith. (2d)
1256—Hinds, William G., 16, Stourbridge Assoc. Institutes, clerk—Arith. (3d)
539—Hobson, George B., 22, Hull Young People's Chr. and Lit. Inst. (no occupation stated)—Bkpg. (3d)
664—Hobson, James, 26, Lockwood M.I., weaver—Eng. Lang. (3d)
662—Hobson, Thomas A., 16, Lockwood M.I., pattern-weaver—Eng. Lang. (2d)
726—Hodges, Maria L., 18, Birkbeck Lit. and Sci. Inst., governess—French (1st)
1262—Hogarth, Joseph, 20, Sunderland Young Men's Chr. Assoc., teacher—Arith. (2d); Eng. Lang. (2d)
1221—Holden, Frederick W., 18, Sheffield Ch. of Eng. Inst., clerk—Arith. (3d)
206—Holden, George H., 18, Burnley M.I., warehouseman—Arith. (2d)
1114—Holden, James, 20, Oldham Lyceum, bookkeeper —Arith. (2d)
1367—Holms, Edwin, 26, Wakefield M.I., clerk—Arith. (3d); Bkpg. (3d)
1232—Holmshaw, Henry, 18, Sheffield Ch. of Eng. Inst., teacher—Arith. (3d)
706—Hooke, George A., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Bkpg. (3d)
1183—Holt, James, 21, Salford W.M. Coll., carder—Arith. (3d)
1089—Hooper, Henry T., 19, Manchester M.I., clerk—Bkpg. (1st)
1109—Hornby, Alexander, 20, Oldham Lyceum, teacher —Th. of Music (2d)
100—Horsfall, John, 18, Bacup M.I., clerk—Arith. (2d)
101—Horsfall, Thomas D., 16, Bacup M.I., warehouseman—Arith. (3d); Eng. Lang. (3d)
476—Horsfield, John, 18, Halifax W.M. Coll., carpet-weaver—Bkpg. (3d)
964—Houghton, John W., 18, Liverpool Inst., clerk—Arith. (1st); Eng. Lang. (2d)
157—Houlston, William E., 18, Birmingham and Mid. Inst., jeweller—Th. of Music (1st)
1099*—Howard, John, 16, Mossley M.I., cotton-piecer—Bkpg. (3d)

44—Howe, Richard, 35, Sheffield Young Men's Chr. Assoc., clerk—Eng. Lang. (2d)
58—Howell, William, 37, Birmingham and Mid. Inst., clerk—Spanish (3d)
91—Hoyle, Wilson, 19, Mossley M.I., warehouseman—Bkpg. (3d)
10—Hudson, Matthew, 28, Burnley M.I. (no occupation stated)—Arith. (3d)
65—Hudson, William C., 20, Liverpool Inst., clerk—Bkpg. (2d)
72—Hudson, William H., 18, Birkbeck Lit. and Sci. Inst., clerk—German (3d)
25—Hughes, George C., 20, Royal Polytechnic Coll., clerk—Eng. Lang. (3d)
23—Hulme, William R., 17, Sheffield Ch. of Eng. Inst., teacher—Arith. (2d); Eng. Lang. (3d)
91—Hunter, Frederick W., 20, Newcastle-on-Tyne Ch. of Eng. Inst., chemist's apprentice—Arith. (3d); Eng. Lang. (2d)
95—Hunter, James, 16, Glasgow Ath., clerk—French (3d)
37—Hunter, John, 33, Aberdeen M.I., clerk—Eng. Lang. (2d)
21—Hutchings, George D., 18, Royal Polytechnic Coll., clerk—Arith. (1st); Eng. Lang. (3d)
69*-Hutchins, Alfred, 22, Leicester W.M. Coll., compositor—Eng. Lang. (3d)
79—Hutchinson, William, 21, Glasgow Ath. (no occupation stated)—French (3d)

56—Iliffe, John W., 17, Leicester W.M. Coll., teacher—Eng. Lang. (1st); French (3d)
81—Ingham, John, 24, Manchester M.I., clerk—Arith. (2d); Bkpg. (1st), with the First Prize of £5, and the Second Prize of £2 for Writing and Manuscript Printing
93—Ingham, Thomas, 22, Bacup M.I., draper's assistant—Arith. (3d)
40—Inkster, Ann, 18, Royal Polytechnic Coll., teacher Arith. (3d); Eng. Lang. (3d)
20—Ireland, Arthur, 19, Leicester W.M. Coll., teacher—Eng. Lang. (2d)
92—Irons, George W., 26, St Stephen's (Westminster) Evg. Classes, writer—Arith. (1st); Th. of Music (1st); Eng. Lang. (1st)
1085—Irving, John, 18, Manchester M.I., in a warehouse—Arith. (3d); Bkpg. (3d)

1184—Jackson, John, 22, Salford W.M. Coll., clerk—Bkpg. (2d)
1185—Jackson, Thomas, 19, Salford W.M. Coll., clerk—Bkpg. (1st)
1083—Jackson, William, 18, Manchester M.I., clerk—Arith. (1st); Bkpg. (1st), with the Second Prize of £3
1315—James, Job, 24, Dudley M.I., clerk—Bkpg. (3d)
1254—James, William L., 20, Stourbridge Assoc. Institutes, clerk—Arith. (2d)
707—Jaquet, Robert G., 18, Birkbeck Lit. and Sci. Inst., in Civil Service—German (1st); Eng. Lang. (1st); Pol. Econ. (2d)
709—Johnson, Elizabeth M., 24, Birkbeck Lit. and Sci. Inst., governess—Eng. Lang. (2d); French (3d)
680—Johnson, George F., 18, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
1157—Johnston, William N., 17, Salford W.M. Coll., clerk—Arith. (3d); Bkpg. (2d)
852—Jones, Owen, 17, City of London Coll., in Civil Service—Arith. (2d); Bkpg. (1st)
1188—Jones, Samuel, 16, Salford W.M. Coll., clerk—Bkpg. (1st)
966—Jones, William, 28, Liverpool Inst., joiner—Pol. Econ. (3d)
631—Jordan, Alfred, 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
1079—Jordan, Henry G., 17, Manchester M.I., engineer—Arith. (2d)

912—Judd, Charles W., 19, Royal Polytechnic Coll., shop assistant—Bkpg. (3d)

853—Karn, James B., 21, City of London Coll., clerk—French (3d)
1022—Kayton, William, 19, Manchester M.I., clerk—Bkpg. (3d)
586—Kedgley, Robert W., 19, Ipswich W.M. Coll., baker—Bkpg. (3d)
967—Keet, Charles H., 17, Liverpool Inst., clerk—Arith. (2d)
854—Kendrick, George E., 24, City of London Coll., clerk—Arith. (2d); Bkpg. (1st)
249—Kennedy, Patrick, 19, Cork Catholic Young Men's Soc., accountant—Arith. (2d); Bkpg. (3d)
855—Kentish, Frederick J., 18, City of London Coll., clerk—Bkpg. (3d)
225—Ker, Hugh, 17, Carlisle M.I. (no occupation stated)—Arith. (2d)
549—Kerman, William P., 16, Hull Young People's Chr. and Lit. Inst., clerk—German (3d)
1027—Kershaw, Thomas, 17, Manchester M.I., clerk—Bkpg. (3d)
1331—Kidd, Thomas, 20, Dundee Young Men's Chr. Assoc., mechanic—Arith. (2d)
1260—Kitts, Arthur C., 17, Sunderland Young Men's Chr. Assoc., clerk—French (3d); Eng. Lang. (3d)
994—King, Arthur R., 20, King's Lynn Ath., clerk—Bkpg. (3d)
530—King, Walter, 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
679—King, William, 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d).
435—Kinnear, Angus M., 22, Glasgow M.I., clerk—Eng. Lang. (3d)
611—Kinton, George, 19, Leicester W.M. Coll., elastic braid maker—Arith. (3d)
738—Kirk, George, 21, Birkbeck Lit. and Sci. Inst., clerk—Eng. Lang. (3d)
599—Kirkby, Alfred H., 16, Leeds Young Men's Chr. Assoc., clerk—Arith. (3d)
508—Knaggs, Robert L., 16, Huddersfield M.I., surgeon—Arith. (2d); Eng. Lang. (2d); French (3d)
1257—Koller, Emil, 23, Sunderland Young Men's Chr. Assoc., teacher—Arith. (1st); Eng. Lang. (2d)
449—Kyles, William, 16, Glasgow Young Men's Soc., clerk—Arith. (3d)

1131—Ladner, William C., 16, Penzance, teacher—Arith. (3d)
675—Lagerwall, Robert, 24, Birkbeck Lit. and Sci. Inst., clerk—Spanish (1st); German (1st)
494—Lake, James C., 16, Hertford, teacher—Eng. Lang. (3d)
939—Lamb, Edith M., 26, Royal Polytechnic Coll., teacher—French (3d)
916—Lamb, Emily A., 34, Royal Polytechnic Coll., governess—French (2d)
99—Lancaster, James H., 17, Bacup M.I., mule spinner—Arith. (3d)
215—Landless, Richard, 20, Burnley M.I., book-keeper—Arith. (3d)
371—Lang, John, 18, Glasgow Ath., clerk—Spanish (2d)
789—Laslett, William H., 17, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
234—Lattimer, Mary, 16, Carlisle M.I. (no occupation)—Arith. (1st), with the Prize of £2 for Females; Eng. Lang. (2d); French (2d)
1354—Laughton, John, 20, Dundee Young Men's Chr. Assoc., clerk—German (3d)
392—Laurence, John, 29, Glasgow Ath., teacher—German (1st)
477—Lawrence, Frank, 20, Halifax W.M. Coll., assistant teacher—Arith. (2d); Bkpg. (1st)
1097—Lawton, Herbert, 18, Mossley M.I., clerk—German (3d)

953—Lee, Susan A. M., 23, Walworth Lit. and Sci. Inst., governess—Eng. Lang. (3d)

1106—Lees, George, 17, Oldham Lyceum, clerk—Th. of Music (2d)

968—Leggett, Herbert, 16, Liverpool Inst., clerk—Bkpg. (3d)

856—Le Maistre, Alfred J., 23, City of London Coll., clerk—French (3d)

995—Lemmon, Charles H., 20, King's Lynn Ath., clerk—Bkpg. (1st)

504—Lendrum, Robert H., 16, Huddersfield M.I., engineer—French (3d)

1190—Lenthall, Alfred, 17, Salford W.M. Coll., warehouseman—Arith. (2d)

969—L'Estrange, Edward F., 16, Liverpool Inst. (no occupation stated)—Arith. (2d)

1191—Lever, Thomas H., 16, Salford W.M. Coll., warehouseman—Arith. (3d)

609—Levitt, William, 20, Leeds Young Men's Chr. Assoc., warehouseman—Bkpg. (3d)

932—Lewis, Clara, 20, Royal Polytechnic Coll. (no occupation)—German (2nd)

796—Leyden, James, 32, Birkbeck Lit. and Sci. Inst., assurance agent—German (3d)

1303—Lillywhite, Frederick E., 16, York Inst., clerk—Bkpg. (3d)

519—Limback, Louisa, 25, Hull Ch. Inst., teacher—German (1st)

300—Lindsay, Alexander, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, joiner—Th. of Music (3d)

1336—Lindsay, Alexander, 16, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d)

236—Linn, Peter J., 19, Carlisle M.I., cotton spinner—Arith. (3d)

1026—Linton, William H., 16, Manchester M.I., clerk—Bkpg. (3d)

1068—Lister, Robert R., 21, Manchester M.I., draughtsman—Arith. (3d)

233—Little, Thomas, 16, Carlisle M.I. (no occupation) Arith. (2d)

1021—Littlewood, Frederick, 18, Manchester M.I., clerk—Bkpg. (1st)

575—Livingston, Walter, 16, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)

301—Livingstone, Robert, 26, Glasgow Anderson's Univ. Pop. Evg. Classes, warehouseman—Th. of Music (1st)

160—Lloyd, Thomas H., 23, Birmingham and Mid. Inst., clerk—Spanish (3d)

228—Lloyd, Thomas R., 19, Carlisle M.I. (no occupation)—Arith. (2d)

857—Lloyd, William H. S., 21, City of London Coll., clerk—French (3d); Bkpg. (3d)

785—Loban, Robert A. T., 20, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (3d); Bkpg. (2d)

441—Lockhead, John, 17, Glasgow M. I., clerk—Bkpg. (1st)

524—Locking, Thomas E., 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)

1280—Lockyer, Joseph, 18, New Swindon M.I., clerk—Arith. (2d); Bkpg. (2d)

858—Loly, Gustave, 17, City of London Coll., clerk—German and Commercial German (1st), with the Second Prize of £3; Arith. (2d); Commercial French (1st); Bkpg. (1st)

1246—Longbottom, Reuben, 23, Sheffield Young Men's Chr. Assoc. (no occupation stated)—Bkpg. (2d)

585—Lord, Robert, 17, Ipswich W.M. Coll., clerk—Bkpg. (2d)

302—Lorimer, Henry, 23, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)

787—Lovesy, John J., 21, Birkbeck Lit. and Sci. Inst., teacher—Arith. (1st)

1—Lovie, John, 18, Aberdeen M.I., shopkeeper—Eng. Lang. (3d)

1098—Lowe, Edward, 17, Mossley M.I., piecer—Bkpg. (3d)

1117—Lowry, Robert S. McA., 17, Oldham Lyceum, book-keeper—Arith. (1st)

161—Lucas, Christopher, 17, Birmingham and Mid. Inst., teacher—Arith. (3d)

162—Luckett, Harry F., 18, Birmingham and Mid. Inst., clerk—German (1st)

303—McArthur, James, 26, Glasgow Anderson's Univ. Pop. Evg. Classes, blacksmith—Th. of Music (1st)

970—McAusland, Humphrey, 16, Liverpool Inst., clerk—Bkpg. (2d)

417*-McCall, James T., 17, Glasgow Ath., clerk—French (3d)

305—McCance, John, 20, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Bkpg. (1st)

306—McCullock, John, 30, Glasgow Anderson's Univ. Pop. Evg. Classes, printer—Th. of Music (2d)

401—Macdonald, James D., 26, Glasgow Ath., book-keeper—Bkpg. (2d)

447—McFarlane, John, 17, Glasgow Young Men's Soc., engineer—Arith. (3d)

443—McGhie, Daniel, 32, Glasgow M.I., clerk—Th. of Music (1st), with the First Prize of £5; Bkpg. (1st)

859—Machin, Joseph, 19, City of London Coll., clerk—French (3d)

437—McIntosh, Daniel, 18, Glasgow M.I., clerk—Eng. Lang. (3d)

386—McIntyre, John, 17, Glasgow Ath., clerk—French (3d)

439—McIver, Roderick, 25, Glasgow M.I., clerk—Arith. (2d); Bkpg. (1st)

444—McKechnie, Neil, 16, Glasgow M.I., engineer—Arith. (3d)

36—Mackenzie, Douglas F., 18, Aberdeen M.I., clerk—Bkpg. (3d)

308—McKillop, Dugald, 26, Glasgow Anderson's Univ. Pop. Evg. Classes, printer—Th. of Music (3d)

379—McKinlay, Duncan M., 18, Glasgow Ath., ship draughtsman—Eng. Lang. (3d)

390—McKinlay, Thomas M., 18, Glasgow Ath., clerk—Spanish (1st), with the Second Prize of £3

427—Mackintoch, David McNab, 22, Glasgow M.I., clerk—Eng. Lang. (2d)

1069—McLachlan, Joseph, 34, Manchester M.I., clerk—Bkpg (1st)

1192—McLean, John, 23, Salford W.M. Coll., clerk—Arith. (3d)

309—Maclean, Lachlan, 24, Glasgow Anderson's Univ. Pop. Evg. Classes, draughtsman—Th. of Music (3d)

1193—McLellan, James, 28, Salford W.M. Coll., warehouseman—French (3d)

415—McLeod, John G., 23, Glasgow Ath., warehouseman—Bkpg. (3d)

311—Macleod, William, 30, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)

1005—McMillan, John, 21, Manchester M.I., bookkeeper—Arith. (1st)

370—McMillan, Malcolm, 16, Glasgow Ath., clerk—Bkpg. (3d)

312—McNair, John, 34, Glasgow Anderson's Univ. Pop. Evg. Classes (no occupation stated)—Th. of Music (2d)

434—McNaughton, Charles J., 21, Glasgow M.I., clerk—Spanish (3d)

1359—McNicoll, Charles, 17, Dundee Young Men's Chr. Assoc., clerk—German (3d)

1342—McPherson, Alexander, 23, Dundee Young Men's Chr. Assoc., clerk—Bkpg. (2d)

1330—McPherson, Stewart, 22, Dundee Young Men's Chr. Assoc., mechanic—Arith. (2d)

1071—Madders, John W., 19, Manchester M.I., warehouseman—French (2d)

37—Makinson, Daniel D., 22, Aberdeen M.I., clerk—Eng. Lang. (3d)

1346—Malcolm, William S., 20, Dundee Young Men's Assoc. (no occupation stated)—French (3d)
314—Malcom, John, 21, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
711—Malim, Herbert, 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Bkpg. (2d)
164—Mallinson, Joseph, 19, Birmingham and Mid. Inst., clerk—German (1st); Eng. Lang. (1st); French (3d)
1374—Mann, Frederick W., 20, Quebec Inst., clerk—Bkpg. (3d)
478—Marshall, James T., 19, Halifax W.M. Coll., overlooker—Arith. (3d)
376—Martin, Alexander, 18, Glasgow Ath., clerk—French (3d)
542—Martin, Joseph J., 19, Hull Young People's Chr. and Lit. Inst., compositor—Eng. Lang. (3d)
501—Marvin, Henry, 24, Birkbeck Lit. and Sci. Inst., warehouseman—French (3d)
1313—Mathews, Richard, 25, Dublin, soldier—Arith. (2d)
1360—Matthews, Alexander, 19, Dundee Young Men's Chr. Assoc., clerk—German (3d)
613—Maunder, Herbert W., 21, Leicester W.M. Coll., clerk—Bkpg. (3d)
768—May, Charles, 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
860—Middleton, Ralph J., 25, City of London Coll., clerk—Bkpg. (2d)
165—Milbourn, Mary L., 17, Birmingham and Mid. Inst. (no occupation), Arith. (3d)
316—Millar, William, 21, Glasgow Anderson's Univ. Pop. Evg. Classes, architect—Th. of Music (1st), with the Second Prize of £3, and the Third Prize of £1 for Writing and Manuscript Printing
913—Millard, Joseph G., 17, Royal Polytechnic Coll., clerk—Arith. (1st); Eng. Lang. (3d)
777—Mills, Alfred T., 20, Birkbeck Lit. and Sci. Inst., warehouseman—Pol. Econ. (3d)
1343—Mills, James M., 22, Dundee Young Men's Chr. Assoc., teacher—Arith. (3d); Eng. Lang. (3d)
479—Mills, Moses W., 23, Halifax W.M. Coll., joiner—Bkpg. (1st)
32—Milne, Alexander, 18, Aberdeen M.I., printer—Eng. Lang. (2d)
317—Milne, William, 22, Glasgow Anderson's Univ. Pop. Evg. Classes (no occupation stated)—Th. of Music (2d)
1195—Mitcham, George, 22, Salford W.M. Coll., book-finisher—Arith. (3d)
166—Mitchell, Albert G., 22, Birmingham and Mid. Inst., organist—Th. of Music (1st)
682—Mitchell, James, 17, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d)
260—Mitchell, Thomas C., 19, Edinburgh Watt Inst., book-keeper—Arith. (2d); Bkpg. (3d)
223—Molineux, James, 19, Carlisle M.I., clerk—Arith. (2d)
65—Mollison, Hans G. L., 19, Aberdeen M.I., clerk—Eng. Lang. (2d)
581—Moore, Henry, 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
602—Moores, Thomas, 20, Leeds Young Men's Chr. Assoc. (no occupation stated)—Arith. (3d); Eng. Lang. (3d)
1143—Moreton, George, 23, Rugby, butcher—Arith. (1st)
407—Morrison, William, 16, Glasgow Ath., clerk—Bkpg. (3d)
917—Morse, Rosa S., 28, Royal Polytechnic Coll., governess—German (2d)
1151—Morton, John, 30, Rugby, gas-fitter—Arith. (3d)
1334—Morton, Samuel, 17, Dundee Young Men's Chr. Assoc., lithographer—Arith. (3d); Eng. Lang. (3d)
480—Morton, Sydney, 23, Halifax W.M. Coll., warehouseman—Th. of Music (3d)
440—Moses, David, 19, Glasgow M.I., clerk—Arith. (3d); Bkpg. (1st)
1061—Mott, Henry, 22, Manchester M.I., clerk—French (3d)
862—Mountford, Allen W., 19, City of London Coll., clerk—Arith. (1st); Commercial French (1st); Bkpg. (3d)
1363—Mudie, Charles J., 17, Dundee Young Men's Chr. Assoc., teacher—German (3d)
1335—Mudie, David, 18, Dundee Young Men's Chr. Assoc., engine fitter—Arith. (3d)
1387—Muir, George J., 18, St. Stephen's (Westminster) Evg. Classes, teacher—Arith. (3d); Eng. Lang. (3d)
387—Muir, James, 19, Glasgow Ath., clerk—French (3d)
318—Muir, Robert, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, teacher—Arith. (2d); Commercial Hist. (2d); Pol. Econ. (3d); Eng. Lang. (1st)
123—Mulholland, Robert W., 28, Belfast Working Men's Inst., gardener—Gardening (2d)
69—Mullen, Michael, 19, Aldershot and Farnham District Board, soldier—Arith. (1st)
788—Mungeam, Mary S., 32, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Commercial Hist. (1st); French (2d)
451—Munro, George, 17, Glasgow Young Men's Soc., clerk—Arith. (3d)
17—Munro, Malcolm, 29, Aberdeen M.I., jeweller—Th. of Music (2d)
724—Murison, Frederick, 27, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
256—Murphy, John, 18, Cork Catholic Young Men's Soc., accountant—Arith. (2d); Eng. Lang. (3d)
192—Murphy, Peter, 21, Bolton M.I., stripper and grinder—Arith. (2d); Bkpg. (3d)
255—Murphy, Timothy, 19, Cork Catholic Young Men's Soc., accountant—Arith. (2d)
368—Murray, Charles R., 17, Glasgow Ath., clerk—German (2d); French (3d)
1326—Murray, James, 19, Dundee Young Men's Chr. Assoc., compositor—Eng. Lang. (3d)
30—Murray, Marion M., 18, Aberdeen M.I. (no occupation stated)—French (1st), with the First Prize of £5, and the Prize of £2 for Females.
863—Mussenden, Matthew M., 19, City of London Coll., clerk—Bkpg. (3d)
167—Myers, Matilda L., 23, Birmingham and Mid. Inst. (no occupation)—French (1st)

238—Nanson, John S., 17, Carlisle M.I., architects' pupil—Arith. (3d)
168—Nason, John R. W. W., 19, Birmingham and Mid. Inst., merchant's apprentice—Spanish (3d)
605*-Naylor, J. H., 17, Leeds Young Men's Chr. Assoc., office boy—Arith (3d)
1377—Neale, Charles M., 19, Quebec Inst., clerk—Arith. (1st); Bkpg. (2d)
1248—Neave, William H. M., 19, Sheffield Young Men's Chr. Assoc., clerk—Eng. Lang. (3d); German (1st); Pol. Econ. (3d)
1015—Needham, Thomas, 16, Manchester M.I., clerk—Bkpg. (3d)
744—Nevers, Claudius, 39, Birkbeck Lit. and Sci. Inst., gardener — Gardening (3d); German (3d); French (3d)
915—Newton, James, 19, Royal Polytechnic Coll., clerk—Bkpg. (2d)
456—Newton, John H., 27, Freetown Working Men's Inst., Glossop, spinner—Bkpg. (3d)
864—Newton, William G., 16, City of London Coll., Civil Service—Arith. (1st); Bkpg. (2d); and the First Prize of £3 for Writing from Dictation; and the Fourth Prize of £1 for Handwriting

1047—Nickson, Harold, 19, Manchester M.I., clerk—Bkpg. (1st)

195—Nightingale, Frederick, 17, Bolton M.I., clerk—Bkpg. (1st)

1325—Niven, Albert, 16, Dundee Young Men's Chr. Assoc., clerk—Eng. Lang. (3d)

1121—Niven, Robert C., 24, Paisley Artisans' Inst., clerk—Arith. (3d)

1020—Nolan, Michael T., 16, Manchester M.I., carver and gilder—Commercial Hist. (3d); Bkpg. (3d)

8—Norrie, Chas., 17, Aberdeen M.I., clerk—Arith. (3d)

1017—Nuttall, John, 19, Manchester M.I., saddler—Bkpg. (1st)

218—Nutter, Charles, 26, Burnley M.I., loomer—Arith. (1st)

1212—Nutter, John H., 19, Stockport Sund. Sch. Soc., warehouseman—Arith. (3d)

1007—O'Brien, Charles, 21, Manchester M.I., draughtsman—French (3d)

1044—Officer, William, 23, Manchester M.I., warehouseman—Arith (3d); Bkpg. (1st)

1093—Ogden, Alfred, 21, Mossley M.I., self-acting minder—Bkpg. (2d)

1113—Ogden, Fred, 16, Oldham Lyceum, draughtsman—Arith. (1st)

865—Oliphant, Charles J., 20, City of London Coll., clerk—French (3d)

213—O'Malley, Patrick C., 33, Burnley M.I., book-keeper—Bkpg. (1st)

1122—Orchardson, John, 19, Paisley Artizans' Inst., foreman's assistant—French (3d)

189—Ormrod, Frederic W., 16, Bolton Ch. Inst., teacher—Arith. (2d); Eng. Lang. (2d); French (3d)

322—Orr, John, 22, Glasgow Anderson's Univ., Pop. Evg. Classes, clerk—Th. of Music (1st)

323—Orrock, Thomas, 22, Glasgow Anderson's Univ., Pop. Evg. Classes, clerk—Th. of Music (1st)

222—Ostle, Wilson, 20, Carlisle M.I. (no occupation)—Arith. (2d)

1365—Ostler, John, 21, Wakefield M.I., grocer's assistant—Arith. (3d); Bkpg. (3d)

257—O'Sullivan, Henry, 18, Cork Catholic Young Men's Soc. (no occupation stated)—Arith. (2d); Eng. Lang. (3d)

934—Overton, Charles M., 17, Royal Polytechnic Coll., clerk—Arith. (3d)

1063—Owen, William A., 21, Manchester M.I. (no occupation stated)—French (3d); Bkpg. (2d)

1251—Pagett, Walter W., 18, Stourbridge Assoc. Institutes, clerk—Arith. (3d)

640—Palmer, Thomas, 19, Leicester W.M. Coll., shoe-rivetter—Th. of Music (3d)

727—Parker, Alfred, 34, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); French (3d)

482—Parker, George, 31, Halifax W.M. Coll., contractor—Bkpg. (3d)

866—Parkin, Henry T., 23, City of London Coll., clerk—Bkpg. (2d)

1019—Parry, Evan H., 21, Manchester M.I., draughtsman—Arith. (3d)

1198—Partington, Margaret P., 21, Salford W.M. Coll., assistant mistress—Arith. (3d)

438—Paten, James, 39, Glasgow M.I., book-keeper—Arith. (3d)

70—Paul, Andrew, 27, Aldershot and Farnham District Board, soldier—Arith. (2d)

1149—Pearson, Louisa J., 17, Rugby, teacher—Arith. (3d); Eng. Lang. (3d)

909—Penfold, William, 17, Royal Polytechnic Coll., clerk—French (3d)

1355—Peters, William A., 20, Dundee Young Men's Chr. Assoc., clerk—German (3d)

1328—Petrie, William, 27, Dundee Young Men's Chr. Assoc., hacklemaker—Arith. (2d)

445—Pettigrew, Gavin, 20, Glasgow Young Men's Soc., clerk—Arith. (2d)

169—Phillips, Walter, 17, Birmingham and Mid. Inst., clerk—Spanish (3d)

948—Phillips, William R., 23, Tonic Sol-fa Teachers' Assoc., messenger—Th. of Music (3d)

420—Philp, William T., 19, Glasgow M.I., draughtsman—Arith. (1st)

1199—Pickard, John, 17, Salford W.M. Coll., clerk—Arith. (2d)

918—Pickering, Edward, 24, Royal Polytechnic Coll., book-keeper—German (2d); Bkpg. (3d)

598—Pickup, Henry, 22, Irwell Inst., timekeeper—Arith. (1st); Eng. Lang. (3d)

929—Pike, Thomas, 26, Royal Polytechnic Coll., jeweller—Bkpg. (3d)

780—Pillar, Alfred C., 24, Birkbeck Lit. and Sci. Inst., joiner—Arith. (2d)

498—Pitts, Tom, 18, Huddersfield M.I., clerk—Bkpg. (3d)

597—Plantin, Arthur H., 16, Ipswich W.M. Coll., clerk—Bkpg. (3d)

646—Platts, Charles, 23, Leicester W.M. Coll., warehouseman—Th. of Music (2d)

529—Plummer, John G., 19, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)

1201—Pogson, Joseph, 22, Salford W.M. Coll., clerk—Arith. (3d); Bkpg. (2d)

490—Pointon, Thomas, 19, Hanley Potteries Inst., clerk—French (3d)

1202—Pollitt, Robert, 17, Salford W.M. Coll., clerk—Arith. (2d)

933—Pool, Caroline, 21, Royal Polytechnic Coll. (no occupation)—Eng. Lang. (3d)

412—Porteous, Christopher, 18, Glasgow Ath., clerk—Eng. Lang. (3d)

751—Porter, Henry, 20, Birkbeck Lit. and Sci. Inst., upholsterer—French (3d)

251—Portley, William, 17, Cork Catholic Young Men's Soc., carpenter—Eng. Lang. (3d)

171—Postgate, Isabella J., 18, Birmingham and Mid. Inst., teacher—Eng. Lang. (2d); French [illegible]

867—Potter, Joseph R., 25, City of London Coll., clerk—French (3d)

172—Powell, Clara, 18, Birmingham and Mid. Inst. (no occupation)—Eng. Lang. (3d)

80—Prankerd, Alfred E., 16, Ashford M.I., clerk—Arith. (2d)

685—Pratt, William J., 26, Birkbeck Lit. and Sci. Inst., in Excise—Arith. (1st); Commercial Hist. (1st); Eng. Lang. (2d)

737—Price, John C., 26, Birkbeck Lit. and Sci. Inst., accountant—French (3d)

1380—Pullen, Annie S., 24, Quebec Inst., governess—German (2d); French (3d); Eng. Lang. [illegible]

1103—Punshon, James B., 30, Newcastle-on-Tyne Coll. of Eng. Inst., teacher—Th. of Music [illegible]; French (3d)

906—Pye, George W., 18, Kentish-town Lit. Inst., warehouseman—Th. of Music (2d)

743—Quilter, Elisha, 24, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (1st)

64—Rae, William A., 18, Aberdeen M.I., clerk—[illegible] Lang. (3d)

868—Raines, John, 20, City of London Coll., clerk—Bkpg. (2d)

584—Ramsey, George, 29, Hull Young People's Chr. and Lit. Inst., warehouse foreman—Eng. Lang. (3d)

1361—Rattray, Robert, 20, Dundee Young Men's Chr. Assoc., clerk—Spanish (2d)

869—Ravenscroft, George A., 19, City of London Coll., clerk—Bkpg. (3d)

997—Rawlinson, Matthew, 20, Manchester M.I., clerk—French (3d)

785—Read, Ernest J., 18, Birkbeck Lit. and Sci. Inst., warehouseman—French (3d)
1154—Reading, Jesse A., 16, Rugby, teacher—Arith. (2d); Eng. Lang. (3d)
431—Readman, George W., 18, Glasgow M.I., clerk—French (3d)
231—Reay, George, 19, Carlisle M.I., clerk—Arith. (2d)
1062—Redfern, John R., 22, Manchester M.I., clerk—Spanish (1st)
595—Reeve, John B., 16, Ipswich W.M. Coll., clerk—Bkpg. (3rd)
1357—Reid, George, 22, Dundee Young Men's Chr. Assoc., assistant inspector of weights and measures—German (3d)
1339—Reid, James W., 19, Dundee Young Men's Chr. Assoc., clerk—Bkpg. (3d)
325—Reid, William, 21, Glasgow Anderson's Univ. Pop. Evg. Classes, warehouseman—Spanish (1st), with the First Prize of £5
326—Reid, William J. D., 22, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Mus. (1st)
1078—Restall, Ernest, 19, Manchester M.I., clerk—Arith. (3d); Pol. Econ. (3d): Eng. Lang. (1st)
870—Reynolds, Nathaniel, 16, City of London Coll., clerk—Bkpg. (3d)
690—Rich, Annette I., 16, Birkbeck Lit. and Sci. Inst. (no occupation)—Th. of Music (2d)
765—Rich, Charlotte I., 33, Birkbeck Lit. and Sci. Inst., music teacher—Th. of Music (1st)
659—Richardson, Frederick, 26, Leicester W.M. Coll., warehouseman—German (3d)
745—Richardson, Henry, 22, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
327—Riddell, John, 28, Glasgow Anderson's Univ. Pop. Evg. Classes (no occupation stated)—Th. of Music (2d)
174—Ridgway, Arthur H., 24, Birmingham and Mid. Inst., clerk and organist—Th. of Music (1st)
173—Ridgway, John W., 26, Birmingham and Mid. Inst., schoolmaster—Th. of Music (2d)
871—Riley, Edmond J., 16, City of London Coll., clerk—Arith. (1st); Bkpg. (1st); and the Third Prize of £1 for Writing from Dictation
483*-Riley, Joseph A., 23, Halifax M.I., clerk—Bkpg. (2d)
220—Riley, William, 17, Burnley M.I., bundler—Arith. (3d)
767—Riorden, George J. J., 24, Birkbeck Lit. and Sci. Inst., engraver—Arith. (1st)
1309—Ritchie, Henry, 31, Dublin, soldier—Arith. (2d)
872—Robbins, James L., 20, City of London Coll., clerk—Pol. Econ. (3d); Bkpg. (2d)
328—Robb, James, 24, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
666—Roberts, Robert A., 21, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
732—Robinson, Frederick W., 23, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
1230—Robinson, Robert H., 24, Sheffield Ch. of Eng. Inst., manager—Bkpg. (3d)
1340—Rodger, David, 21, Dundee Young Men's Chr. Assoc., clerk—Bkpg. (1st)
1087—Roe, John, 20, Manchester M.I., book-keeper—Arith. (3d); Bkpg. (1st)
1051—Roscoe, James, 18, Manchester M.I., clerk—Arith. (2d); Commercial Hist. (1st); with the First Prize of £5; Eng. Lang. (2d)
873—Rose, John H., 27, City of London Coll., clerk—Eng. Lang. (3d)
56—Ross, James A., 21, Aberdeen M.I., clerk—French (3d)
23—Ross, John K. M., 18, Aberdeen M.I., clerk—French (3d)
1318—Round, Jane, 22, Dudley M.I., teacher—Arith. (3d)
1317—Round, Kate, 16, Dudley M.I. (no occupation stated)—Arith. (3d); Th. of Music (3d)
226—Rudd, Mary E., 19, Carlisle M.I. (no occupation stated)—Th. of Music (1st), and the Council Prize of Ten Guineas for Females.
1104—Rutherford, George, 24, Newcastle-on-Tyne Ch. of Eng. Inst., clerk—Bkpg. (2d)
22—Ruxton, John C., 19, Aberdeen M.I., pupil-teacher—Arith. (1st); Eng. Lang. (2d)
175—Rylatt, Emily J., 22, Birmingham and Mid. Inst., (no occupation)—Th. of Music (1st)
574—Rymer, Frederick J., 16, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

658—Sage, Joseph, 21, Leicester W.M. Coll., warehouseman—German (3d)
874—Salin, James F. A., 27, City of London Coll., clerk—Spanish (3d); German (1st); Commercial French (1st)
493—Salmon, Julia E., 17, Hertford, teacher—Arith. (3d); Eng. Lang. (3d)
1140—Sampson, William T., 18, Penzance, plumber—Arith. (3d)
84—Samson, William B., 22, Ashford M.I., boiler maker—Arith. (3d)
364—Sandeman, Frank, 18, Glasgow Ath., warehouseman—Eng. Lang. (3d)
1227—Sanderson, Newlove E., 16, Sheffield Ch. of Eng. Inst., teacher—Arith. (1st)
754—Sargeant, William H., 20, Birkbeck Lit. and Sci. Inst., clerk—German (2d)
579—Scaum, George, 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
1095—Schofield, John, 22, Mossley M.I., clerk—Arith (3d)
665—Schofield, Joseph, 21, Lockwood M.I., weaver—Eng. Lang. (3d)
1098*-Schofield, Joseph, 19, Mossley M.I., clerk—Arith. (3d)
329—Scobie, James, 26, Glasgow Anderson's Univ. Pop. Evg. Classes, warehouseman—Th. of Music (3d)
556—Scott, Anthony E., 17, Hull Young People's Chr. and Lit. Inst., hosier—Eng. Lang. (3d)
1253—Scott, Charles H., 19, Stourbridge Assoc. Institutes, clerk—Arith. (2d)
176—Scott, Edward J., 26, Birmingham and Mid. Inst., gold chain manufacturer—Th. of Music (1st)
330—Scott, James, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, teacher—Arith. (2d); Eng. Lang. (3d)
229—Scott, Joseph, 18, Carlisle M.I. (no occupation)—Arith. (1st)
331—Scott, William, 24, Glasgow Anderson's Univ. Pop. Evg. Classes, draper—Th. of Music (2d)
332—Scouler, John, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Bkpg. (3d).
1125—Scurlock, Thomas H., 17, Pembroke Dock M.I., shipwright's apprentice—Arith. (1st)
760—Seary, Thomas C., 25, Birkbeck Lit. and Sci. Inst., draughtsman—Th. of Music (1st)
484—Seed, John W., 18, Halifax W.M. Coll., book-keeper—Arith. (2d)
705—Sellar, George W., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); French (3d); Bkpg. (2d); and the First Prize of £5 for Handwriting.
663—Semley, William, 21, Lockwood M.I., blacksmith—Eng. Lang. (3d)
1092—Sergeant, Seth, 21, Mossley M.I., minder—Bkpg. (1st)
615—Seville, William G., 22, Leicester W.M. Coll., clerk—Bkpg. (3d)
1105—Sewell, William, 20, Newcastle-on-Tyne Ch. of Eng. Inst., clerk—Bkpg. (3d)
433—Shanks, John B., 20, Glasgow M.I., clerk—Spanish (3d)

670—Sharpe, James, 19, Birkbeck Lit. and Sci. Inst., in Civil Service—Arith. (1st)

764—Sharpe, Phillip, 22, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st), with the Second Prize of £3

718—Shaw, Arthur H., 18 Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); German (3d)

661—Shaw, John W., 26, Lockwood M.I., weaver—Eng. Lang. (3d)

1207—Shawcross, James J., 18, Salford W.M. Coll., clerk—Arith. (3d)

94—Shepherd, James, 18, Bacup M.I., weaver—Arith. (3d).

728—Sherlock, Peter, 24, Birkbeck Lit. and Sci. Inst., engineer—French (2d)

333—Shirlaw, William, 29, Glasgow Anderson's Univ. Pop. Evg. Classes, fancy wood worker—Th. of Music (2d)

1045—Shorrocks, Thomas, 16, Manchester M.I., draper—Bkpg. (1st)

1255—Short, Francis J., 17, Stourbridge Assoc. Institutes, engineer's pupil—Arith. (2d)

973—Shortall, Nicholas, 17, Liverpool Inst., clerk—Arith. (3d)

1009—Sidebottom, Alfred W., 17, Manchester M.I., apprentice—Arith. (3d)

83—Silverwood, Joseph, 18, Ashford M.I., coachmaker,—Arith. (2d)

1072—Simons, Charles, 17, Manchester M.I., clerk—Bkpg. (1st)

205—Simpson, James, 16, Burnley M.I., weaver—Bkpg. (3d)

209—Simpson, Jesse, 19, Burnley M.I., cloth-looker—Arith. (2d)

1031—Simpson, John W., 17, Manchester M.I., apprentice—Arith. (3d); Eng. Lang. (3d)

421—Sinclair, John, 18, Glasgow M.I., clerk—Arith. (2d)

54—Sivewright, David, 16, Aberdeen M.I., clerk—Eng. Lang. (3d)

876—Skelt, Joseph, 23, City of London Coll., clerk—Bkpg. (1st)

554—Skinner, William H., 17, Hull Young People's Chr. and Lit. Inst., clerk—Eng. Lang. (3d)

762—Slater, Charles F., 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)

237—Slater, John, 16, Carlisle M.I., student—Arith. (1st)

113—Slean, Michael, 18, Belfast Working Men's Inst., clerk—Arith. (1st)

1111—Sleightholm, John F., 22, Oldham Lyceum, roller turner—Th. of Music (3d)

696—Smith, Alfred, 28, Birkbeck Lit. and Sci. Inst., agent—Pol. Econ. (2d)

719—Smith, Arthur G., 16, Birkbeck Lit. and Sci. Inst., clerk—Eng. Lang. (3d)

951—Smith, Charles E., 21, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (2d)

63—Smith, David, 27, Aberdeen M.I., clothier's assistant—Th. of Music (1st)

561—Smith, Francis, 26, Hull Young People's Chr. and Lit. Inst., compositor—Arith. (3d)

1358—Smith, Harry, 19, Dundee Young Men's Chr. Assoc., clerk—German (3d)

1314—Smith, John, 26, Dublin, soldier—Arith. (3d); Th. of Music (3d); French (3d)

715—Smith, John H. A., 24, Birkbeck Lit. and Sci. Inst., clerk—French (2d); Bkpg. (1st)

878—Smith, John S. 19, City of London Coll., clerk—Bkpg. (1st)

975—Smith, John S., 43, Liverpool Inst., clerk—Pol. Econ. (2d)

1208—Smith, Mary J. 19, Salford W.M. Coll., assistant schoolmistress—Arith. (3d)

334—Smith, Thomas, 23, Glasgow Anderson's Univ. Pop. Evg. Classes, pawnbroker—Th. of Music (3d)

976—Smith, Thomas J., 28, Liverpool Inst., clerk—Pol. Econ. (3d)

374—Smith, William, 27, Glasgow Ath., clerk—Sp (1st)

974—Smith, William, 17, Liverpool Inst., clerk—Arith. (2d)

879—Smyth, James, 31, City of London Coll., clerk—Arith. (2d); Bkpg. (3d)

927—Snudden, Alice M., 26, Royal Polytechnic Coll., music teacher—Th. of Music (1st)

230—Somerville, Michael B., 16, Carlisle M.I., clerk—Arith. (2d)

880—Soundy, Arthur T., 17, City of London Coll., cler—Bkpg. (3d)

881—Soundy, Henry, 19, City of London Coll., clerk—Bkpg. (3d)

423—Souttar, George, 23, Glasgow M.I., engineer—Arith. (3d)

203—Spencer, Samuel H., 19, Burnley M.I., cloth-looker—Arith. (3d)

81—Spencer, Walter, 16, Ashford M.I., clerk—Arit (2d)

882—Spooner, George, 21, City of London Coll., cl—Bkpg. (3d)

680—Stafford, Frederick, 18, Birkbeck Lit. and S Inst., clerk—Arith. (2d); Pol. Econ. (2d)

96—Standring, Benjamin, 18, Bacup M.I., twister Arith. (3d)

1156—Staniforth, Harry, 16, Salford W.M. Coll., teach—Arith. (1st)

1100—Stanners, Thomas, 19, Newcastle-on-Tyne Ch. Eng. Inst., clerk—Arith. (1st)

497—Starr, Henry P., 18, Hertford, printer—Arith. (3

1295—Stead, James E., 20, York Inst., hosier—Arith. (

178—Steer, Rebecca, 19, Birmingham and Mid. In teacher—French (3d)

573—Steventon, Wilbert, 22, Hull Young People's C and Lit. Inst., clerk—German (2d)

33—Stewart, George, 16, Aberdeen M.I., clerk—En Lang. (3d)

337—Stewart, John, 29, Glasgow Anderson's Un Pop. Evg. Classes, assistant inspector of poor Th. of Music (3d)

338—Stewart, John R. W., 20, Glasgow Anderso Univ. Pop. Evg. Classes, teacher—Th. of Mu (1st)

340—Stobbs, James T., 20, Glasgow Anderson's Un Pop. Evg. Classes, clerk—Th. of Music (2d)

341—Stobo, Gavin, 29, Glasgow Anderson's Univ. P Evg. Classes, mason—Th. of Music (1st)

930—Stone, Mary A., 29, Royal Polytechnic Coll. occupation)—German (2d); Eng. Lang. (3 French (2d)

1266—Stone, Samuel, 30, New Swindon M.I., clerk Bkpg. (1st)

1269—Stone, Sidney, 17, New Swindon M.I., teacher Arith. (3d)

342—Strang, David B., 22, Glasgow Anderson's Un Pop. Evg. Classes, clerk—Spanish (1st)

771—Streng, Hermann, 21, Birkbeck Lit. and S Inst., clerk—Arith. (2d); French (2d)

68—Stribling, Henry, 35, Aldershot and Farnb District Board, soldier—Arith. (2d)

20—Stuart, Alexander, 23, Aberdeen M.I., warehouseman—Th. of Music (2d)

687—Suffell, Arthur J., 21, Birkbeck Lit. and S Inst., clerk—French (3d)

701—Sullivan, Daniel, 22, Birkbeck Lit. and Sci. In compositor—Arith. (3d)

485—Sutcliffe, Novello, 19, Halifax W.M. Coll., sizer—Arith. (2d); Bkpg. (3d)

53—Sutherland, David, 18, Aberdeen M.I., Bkpg. (3d)

459—Swann, Joseph, 20, Freetown W.M. weaver—Arith. (3d)

486—Sykes, John H., 19, Ha Arith. (2d)

406—Sym, William, 18, (3d)

353—Syred, George M., 19, Rugby, clerk—Arith. (2d)

343—Taggart, George, 25, Glasgow Anderson's Univ. Pop. Evg. Classes, traveller—Th. of Music (1st)
883—Taylor, Charles D., 23, City of London Coll., clerk—Bkpg. (1st)
344—Taylor, Edward, 20, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Bkpg. (2d)
97—Taylor, Henry, 20, Bacup M.I., weaver—Arith. (3d)
803—Taylor, Henry W., 19, Bow and Bromley Inst., clerk—Bkpg. (3d)
105—Taylor, Hugh, 17, Bacup M.I., teacher—Eng. Lang. (3d)
179—Taylor, William H., 28, Birmingham and Mid. Inst., clerk—Eng. Lang. (1st)
332—Teggin, James, 16, Manchester M.I., clerk—Bkpg. (3d)
321—Teesdale, Eugene V., 16, Hull Ch. Inst., sub-librarian—German (3d)
345—Templeton, John, 28, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
884—Thatcher, James, 36, City of London Coll., warehouseman—Bkpg. (3d)
885—Thatcher, Thomas W., 17, City of London Coll., clerk—Bkpg. (3d)
341—Thom, James, 24, Dundee Young Men's Chr. Assoc., draper's assistant—Bkpg. (3d)
377—Thomas, Glegge, 19, Liverpool Inst., accountant—Arith. (2d); Eng. Lang. (3d)
343—Thomas, Thomas, 35, Carmarthen Lit. and Sci. Inst., bookkeeper—Arith. (3d); Pol. Econ. (2d)
[illegible]—Thomas, William J., 17, Penzance, teacher—Arith. (3d)
555—Thompson, Edward H., 21, Hull Young People's Chr. and Lit. Inst., printer—Eng. Lang. (3d)
[illegible]—Thompson, Frederick M., 20, Glasgow Ath., clerk—Arith. (3d)
[illegible]—Thompson, Robert A., 16, Bow and Bromley Inst., clerk—Bkpg. (3d)
[illegible]—Thompson, Thomas P., 19, New Swindon M.I., clerk—Arith. (2d)
11—Thomson, Alexander, 20, Aberdeen M.I., clerk—Arith. (2d)
886—Thomson, David B., 19, City of London Coll., clerk—French (3d)
346—Thomson, Frederick M., 20, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Bkpg. (1st)
12—Thomson, James, 21, Aberdeen M.I., assistant teacher—French (2d)
16—Thomson, James, 18, Aberdeen M.I., clerk—French (3d)
114—Thomson, John M'C., 21, Belfast Working Men's Inst., teacher—Arith. (2d)
867—Thorn, Arthur G., 20, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
[illegible]—Thornber, Sharp, 17, Burnley M.I., cabinet-maker—Arith. (1st); Eng. Lang. (2d)
950—Thynne, Charles J., 20, Tonic Sol-fa Teachers' Assoc., bookbinder—Th. of Music (2d)
[illegible]—Tinker, Robert, 17, Salford W.M. Coll., clerk—Arith. (3d)
25—Tocher, Maria M., 18, Aberdeen M.I., pupil-teacher—French (3d)
[illegible]—Todd, Frederick J., 17, Hull Young People's Chr. and Lit. Inst., wine merchant's assistant—Arith. (3d)
[illegible]—Todd, Robert, 27, Glasgow Anderson's Univ. Pop. Evg. Classes, tailor—Th. of Music (3d)
[illegible]—Tolmie, Elizabeth A., 35, Glasgow Anderson's Univ. Pop. Evg. Classes, teacher—Th. of Music (3d)
[illegible]—Tolmie, Mary J. A. M., 32, Glasgow Anderson's Univ. Pop. Evg. Classes, teacher—Th. of Music (1st)
[illegible]—Tolton, William A., 16, Leicester W.M. Coll., clerk—Bkpg. (3d)

239—Topping, George, 18, Carlisle M.I., student—Arith. (1st)
731—Tozer, George T., 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Bkpg. (1st)
887—Trathan, Walter, 16, City of London Coll., Civil Service—Arith. (2d)
181—Trobridge, John, 21, Birmingham and Mid. Inst., clerk—Arith. (1st); Eng. Lang. (2d)
1123—Turnbull, George, 23, Paisley Artisans' Inst., book-keeper—Bkpg. (2d)
1218—Turner, William A. W., 19, Sheffield Ch. of Eng. Inst., teacher—Commercial Hist. (3d); Arith. (3d)
980—Tyson, John, 19, Liverpool Inst., engineer's apprentice—Arith. (2d)

487—Uttley, William H., 17, Halifax W.M. Coll., pupil-teacher—Arith. (2d); Eng. Lang. (2d); Th. of Music (3d)

608*—Vickers, John, 19, Leeds Young Men's Chr. Assoc., teacher—Eng. Lang. (2d)
1284—Volans, William G. B., 34, York Inst., printer—Bkpg. (1st)

352—Waddell, Alexander, 33, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)
538—Waddington, John W., 27, Hull Young People's Chr. and Lit. Inst., clerk—Eng. Lang. (3d)
543—Wagner, Leopold, 16, Hull Young People's Chr. and Lit. Inst., goldsmith and jeweller—Bkpg. (3d)
1023—Wainwright, George, 18, Manchester M.I., clerk—Bkpg. (1st)
442—Walker, James, 18, Glasgow M.I., warehouseman—Arith. (3d)
1030—Walker, Richard, 20, Manchester M.I., clerk—German (2d)
353—Walker, William, 27, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
362—Walker, William W., 18, Glasgow Ath., clerk—Arith. (3d); Bkpg. (1st)
354—Wallace, John, 22, Glasgow Anderson's Univ. Pop. Evg. Classes, warehouseman—Th. of Music (1st)
1388—Walters, Henryetta, 17, St. Stephen's (Westminster) Evg. Classes, teacher—French (3d); Eng. Lang. (2d)
1276—Walters, John E., 17, New Swindon M.I., clerk—Arith. (3d)
784—Wans, David, 36, Birkbeck Lit. and Sci. Inst., clerk—French (2d)
1283—Ward, John B., 18, York Inst., bookkeeper—Arith. (3d); Eng. Lang. (3d)
1231—Ward, Jonathan M., 20, Sheffield Ch. of Eng. Inst., clerk—Arith. (1st); French (3d)
182—Ward, William G., 17, Birmingham Mid. Inst., clerk—Arith. (2d)
528—Warden, John, 18, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
1042—Wardle, John, 23, Manchester M.I., buyer—Italian (3d)
360—Warner, Robert, 18, Glasgow Ath., law apprentice—Eng. Lang. (3d)
919—Warton, Alfred, 21, Royal Polytechnic Coll., clerk—German (2d)
567—Watkinson, Walter H., 24, Hull Young People's Chr. and Lit. Inst., whitesmith—Arith. (2d)
9—Watson, John, 42, Aberdeen M.I., dyer—Th. of Music (2d)
943—Watts, Mary A., 20, Tonic Sol-fa Teachers' Assoc. (no occupation stated)—Th. of Music (2d)
893—Webb, Alfred J., 17, City of London Coll., clerk—French (2d)
790—Webb, Edwards G. C., 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Eng. Lang. (2d)

513—Webster, George W., 20, Hull Ch. Inst., clerk—Bkpg. (2d)
1018—Webster, John W., 18, Manchester M.I., clerk—Arith. (2d); Bkpg. (1st)
1059—Welch, Ralph, 19, Manchester M.I., clerk—Bkpg. (1st)
391—Welsh, Thomas, 22, Glasgow Ath., clerk—Spanish (2d)
791—West, Alice, 23, Birkbeck Lit. and Sci. Inst., music-teacher—Th. of Music (2d)
1278—West, William, 30, New Swindon M.I., clerk—Bkpg. (2d)
702—Wetherill, Charles J., 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)
894—Wheeler, Edward J., 28, City of London Coll., clerk—Arith. (1st); German (1st); Bkpg. (1st)
896—White, John H., 19, City of London Coll., clerk—French (3d); Bkpg. (2d)
183—White, William, 19, Birmingham and Mid. Inst., teacher—Arith. (2d); Eng. Lang. (1st)
1247—Whitehead, James S., 19, Sheffield Young Men's Chr. Assoc., joiner—Arith. (3d); Eng. Lang. (2d)
512—Whitehead, Robert W. E., 22, Hull Ch. Inst., clerk—Bkpg. (3d)
1233—Whitfield, William F., 16, Sheffield Ch. of Eng. Inst., teacher—Arith. (3d); Eng. Lang. (3d)
487*-Whitley, George, 19, Halifax W.M. Coll., grocer—Eng. Lang. (3d)
184—Whittingham, Sarah P., 20, Birmingham and Mid. Inst., teacher—Arith. (3d); Eng. Lang. (2d)
1277—Whitton, Charles, 19, New Swindon M.I., clerk—Arith. (3d)
548—Whitton, Mary, 19, Hull Young People's Chr. and Lit. Inst. (no occupation stated)—German (2d)
365—Whyte, Dugald M., 21, Glasgow Ath., clerk—Bkpg. (1st)
540—Wiglesworth, John, 23, Hull Young People's Chr. and Lit. Inst., clerk—Eng. Lang. (3d)
219—Wilcock, Frederick, 23, Burnley M.I., warper—Bkpg. (3d)
708—Wilkinson, Jeannette G., 31, Birkbeck Lit. and Sci. Inst., upholstress—Eng. Lang. (3d)
1067—Wilkinson, John H., 29, Manchester M.I., clerk—Bkpg. (1st)
804—Wilkinson, Robert B., 22, Bow and Bromley Inst. clerk—Bkpg. (3d)
547—Willoughby, Alice, 20, Hull Young People's Chr. and Lit. Inst., governess—German (2d)
546—Willoughby, Minnie, 18, Hull Young People's Chr. and Lit. Inst., governess—German (2d)
897—Willoughby, William H., 33, City of London Coll., clerk—Italian (2d); French (3d)
405—Wilson, Andrew, 17, Glasgow Ath., clerk—Bkpg. (2d)
488—Wilson, Arthur, 18, Halifax W.M. Coll., wool-stapler's apprentice—Bkpg. (1st)
404—Wilson, James, 20, Glasgow Ath., clerk—Bkpg. (1st)
725—Wilson, Meta, 30, Birkbeck Lit. and Sci. Inst. (no occupation)—French (3d)
1102—Wilson, Thomas, 23, Newcastle-on-Tyne Ch. of Eng. Inst., clerk—Arith. (2d)
489—Wilson, Walter, 19, Halifax W.M. Coll., wool-stapler—Bkpg. (3d)
373—Wilson, William, 23, Glasgow Ath., warehouse-man—Eng. Lang. (2d)
1014—Wood, George R., 22, Manchester M.I., engraver—Bkpg. (3d)
1271—Wood, John W., 16, New Swindon M.I., teacher—Arith. (2d); Commercial Hist. (2d); Eng. Lang. (3d)
1216—Wood, William, 16, Sheffield Church of Eng. Inst., teacher—Arith. (3d); Eng. Lang. (3d)
610—Woodward, Ernest, 24, Leeds Young Men's Chr. Assoc., engineer—Bkpg. (3d)
899—Wootton, John J., 21, City of London Coll., clerk—Arith. (1st)
244—Woozley, David A., 28, Carmarthen Lit. and Sci. Inst., in Inland Revenue—Arith. (1st); Pol. Econ. (2d)
71—Worstall, William, 39, Aldershot and Farnham District Board, soldier—Arith. (3d)
1160—Worthington, Henry, 21, Salford W.M. Coll., warehouseman—Arith. (2d); Bkpg. (2d)
900—Wortley, George, 18, City of London Coll., clerk—Bkpg. (1st)
425—Wotherspoon, James H., 21, Glasgow M.I., clerk—Eng Lang. (2d)
1011—Wrathmall, John H., 20, Manchester M.I., print looker—Arith. (3d)
1228—Wright, Albert T., 20, Sheffield Ch. of Eng. Inst., clerk—Bkpg. (3d)
770—Wright, Charles, 17, Birkbeck Lit. and Sci. Inst., Civil Service—Arith. (1st); Eng. Lang. (2d), and the Second Prize of £3 for Handwriting.
187—Wright, James, 20, Birmingham and Mid. Inst., clerk—Spanish (2d)
357—Wright, Robert H., 25, Glasgow Anderson's Univ. Pop. Evg. Classes, tin-plate worker—Th. of Music (3d)
902—Wright, William H., 20, City of London Coll., clerk— Eng. Lang. (1st), with the First Prize of £5
903—Wyatt, James J. C., 25, City of London Coll., clerk—Bkpg. (2d)
453—Wyllie, John R., 21, Glasgow Young Men's Soc., clerk—Bkpg. (3d)

904—Yeates, John S., 18, City of London Coll., clerk—French (3d)
358—Youden, John, 24, Glasgow Anderson's Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
411—Young, David W., 19, Glasgow Ath., foreign correspondent—Spanish (1st); German (3d); Eng. Lang. (2d); French (3d)
694—Young, George H., 29, Birkbeck Lit. and Sci. Inst., draughtsman—Pol. Econ. (2d)
378—Young, Henry C., 22, Glasgow Ath., clerk—Spanish (2d)
430—Young, Robert, 18, Glasgow M.I., grocer—Eng. Lang. (3d)
1362*-Young, Walter, 20, Dundee Young Men's Chr. Assoc., clerk—German (3d)

On Tuesday, June 29, at 3 o'clock, Mons. Rahn, Professor of Harmony in Paris, will give, in the Great Room of the Society, a practical demonstration of his method of Instruction in Music, based on the science of harmony and musical composition. Members and their friends are invited to attend.

MEETINGS FOR THE ENSUING WEEK

Mon. ...Victoria Institute (at the House of the Society of Arts), 8 p.m. Mr. Isaac Taylor, "The Etruscan Language." Asiatic, 22, Albemarle-street, W., 3 p.m.

Tues. ...Birkbeck Scientific Society, Southampton-buildings, W.C. Mr. H. C. Jones, "Bleaching Re-agents." Anthropological Institute, 4, St. Martin's-place, W.C. Mr. Herbert Spencer, "The Comparative Psychology of Man." 2. Mr. John Forrest, "The Natives of Central and Western Australia." 3. Captain John A. Lawson, "Papuans of New Guinea."

Wed. ...Aeronautical Society (at the House of the Society of Arts), 8 p.m. Geological, Somerset House, C.W., 8 p.m. Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

Thurs... Antiquaries, Burlington House, W., 8½ p.m. Royal Society Club, Willis's Rooms, St. James's, S.W., 6½ p.m. Annual Meeting.

Fri.......SOCIETY OF ARTS. Conversazione at the South Kensington Museum. 8 p.m. Quekett Club, University College, W.C., 8 p.m. Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "The Classification of Plants." (VII.)

Sat.......Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,179. VOL. XXIII.

FRIDAY, JUNE 25, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 42 of the Society's Bye-laws:—

TREASURERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 31ST, 1875.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1874	290	3	8			
Do. do. Secretary	2	3	8			
				292	7	4
To subscriptions received during the year from Members and Institutions in Union	6,337	14	1			
Life Contributions	394	16	0			
				6,732	10	1
To dividends on Stock:—						
Consols, £4,914 6s. 8d.	146	4	0			
Reduced 3 per cents., £2,619 16s. 1d.	77	18	10			
New 3 per cents:—						
Dr. Fothergill's Trust, £388 1s. 4d.	11	11	0			
Great Indian Peninsular Guaranteed 4 per cent. Railway Debenture Stock, £2,170	86	1	6			
£2,450 Bombay and Baroda Guaranteed Railway Stock	122	3	9			
£2,460 Oude and Rohilcund Guaranteed Railway Stock	121	19	6			
2,500 dols. United States Funded Bonds 1871, cost £509 1s. 3d.	25	1	0			
				590	19	7
To Interest on Deposit Account with Messrs. Coutts and Co., £600				15	15	6
To Subscriptions and Donations:—						
Endowment Fund	200	6	6			
Chemical Section (Thomas Twining)	25	0	0			
				225	6	6
To Examinations:—						
The Prince Consort's Prize	26	5	0			
Candidates' Fees, sale of papers, &c.	10	15	6			
				37	0	6
To Technological Examinations, for Prizes, &c.	31	10	0			
Do. do. Scholarships	50	0	0			
				81	10	0
To Sales:—						
Cantor Lectures	19	11	5			
Sale of *Journals*, Advertisements, &c.	1,768	9	4			
Sale of Papers, &c.	5	0	3			
				1,793	1	0
To Stove Competition	1	3	0			
Railway Lamp Competition	1	5	0			
				2	8	0
To Mulready Trust	109	12	9			
House and Office	14	5	9			
Sir Joseph Whitworth's Prize	50	0	0			
				173	18	6
				£9,944	17	0

Cr.

	£	s.	d.	£	s.	d.
By House and Premises:—						
Rents, Rates, and Taxes	308	6	1			
Insurance, Gas, Coal, and House Charges	183	4	8			
Repairs and Alterations	78	8	5			
				569	19	2
By Office:—						
Salaries, Wages, and Commissions	1,845	16	2			
Stationery and Printing	332	2	0			
Advertising	109	7	10			
Postage Stamps and Parcels	157	18	1			
				2,445	4	1
By *Journal*, including Printing, Advertisements, Stamps, and Distribution to Members	3,647	6	3			
Library, Bookbinding, &c.	126	16	5			
Conversazione	259	1	0			
				4,033	3	8
By Union of Institutions, including Examinations, Prizes, Postage, Printing, &c.	494	0	11			
Prince Consort's Prize	26	5	0			
Technological Examinations	165	18	3			
Do. do. Scholarships	50	0	0			
				736	4	2
By Society's Albert Medal	21	13	0			
Do Medal	2	2	0			
				23	15	0
By Prizes:—						
Dr. Swiney's	100	10	6			
Sir Joseph Whitworth's	50	0	0			
Stove Competition	249	4	7			
Hall-marking of Jewelry	0	5	0			
				400	0	1
By Exhibitions:—						
Annual International, Reports				9	5	10
By Committees:—						
General Charges	40	10	6			
Cab	4	0	0			
Drill	0	11	0			
Musical Education (National Training School)	238	5	3			
Indian Section	90	10	1			
African do.	44	4	8			
Chemical do.	75	15	4			
Museums	5	1	6			
Telegraphs	6	7	0			
Rivers Pollution	6	7	0			
Railway Lamps	11	9	10			
Revolution Indicators	13	3	1			
Patent Laws	0	8	0			
Memorial Tablets	0	12	0			
Road Traction	5	0	6			
Conflagrations	17	0	6			
				559	6	3
By Endowment Fund				16	14	0
By Purchase of £527 14s. 6d. Reduced 3 per Cent. Stock	490	2	6			
Do. do. £105 18s. 7d. Indian 4 per Cent. Stock (Mulready Trust)	109	12	9			
The Blenheim Institute	1	2	7			
Cantor Lectures	271	10	8			
Juvenile Lectures	29	2	6			
				901	11	0
				9,695	3	3
Cash in hands of Messrs. Coutts and Co., 31st May, 1875	228	14	3			
„ in the Secretary's hands	20	19	6			
				249	13	9
				£9,944	17	0

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors:—		
Prince Consort's Prize	26 5 0	
Examination Prizes (Society's)	113 10 0	
Examiners' Fees	129 3 0	
Rent, Rates, and Taxes	31 13 4	
Tradesmen's Bills	1,571 16 9	
Musical Scholarship	50 0 0	
Technological Examination Fees	84 0 0	
Do. to the Clothworkers' Company's Prizes	105 0 0	
Sections: — Indian, African, and Chemical	180 0 0	
Memorial Tablets	10 10 0	
Repairs	238 10 6	
		2,540 8 7
By excess of Assets over Liabilities		7,260 10 2
		£9,800 18 9

Assets.

	£ s. d.	£ s. d.	£ s. d.
By Society's money invested in—			
Reduced 3 per Cent. Stock, £3,147 10s. 7d., viz., £2,896 12s. 3d., less £577 12s. 6d. reserved to meet trusts stated below		2,318 19 9	
Consols £146 19s. 5d., at 93¼ per cent.		135 18 11	
Great Indian Peninsula Railway 4 per cent. Debenture Stock		200 0 0	
Oude and Rohilcund and Bombay and Baroda Guaranteed Debenture Railway Stock		355 2 7	
Deposit Account with Messrs. Coutts and Co. £600, less £421 13s. 9d. reserved to meet trusts stated below		178 6 3	
Subscriptions of the year uncollected	£1,700 8 0		
Less 15 per cent.	250 8 0		
		1,458 0 0	
Do. of former years unpaid	£2,457 0 0		
Less 50 per cent.	1,228 10 0		
		1,228 10 0	
Barry's Pictures and other property		2,000 0 0	
Prince Consort's Prize		26 5 0	
Mrs. Harry Chester's do.		4 0 0	
Journal, by Advertisements*		1,651 2 6	
			9,551 5 [illegible]
Cash in hands of Messrs. Coutts and Co., 31st May		228 14 3	
Do. in hands of Secretary, petty cash		20 19 6	
			249 13 [illegible]
			£9,800 18 [illegible]

* A portion of this sum is still subject to charges for printing, &c.

P. Le Neve Foster, *Secretary.*

Stock and Cash Standing in the Name of the Society.

Consols	£4,914 6 8
New 3 per Cents.	388 1 4
Reduced 3 per Cents.	3,147 10 7
Great Indian Peninsular Railway 4 per Cent. Guaranteed Debenture Stock	2,170 0 0
Oude and Rohilcund " " "	2,460 0 0
Bombay and Baroda " " "	2,450 0 0
Cash in hand of Messrs. Coutts and Co., in deposit	600 0 0
United States 2,500 dols. Five per Cent. Funded Bonds, 1871, cost	509 1 3
Indian 4 per Cents.	105 18 7

Trust Funds included in the above.

Dr. Swiney's Bequest	£4,500 0 0	Consols, chargeable with a sum of £200 once in five years.
John Stock's Trust	100 0 0	" " " the Award of a Medal.
North London Exhibition Trust	167 7 3	" " " Award of the Interest as a Money Prize.
Fothergill's Trust	388 1 4	New 3 per Cents., chargeable with the award of a medal.
J. Murray, Esq., in aid of a Building Fund	50 0 0	Invested in Reduced 3 per Cent. Stock.
Subscriptions to an Endowment Fund	437 12 6	
Dr. Aldred's Bequest	90 0 0	
Thomas Howard's Bequest	500 0 0	" " United States 5 per Cent. Funded Bonds, 1871.
Dr. Cantor's Bequest	5,049 9 7	" " Bombay and Baroda and Oude and Rohilcund Guaranteed Railway Debenture Stock.
Mulready Trust	109 12 9	" " Indian 4 per Cent. Stock.
Alfred Davis's Bequest	1,800 0 0	" " Great Indian Peninsular Guaranteed Railway Debenture Stock.
Memorial Window Fund	345 0 0	In Deposit with Messrs. Coutts and Co.
Sir W. C. Trevelyan's Prize	100 0 0	
Musical Scholarships	50 0 0	
Technical Examinations, Clothworkers' Company Prizes, &c.	105 0 0	

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.
The Payments set forth above have been made by authority of the Council.
The Assets, represented by Stock at the Bank of England, and securities, cash on deposit, and cash balance at Messrs. Coutts, as above set forth, have been duly verified.

I. Gerstenberg, J. O. Chadwick, *Auditors.*

Society's House, Adelphi, 14th June, 1875.

ANNUAL GENERAL MEETING.

The One Hundred and Twenty-First Annual General Meeting, for the purpose of receiving the Council's report and the Treasurers' statement of receipts, payments, and expenditure during the past year, and also for the election of officers, will be held, in accordance with the Bye-laws, on Wednesday next, the 30th of June, at 4 o'clock p.m.

At this meeting, in conformity with the provisions of the Act of Parliament, 3 William IV., c. 4, intituled "An Act for Settling and Preserving Sir *John Soane's* Museum, Library, and Works of Art in *Lincoln's Inn Fields*, in the County of *Middlesex*, for the Benefit of the Public, and for Establishing a sufficient Endowment for the due maintenance of the same," an election will take place of the Society's Trustee of the Soane Museum, in the place of Mr. Samuel Redgrave,

Vice-President of the Society, whose term of office under the Act has expired. Mr. Redgrave is eligible for re-election.

The Council hereby convene a Special General Meeting of the Members of the Society to ballot for members, such meeting to take place at the close of the Annual General Meeting.

By order,

P. LE NEVE FOSTER, *Secretary*.

Society's House, Adelphi, June 23rd, 1875.

CONVERSAZIONE.

The Annual Conversazione of the Society will be held this evening (Friday, June 25th), at the South Kensington Museum.

TRACTION ON ROADS.

The following is the Report of the Committee appointed to consider this subject, and consisting of—

C. E. Amos.	Captain Douglas Galton, C.B., F.R.S.
E. Chadwick, C.B.	W. Hawes, F.G.S.
Major-General F. Eardley-Wilmot, R.A. F.R.S. (Chairman of Council).	E. Lawrence.
	R. Rawlinson, C.B.
	Capt. R. Scott, R.N.

The conditions of the surface formation, paving, and cleansing of the streets of the metropolis, as influencing the cleanliness and health of the population, its circulation of passengers and goods, and the extent to which those conditions may be improved by the application of sanitary engineering and mechanical science have been the subject of careful inquiry by your Committee.

The first course of inquiry was to ascertain the intrinsic qualities of the works required to be done; the next to determine the character of the agencies required to do them.

Before entering into our own direct and recent inquiries on the subject, we consider that it may be not less important to state what has been the course of previous inquiries, and what the practical conclusions arrived at from them on which no scientific and practical action has hitherto been taken.

ON THE SANITARY SCIENCE APPLICABLE TO STREET PAVING AND CLEANSING.

The sanitary effects of street pavement and cleansing were examined in England, in part, under the sanitary inquiry of 1842; in part by the Health of Towns Commission in 1844, by the Metropolitan Sanitary Commission in 1848, and by the first General Board of Health in 1850. It was also examined about the same time by hygienists in France. But the effects of different conditions of street and road surfaces on the public health, as a branch of sanitary science, have not hitherto been comprehended in any instructions to sanitary officers, and have yet to be made known and appreciated in this country.

The first inquiries related to the conditions of the surface dirt of the streets. This appeared to consist chiefly of horse dung, combined with abraded granite and abraded iron in proportion to the traffic. In the chief thoroughfares from three to four loads of horse dung per mile were taken up daily, when the streets were well swept. From the number of horses kept as well as from the quantities of dung removed, it was then estimated that the total quantity of dung deposited in the streets could not be then, and it can scarcely be less now, than 1,000 tons daily in the metropolis. A great part of the filth accumulated on the skin must therefore be pulverised horse dung.

The domestic fire acts as a pump, which draws in the air of the street, and with it the filth of the street, for deposit on the person, clothes, and furniture. A lady living near the drive in Hyde-park, stated that she could write her name twice a day on the dust on her piano, that is to say in summer time, when there are comparatively few fires and little soot. The rate of accumulation on the skin may be observed by well-to-do people, who have to wash their hands and faces two or three times a day to maintain cleanliness; and as to clothes, by an increased rate of expense of washing. The estimated washing bill of the metropolis is upwards of £5,000,000 per annum. As to the special sanitary effect of the chief ingredient of the filth of the streets, it is found that the gaseous products of putrid and decomposed horse-dung partake in a greater or less degree of the pernicious character of those from the human fæces. In urban districts, which have been well drained, with proper self-cleansing sewers, and freed from emanations from them, fever, nevertheless, has been found to lurk in those quarters where the surface paving and the surface cleansing is bad, especially amongst the children who are much out in the streets, and who, from their habit of playing with street dirt, and their lower stature, are more within the influence of low surface emanations than adults. On the other hand, the extension of impermeable paving alone, other conditions as to drainage, &c., remaining the same, has been attended with a marked reduction of malarious disease. The greater part of the dirt deposited on the skin, which constitutes the visible filth and squalor of the lower class of the population in towns, is considered to be chiefly composed of street or road mud, or of pulverised dung. The effect of the deposit of dirt on the skin is displayed by the effect of its

effectual removal by regular ablutions with tepid water. This has been marked in the instance of some ragged schools, where the assemblage of dirty children created an atmosphere so offensive, and attended by so much illness to the teachers as well as to the children, that for their protection, as well as for the protection of the teachers, it was found necessary to have recourse to ablution with tepid water as a means of prevention, and thus the condition of the atmosphere was considerably freshened, and the health of the children and of the teachers considerably improved. As a rule in sanitary science, the death-rates of children are considered the most important tests of general local sanitary conditions, as children are the least affected by occupation, and the most kept within those conditions.

The effect of skin cleanliness on health has been most marked on numbers, in children's institutions, where sanitary results may be the best discriminated. In some of these institutions, in old buildings, the death-rate had been regularly for years about 12 per 1,000; but a removal of cesspools, an improvement in the drainage, and better ventilation, producing what may be called comparative air cleanliness, were attended by a reduction of the death-rate to 8 per 1,000. The next step in sanitary improvement was to effect skin cleanliness by the introduction of regular, complete head to foot ablution with tepid water, and this was attended by a further reduction of the death-rate from 8 to 4 in the 1,000. Other instances gave as high a value as one-third as the result due to the sanitary efficiency of complete skin cleanliness as a preventive. One noted example of the combined results was presented in the instance of a children's Institution at Limehouse, where the death-rate amongst the children was not above 4 in 1,000, or about one-third of that of the children of the general population of the same neighbourhood. During the prevalence of a severe epidemic of cholera, which ravaged the population of the neighbourhood, not a single case occurred in that Institution. In that, as in other children's Institutions, the children had, too, a paved, dry, and well-cleansed courtyard to play in. If they had been let out to pass their play-time on the adjacent ill-cleansed and dirty streets, and had been subjected to the same amount of dirt on the skin, and also on the clothes, and to the emanations from excrement-sodden surfaces, and had been as little washed as the other children, there is no doubt they would have participated in the common excessive sickness and death-rates. In those institutions, variations in management, attended by variations in cleanliness, in the cleanliness of the clothes as well as of the skin, are observed to be attended by variations in the sickness and death-rates. Coal soot is, undoubtedly, contributory to the skin dirt. But the rural cottages in the northern districts, where coal is cheap and the grates bad, do not appear to possess much advantage, if any, as respects the amount of smoke and coal dust over the dwellings of the wage classes in London; but as they have an immunity from street dirt and dust, the children are visibly less dirty than the urban children, and have considerable advantages in reduced sickness and death-rates.

In summer time the consumption of coal and the production of soot is greatly below what it is in winter, but no great difference is observed in the filth and squalor of the children of the wage classes inhabiting the ill-paved and ill-arranged urban districts.

In the urban prisons, where the prisoners have to walk upon clean and dry paved yards, and are subjected to enforced personal cleanliness, notwithstanding their comparatively low diets, and other depressing causes, they have an immunity from epidemic visitations, and a very high degree of health, far exceeding the general outside population.

In Paris, where wood chiefly is used for fires, and very little coal, and where there is comparatively little soot—improvements in street pavements, and in street cleansing by the use of water, have, according to the reports of hygienists, been attended by great reductions of cases of fever, and improvement in the general health.

People who are nice in the air they breathe, as well as in outward personal cleanliness, will let as little as possible of street air enter their houses, except through screens of the finest wire gauze as window blinds, as did our late member, Mr. Appold. He stated that in the city he found it necessary to have his screens washed every day, to prevent their being clogged up, and that on foggy days they were choked up in three hours. Parliament, for its own protection against the common street air, has had recourse to science to free that air, as well as might be done, from its grosser impurities. The late Dr. Reid, to whom the task was first confided, proposed to avoid the street air, by drawing down less impure air from the superior strata at the top of the two towers, the Victoria and the clock tower;—but he found even then that at times Parliament might be exposed to polluted currents from the tall chimneys of manufactories in the neighbourhood; one a bone-boiling manufactory, another a muriatic acid manufactory. Being driven back for a supply to the street air, he resorted to various contrivances to screen it, and at times to wash it. Appliances for this—screens of fine cambric and means of washing the air—are now applied under the direction of Dr. Percy. On the establishment of a sugar refinery at the east of London detrimental results were avoided

and superior results were obtained, by screens and careful manipulation to purify the street air for the process.

The importation of granite is upwards of six hundred tons per annum, to supply the abrasion and wear of the streets, besides large quantities of flint and other cheaper stones obtainable near London.

The special effects of insoluble matter as detritus are the most clearly distinguishable in continental towns, where there is very little traffic, and little dung dust; but where there is a great deal of sand or inorganic dust, the excess of this condition is attended by an excess of disease of the respiratory organs. The influences of particular sorts of street and road dust are instanced by the effect of constant exposure to them in highly concentrated states;—as of abraded granite, by the diseases of the constant workers in granite in Scotland; of abraded iron (which is found in considerable proportions in streets of great traffic) by the diseases of the Sheffield knife-grinders and metal workers;—of powdered flints, which are extensively used on metropolitan suburban roads, by the special effects of constant working in flint dust in the potteries, where it is known that it cuts short the lives of robust persons in an average of twelve years. Dr. James Sutherland, the Army Sanitary Commissioner, thus describes the production of flint spiculæ, which are peculiarly irritating. In certain districts of the metropolis "the road-making consists of emptying and spreading ordinary flints, one of the most brittle of all materials. The first heavy cart which passes over it fractures the flint, and with moderate traffic, as for instance, on the roads leading up to the Crystal Palace,—the pulverising of the flint is so rapid that a layer rarely lasts above three weeks, and the entire mass is then scraped off and used by builders instead of sand. The spicular flint particles are wafted about by the slightest wind, and enter all the houses, and are breathed by all passengers. The cost to the ratepayers must be very great, while no one object of a really scientific and healthy road is attained." The dry days of March, when winds and dust predominate, are, as medical men are aware, attended by numerous affections of the mucous membranes of the throat and frequently of the eyes. Foul air leads to the disagreeable habit of expectoration.

Professor Fonssagrives says:—"There can be no doubt of its tendency to produce those obstinate and now very prevalent disorders, ophthalmia, laryngitis, and granulous pharyngitis. I must add, the serious influence of dust upon the hair, which it hardens, and, so to say chokes, till it falls off by the repeated brushing which is necessary in order to clean the head."

In addition to the marked evils noted as arising from the moveable matter on street surfaces—dung, dust, and abraded stones—there is great sanitary evil arising from the emanations of immoveable absorbed matter between the stones of the pavement, and excrementitious matter retained beneath them. Excrement-sodden soils are distinguished as seats of epidemic disease amongst populations. On the occasion of the visitation of the cholera epidemic in 1848, the General Board of Health gave particular directions to their Inspectors that the street surfaces in the seats of the epidemic visitations of ordinary fever should be carefully cleansed; but it was found extremely difficult to get at such excrementitious matter in some boulder-paved and cobble-paved districts. To accomplish the object the entire surface paving must be taken up, and there was neither time nor money to do this. In those cases where the matter could not be got at or removed, the Board ordered that it should be covered three inches deep with good fresh earth mould. Where this was done there were frequent expressions of surprise from the people at the result—that they felt themselves living in a new atmosphere, such as they had never experienced there before. As a sanitary rule, of which decisive illustrations may be given, perfect impermeability of street covering is of primary importance, not only as a shield against subsoil-damp, but as against subsoil malarious emanations of every description.

Where there are various contributing causes of preventible disease and mortality acting upon such mixed masses of population as those of the metropolis, it is not at present possible to discriminate, with an approach to certainty, the separate results of each cause; but there is no doubt amongst sanitary authorities that the deaths due to the conditions in which the streets and the subsoils of the metropolis are at present kept are far more numerous, and give a larger proportion to the great mass of preventable sickness and mortality than has hitherto been taken into account. Such facts are brought forward as establishing the conclusion that the responsibility for the amendment and care of the cleansing of the public thoroughfares should be charged upon the newly appointed functionaries, the Medical Officers of Health.

The children's Institutions adverted to, where the greatest sanitary improvements have been effected, were under the supervision of selected Poor-law guardians, or persons of the class of vestrymen—persons of respectability, but not men of science, who did not appear to appreciate particularly the results of the sanitary science displayed before them, or to be likely to apply them in the other branches of local administration in which they might be engaged.

The improvements were initiated by medical and other inspecting officers, of special science, and would in all probability fall through if their active supervision were withdrawn. It may be mentioned that the Guardians were mostly opposed to the expense of paving the open yards or playgrounds of the children's institutions, proposed on sanitary grounds,—but it has been found that smooth pavements have effected savings of shoe leather and its expense to the extent of one half. There can be no doubt that the good cleansing, as well as the smooth paving of the footpaths, is to be regarded as productive of similar economy to the general population.

The coarseness and want of refinement in the common local administrations is displayed not alone by the filth of the streets under their charge, but by the disregard of the production of pain and other evils by the noise of traffic over different sorts of paving of the carriage ways. The *Times* newspaper has recently aroused attention in London to the importance of noiseless street pavements. The following extract, from a work by Mons. Fonssagrives, Professor of Hygiene at Montpelier, is deserving of attention as showing the position of the topic in the sanitary science of France:—

"I have characterised in the following terms the evil effects which the noise of large towns appear to me to exercise on the health:—Firstly, there is in populous towns a daily and nightly din, and there is scarcely any degree of silence even during two or three hours of the night. I cannot consider such a perpetual vibration of the nerves as harmless even for those who have been born and bred in the midst of the noise. It is certain that it is a very genuine cause of "erethisme," and to it must be ascribed the prevalence of nervous temperaments and diseases in the large towns. A countryman transported suddenly from the calm of the streets of Vannes during the night to the uproar of the Parisian streets would very soon be able to appreciate the difference. There are, it is true, some exceptional natures which nothing can disturb, which pass unmoved through the roar of a crowded street; on which the creaking of carts and ceaseless rumble of carriages have no effect, and which can sleep anywhere and everywhere, in town or country, under good or bad circumstances. But, nevertheless, Paris, that producer of nerves, will very soon have transformed even these placid natures. And this is not without danger, especially to women. I have known a young girl, of seventeen years old, suddenly transported from the provinces to a noisy quarter of Paris, show the most alarming symptoms of nervous disorder, which did not subside until she returned to a quieter and less exciting atmosphere. At the periods of a woman's life when she is most subject to nervous maladies, this danger should be most carefully guarded against. And what shall we say about the nerves of children and invalids? If the former are hard to rear in cities which create hysterics at eight years of age, some blame must certainly be laid on the air they breathe and the moral conditions in which they have been educated; but some part of the evil must be attributed to the influence exercised by noise on these little beings, in whose organisation the cerebral predominance is the most marked feature. As for invalids, quiet is of the first importance, and the noise in the streets is the cruellest stumbling-block in the way of recovery. The works of all authors are full of observations which testify to the pernicious influence of noise in cases of illness. The commentator of Boerhaave, Van Swieten, has cited a great number of facts to prove it. (Aphorismes de Chirurgie.) A. Paré said on this subject:—'It is of importance that the patient should be kept in a quiet place, away from all noise if possible, far from clocks, muleteers' carts, &c.' But in a large town such quiet is a rare occurrence, and the noises which result from the life in a lodging-house only increase this of the streets.

"Besides the permanent noises of a town there are accidental noises, such as discharges of artillery, which may produce the effects observed by A. Paré at the 'Chateau de Hedin,' where each discharge of cannon seemed to act like the blow of a stick on the head wounds of the patients, and frequently resulted in hæmorrhage, delirium, and even death . . . ."

"As for the activity of the traffic, this is what produces the noise of towns (and the more when the ground is furrowed), by the wheels of heavy carts and omnibuses, of which the roll makes the nerves and the very window panes vibrate. The sedative qualities of the Venetian atmosphere is due to the absence of street noise. As for narrow streets, in addition to all other arguments I have brought up against them, I will add this one, that they are the cause of the re-echoing of sounds of which we have a good example when a train passes through a tunnel."

Double-paned windows exclude much noise and save much warmth; but the annoyance caused by the vibration of the buildings continues where the roads are rough. Relief is provided for the wealthy by covering the roadways before their houses with straw, but the great majority of persons and the poor cannot afford the expense of such relief. It is estimated that in urban districts there are always about 10 per cent. of cases of "bed-lying" sickness amongst the population. In a mile of public thoroughfare there will be constantly between fifty and a hundred ailing persons whose sufferings will be specially aggravated by such conditions of noise and vibration as those described.

The Conclusions as to Road Construction and Pavement Obtained by Mechanical and Engineering Science and Art.

The general conclusion arrived at is that, as a rule, all loud noise from vehicular transit in the streets—all grinding and rumbling of wheels, and jolting and banging of carts and carriages—all vibrations of the houses and shaking of doors and windows denote a greater or less waste of force, and a low state of science and knowledge on the part of those who are charged with the construction and maintenance of the public thoroughfares. To the same ignorance may be charged the greater proportion of all dust, dirt, and mud, and all bad smells on street surfaces, as well as of the dirt on clothes and on the person from the dirt and dust of the street, and the nervous agitation, restlessness, and sleeplessness at nights from the noise of carts and carriages in the streets.

LOSS OF TRACTIVE FORCE BY BAD ROAD CONSTRUCTION AND BAD CLEANSING.

The loss of traction force even from small elevations, such as those occasioned chiefly by bad cleansing, is stated in Sir Henry Parnell's work on roads as the results of experiments. The draught is stated to have been :—

On a paved road	2
On a well-broken stone road in a clean state ..	5
On the same covered with dust	8
On the same wet and muddy	10
On a gravel or flint road, clean	19
On the same road, wet and muddy	32

The effect of small elevations of surface in occasioning loss of force, may be observed in the retardation of the heaviest railway trains by scattering gravel on the railway.

It was shown by experiments with Sir John M'Neill's "road indicator," that by a granite tramway, on a slope of 1 in 35, the power required to draw a ton was reduced from 294lbs. to 132lbs.

Mr. Guilford Molesworth, in his text book of formulæ for engineers, gives as the resistance in pounds per ton on different roads (exclusive of gravity). On

Stone tramway	20 lbs. per ton.
Paved roads	33 " "
Macadamised roads........ 44 to	67 " "
Gravel	150 " "
Soft, sandy, and gravelly ground..	210 " "

These may be stated to be the chief results hitherto obtained in England as to the traction on roads.

The results of trials made on different roads in France by General Morin and M. Dupuit are thus stated by Professor Fonssagrives :—

Roadway asphalted	1
Roadway paved, dry, and in good condition	2·0 to 1·5
Roadway paved and in mediocre condition	2·5 " 2
Roadway paved, but covered with a little mud	2·7 " 2
Macadam in good condition and dry ..	3·3 " 2·5
Macadam, wet	3·3
Macadam in a mediocre condition......	4·5
Macadam covered with dirt	5·5
Macadam with the stones loose........	8·2 " 5

Experiments made by the direction of the French Government on the tramway between Sèvres and Versailles, showed that a horse on a level tramway draws three-and-a-half times the weight, at the same speed and with the same expenditure of power, that he can do on an ordinary road. Up a gradient of 1 to 100, he is capable of drawing 2·25 times the weight he can do up the same gradient on an ordinary road, and up a gradient of 1 to 25, he can draw 1½ times the load he can do under similar circumstances on the ordinary road.

In the varying conditions of the different roads, or of the same road at different times, wet or dry, as also the varying sizes of the vehicles, with their wheels and their weights, such results can only be taken as approximate, but they are sufficient to indicate the enormous waste of force and expense incurred in the traffic of the metropolis and of other districts by the wide differences of conditions visible to the eye, the results of unscientific and inferior management. In other words, they indicate the gains derivable from appropriate scientific treatment.

The losses occasioned by differences of conditions of the surface are aggravated by frequent unnecessary differences of inclines. Assuming the surface pavement of the streets to be smooth, and as good as the surfaces of iron railways, the loss of force from street inclines will be as great as it is demonstrated to be on railway inclines. The late Mr. Butler Williams, C.E., formerly engaged on the Ordnance Survey in Ireland, and afterwards Professor of Geodesy at the College of Civil Engineers at Putney, gave some evidence on this subject before the Health of Towns Commissioners in 1844. He displayed a study of the plan of Sir Christopher Wren for the rebuilding of the City of London after the Great Fire. He presented that plan as displaying the enormous loss by ignorance or by the absence of science in the directing minds of local public works. He showed the gain in distance by direct lines, as well as the gain from avoiding the losses of force by bad gradients. To illustrate this loss he got a survey of two lines, one from Holborn to Cheapside, and the other from Fleet-street to Cheapside, and taking the then traffic over these two lines, he showed that the loss of time and power entailed by the defective gradients and increased distances could not be less than one hundred thousand pounds per annum Such losses of force from defective gradients, i will be perceived from a view of any contour map, were more or less entailed over the whole area, from setting aside Sir Christopher Wren's plan of rebuilding the city as nearly as possible on a level plane.* It may be mentioned, in the way of illustration of administrative principle, that Sir Christopher Wren would have excluded blind alleys and the inferior dwellings of the wage classes, and also graveyards and noxious trades; and yet have given to every owner the same area, though perhaps in a different, and invariably in a better position, with frontages in wider streets, with better sweeps of winds and ventilation. The plan was approved by the King and the most instructed minds of the day; but the corporate, or what may be called the vestral minds of the day, prevailed in retaining the

* This plan deserves and requires a separate and careful study, but as it is little known, and is very scarce, a copy is given in the Appendix VII.

same old lines, the old gradients, and the old structures, and, in doing so, it is estimated by sanitary authorities, they entailed upon the population, besides the loss upon the traffic, a death-rate greatly in excess of what there would have been under the rudimentary sanitary conditions which Sir Christopher Wren's plan would have achieved.

The professor observed—"With respect to old districts, improvements of importance might be accomplished without interfering with the convenient access to houses, and at very moderate cost, by taking advantage of the repavement of streets, to level or reduce, by a few feet, the mere surface irregularities, such as may be noticed in many of the thoroughfares of the metropolis. In the repavement of the streets, as generally conducted at present, the old curves following the existing irregularities of the surface are retained, whereas, not unfrequently, an excavation of even as little as one or two feet at one point, and a corresponding filling up of one or two feet at another point, would remove irregularities which, as far as they go, are objectionable. Every foot reduced in the rise of a thoroughfare open to great traffic produces a corresponding saving of power by no means unimportant." In illustration of this point, it may be mentioned that Molesworth states that the traction due to the inclination of the road alone is always the load multiplied by the angle of inclination, say

$$\text{One ton} \times \frac{1}{50} \text{ (one foot in fifty).}$$

If the total friction alone be 33 lbs. to the ton, or $\frac{1}{68}$ of load, then the total traction will be

$$\frac{1}{50} + \frac{1}{68} \text{ or } \frac{1}{29}\text{th of load,}$$

equivalent to 78 lbs. to the ton.

After adducing various examples of the wastefulness of ignorance, Professor Butler Williams observed, "they show that, for amendment, you must have men of extended views, capable of embracing all the elements that combine to produce the results that ought to be obtained, and that it can scarcely be expedient in most cases that men of limited education should be called upon to decide on important sanitary matters."

Economic Principle of the Distinct Provision for Wheel Tracks and for Horse Tracks in Roadways.

The first conclusion arrived at by the General Board of Health for the improvement of the pavement of the metropolis was that provision must be made of smooth tracks for the wheels, distinct from the provision for the track and the foothold of the horses. This distinct provision had, indeed, long been made and successfully applied in the cities of Northern Italy. Lord Palmerston once called public attention to it, and expressed a hope that so luxurious and excellent a system might be introduced into this country. Mr. A. Stevenson, C.E., calls attention to it in his article on road construction, in the *Encyclopædia Britannica*. Mr. P. Le Neve Foster, jun., the son of our respected Secretary, a civil engineer in practice in Italy, has been so good as to give us sketches and a report descriptive of the method in which the principle is applied in Milan and other cities, together with the costs in detail. The Report, with the sketches, will be found in the appendix. (See Appendix I.) On wide thoroughfares, as at Milan, there are three or four lines of wheel track of this description. On some, however, the horse track is paved with Dutch clinker brick. The principle of the Italian roadway described has, indeed, been applied by stone trams as wheel tracks, on a part of the road to the Commercial Docks, at the East-end of London, in several narrow streets in the City of London, at Holyhead, and in other places. Some experiments made by Sir John McNeil on the granite tramways at Holyhead, and others on the granite tramways near the Commercial Docks demonstrated that by their use a saving of more than half the horse-power, as compared with the common roads, was effected. It was shown that whilst the horse retained his rough foothold, considerable gain in force is obtained by the tramways in ascending inclines. On an incline of 1 in 20, the power required to draw a ton was reduced from 295 lbs. to 132 lbs. An incline of 1 in 35 might be ascended at a good rate of speed, and descended at 12 miles an hour without risk. In passing over these granite tramways horses will have two feet on the roughened foothold; they do not fall, and generally there is no more slipping on them than on the common granite roads in the common conditions as to cleansing. When they were first laid down in England, each wheel track had kerbs; but in recent constructions they are dispensed with, and vehicles may freely move from one part of the road to another.

The General Board of Health contemplated the general adoption of the principle of the stone tramways, or of the Italian smooth wheel track, as in great part a sanitary measure for the entire metropolis. By reducing by one-half the tractive force required for transit, by enabling a single horse to do the work of two, a reduction would be effected of half the dirt and dust of the streets. By the smooth wheel tracks they reduced the greater part of the noise of the street traffic, and gave to carriage riders, who experienced it in the northern Italian cities, what they called luxurious as well as less expensive transit. Recent observations, made at the instance of this Committee, show that

whilst the wear on the horse track is as one, on the wheel tracks it is as two, which is about the proportion of the weight of the cart and load to the horse. If the wheel wear be taken on the smooth track, on which the wear is inconsiderable, it gives a proportionate reduction of the general wear of the road. In a Bill for additional power for the first consolidated Commission of Sewers, powers were taken to connect the service of the care of the road surface with the care of the road, as well as the house drains and sewers, which properly belong to any civil arrangement pretending to system. It contemplated bringing all the metropolitan streets and roads, suburban as well as urban, under unity of competent scientific administration—the suburban, as well as the urban, of necessity, for economy as well as efficiency;—for if the change were restricted to the urban district the gain would only be partial, inasmuch as a large proportion of the interior traffic being from suburban districts, if the rate of tractive force were unaltered for the suburban districts, the same amount of tractive force must continue through the whole district. It was therefore contemplated that the principle of a separate provision for the wheel tracks should prevail over all the suburban roads. The developed application of these views was prevented by legislative exigencies, into which it is unnecessary to enter. Such measures would, it is considered, have followed a competent examination of existing conditions of the metropolis, and also of the means which art and science had provided for dealing with them.

APPLICATION OF MECHANICAL AND ENGINEERING ART AND SCIENCE TO THE CLEANSING OF THE PAVEMENTS IN THE METROPOLIS.

However well a city may be laid out, however complete may be the paving of the streets, a great part of these advantages will be lost if they be not regularly and completely cleansed. Cleanliness and dryness, complete surface as well as subsoil and household cleanliness are the points on which the sanitary improvement of an urban population chiefly turns.

The attention of Mr. (now Sir) Joseph Whitworth was given, in 1840, to the bad cleansing of the streets of Manchester by hand labour, and he directed his great scientific genius to the means of producing superior cleanliness in them by machinery. He invented a machine which, while going at the rate of only two miles an hour, with brooms three feet wide, would clean nearly sixty superficial yards per minute, and lift the mud into a cart for removal. This was the average rate of work done by about sixty men. He constructed machines, and presented prolonged demonstration of their power in London and also in Manchester. He offered engagements, in Manchester and also in London, to sweep the streets thrice as often as under the old system, for the same money. But these demonstrations and offers were presented to minds which proved to be incapable of mastering them, and the machine was rejected on the ostensible ground that it would interfere with the labour of poor people, or of paupers. His particular views as to street paving, as well as street cleansing, will be noticed subsequently.

As to surface cleansing, the Commissioners of the Board of Health, having examined the subject and got trials made, came to the conclusion that the best cleansing by the broom alone was very imperfect—inasmuch as the broom alone, whilst it removes the greater proportion of solid or semi-fluid matter, spreads and daubs the pavement with that which is sticky and adhesive.

For cleansing street pavements, as well as for the cleansing of a paved court-yard or floor, the broom and the dry mop do not alone suffice, but need the aid of water for perfect cleansing and purification. During the prevalence of cholera, and periods of severe epidemic visitations, especially in hot weather, the General Board of Health, whose orders were at that time law, directed that filthy courts and alleys, the seats of fever, should be cleansed by strong jets of water, and where the immediate water service was insufficient, fire-engines were directed to be used to cleanse the walls of the foul habitations; to dissipate the close stagnant atmospheres, jets were thrown up as spray. By these means such freshness was given to the air and relief to the lungs as is experienced after heavy thunder showers. The inhabitants of the oppressed districts expressed their pleasure at the relief they received, and their hope that the practice might be continued.

The reduction of the time occupied in cleansing thoroughfares of great traffic is of economical value, but speed is everywhere of great sanitary importance for the quick removal of dung droppings and the prevention of the vitiation of the air by evaporation and by the dispersion of pulverised dung and other matters. Speed is also of economical importance for the saving of manure, as "fresh" manure is upwards of a third more in price and value than old or dried manure. The effectual hand-scavengering done at Manchester was from 1,000 to 1,500 square yards daily by each man. When Sir Joseph Whitworth's machine was in operation, going at the rate of 2¼ miles per hour, it swept the same extent of surface in a quarter of an hour. But the average extent of surface which could be so swept depends on the distance of the places of deposit to which the matter taken up must be removed.

TRIALS OF STREET CLEANSING BY JETS.

The Sanitary Commissioners directed trials and a report on them to be made by Mr. T. Lovick, C.E., of the comparative time and cost of street cleansing by washing. From these trials, which were made at the West-end in several streets, it appeared that complete washing by jet was effected in a third of the time in which it was accomplished by the scavenger. But these experiments could then be made only with jets of 20 feet vertical height. Other trials at Sheffield, by Mr. Lee, C.E., one of the engineering inspectors to the Board, made with a jet three times as powerful, or 60 feet, gave results with a third of the time, a third of the expenditure of water, a third of the labour, a third of the total expense, and at about a tenth of the time of the hand-scavengering. The expense with the more powerful jet, taking the cost of water at the price at which it would be on a public footing at 2d. per 1,000 gallons, was for labour 2d. per 1,000 yards, and water ¼d. With the lower jet, the expense of labour was 8d., and of water 2d. These results were obtained upon old boulder, or rough cobble pavements. With smooth pavements, and with jets skilfully applied in streets, the effect would be much greater. With some unctuous and adhesive mud the aid of the street-sweeping machine would be required to expedite the work. The total additional quantity of water required for this service would be about one-third of that which was then and is now wasted by the intermittent system of supply, and this on the constant system would suffice for the cleansing of the whole of the footways as well as the carriage-ways of the metropolis. Viewing the common parochial regulation requiring every householder, by himself or his servant, to cleanse properly the footpath before his house, as rude, wasteful of labour, and impracticable in its application to more than a quarter of a million of householders, the Commissioners directed inquiry to be made as to the extra expense at which it might be more satisfactorily accomplished as a common service; when it appeared that a penny per week, or less, would cover the expense of cleansing by jet. (*Vide* Mr. Lovick's Report, Appendix No. 2.) The total cost of cleansing the footways as well as the carriage-ways in the Strand daily was estimated at fourpence farthing per house weekly; in High-street in the Borough, it would have been threepence farthing per house per week for the daily cleansing of the footways and the carriage-ways.

In ignorance of the scientific construction of drains and sewers, so as to keep them self-cleansing and free from deposit, it was objected to the introduction of the street-sweeping machine in Manchester, that it would occasion more mud to be sent into the sewers, and would clog them. Sir Joseph Whitworth engaged that if such a result did occur he would undertake to defray the expense of cleansing them. But it never did occur, from the extra cleansing given by his machine, and indeed it was admitted that the sewers required less expenditure for cleansing them than they did before. Some later trials of cleansing by the jet were made by Mr. Haywood, the City engineer, with general advantageous results, though with conditions of extra expense which are not accepted as of general application on a public system of water supply for the metropolis. But with reference to the discharge of the liquified mud through the sewers, he states that "during the experiment in street washing I had the gullies and sewers within the City carefully examined from time to time, and they were found to be not only as clean as they previously were, but if anything cleaner; and indeed I think that if the surfaces of the City pavements were cleansed by water alone, that both gullies and sewers would be cleaner than at the present time, for, as before stated, much dust or dirt is now swept into them in such condition that the usual current does not readily move it; whereas if the streets were daily washed nothing would go into the sewers excepting that which found its way there by reason of its fluidity. The street sweepings would, in fact, run into the sewers in as great a state of dilution as they do even during the heaviest storms of rain; and I believe, therefore, that no injury would accrue thereby to the sewers under the control of the Commission, but, on the contrary, that they would be benefited." And yet the City sewers, when examined by the Sanitary Commissioners, were found to be by no means of a first class for such a service. It marks the empiricism which at present commonly rules in such works, that it should be supposed that matter in such a state of fluidity as to flow over the *flat* surface of the street, and therefore with increased friction, must with less friction when discharged and concentrated into a narrow channel beneath—instead of receiving an accelerated flow—become stagnant and accumulate there. It is desirable, and important as principle, that the contrary result should be known and applied;—that as much surface matter as possible should be removed by the quickest, cheapest, and best method that there is by suspension in water. If every load were to be taken to a distant depôt as soon as the semi-fluid matter could be collected, the cartage would be increased, perhaps, eight or ten fold. If the cleansing were carried on under conditions of very wet weather, it would be almost impracticable. If the depôt for the City were a mile distant—and it might be difficult to find any so near—it might involve

a hundred miles of cartage daily for speedy cleansing. It is shown that the service of street-cleansing, to be effectual, must be closely combined, and must indeed be as one. Hence the error of the vestries and local administrations, who—as if it were to multiply contracts for patronage—let the work of watering the streets to one contractor, who does the work at his own time and in his own way; and the work of sweeping the streets to another contractor, who does the work at his own time and in his own way—both operations being thus spoiled. The sweeping contractor usually delays his work as long as he can—lets the mud remain as long as he can; and waits for the rain to enable the mud to be swept to the side, and late at night to get as much of it as he can down into the sewers to save the heavy expense of cartage. He will not, if he can help it, contend with the surface unless when he may do the work with the least disadvantage to himself. His great object is to avoid cartage. Now, the jet which, with the aid of the street sweeping machine, dispenses with the scavengers, attains the desideratum of dispensing, to the greatest extent, with the annoyance and labour of cartage. Instead of waiting for the uncertain rain, the jet is at instant command to do, in the most complete manner, the work of the thunder-shower, to put all soluble matter into the "creamy" condition, for its immediate discharge into properly-adapted sewers for its instant removal with all other soluble matter from thence.

Mr. Haywood has stated that the sewers of the City would be benefited by the practice. Sanitary science pronounces that the health of the population would be benefited by it. The death-rates of the metropolis reach their lowest point after continued, unusually heavy rainfalls, which have swept and kept down the stagnant deposit of old and ill-constructed sewers and their putrid emanations. The jet, properly applied, would in dry weather regularly do the work of heavy rainfalls or of thunder showers. The combined surface and subterranean cleansing in streets of large traffic, and with sewers properly adapted for quick removal in water, will be of great sanitary importance.

In Paris, where much of science enters into the administration, the principles set forth by the General Board of Health have been adopted with the appliances then recommended, but with a low amount of water power, requiring a greater amount of hand-sweeping than would otherwise be necessary. But as it is, much of the surface mud, the liquified manure, is removed quickly in suspension in water, fresh and undecomposed, and to the greatest extent unwasted, by means of which a superior order of vegetation is obtained such as has never before been seen near Paris.

There, as elsewhere, as a better knowledge of hydraulics has begun to extend, as the force of sweep gained by concentrated flows in smooth tubular or oval sewers has become better known, catch-pits, which were regularly made cesspools, to detain street detritus, are being abandoned, and surface matters are swept to what is a great general catch-pit at the outfall, where it may be most safely and economically dealt with in bulk.

To abate the inconvenience and torment of excessive street dust in summer time, or in dry weather, street watering is used to keep it down. But the evil of such amount of dust is in great part due to the defective condition of the pavements and cleansing of the road surfaces on which the dust is produced, and the sanitary evil is often aggravated by the means used to relieve it. Open gravel road-ways, Macadam pavement — merely mud-bound — loose-jointed granite or wood pavements of the common construction are permeated with the solutions of the surface dung deposits, and become excrement sodden. The dry decomposition of such matter is less injurious than the moist emanations produced by street watering at certain times, denoted by offensive smells, even in first-class thoroughfares at the West-end of the metropolis. To repress these offensive and noxious emanations, the distribution of disinfectants from the water-carts is frequently urged, in like manner as the use of disinfectants is urged to mitigate the emanations from putrid deposit in badly constructed sewers. The expense of the street watering would often go far to the formation and proper keeping of impermeable street surfaces, from which fæcal matter would be immediately removed before it could enter into decomposition, and on which at any time there would be scarcely anything to be removed.

Proper cleansing by jet on proper pavement, as described, leaves little or no mud or dust to be kept down. A well-paved court-yard, kept clean by water and mop, should be the type of the general condition of the thoroughfares of the metropolis under a proper competent scientific administration, which would maintain a state of cleanliness and freshness heretofore unknown.

PRIMARY CONCLUSIONS.

On the whole, it will be found that there have been established, as standing demonstrations long made, but existing fruitlessly, during nearly the last quarter of a century, for the guidance of local administrations, viz.:—

First, that the cleansing of the surfaces, and the preservation of the subsoils immediately beneath them, from putrid animal or vegetable matter in suspension or solution, is an important branch of sanitary art and science, powerfully affecting

the health of the population, which ought, for the safety of the health and the lives of the population, to be placed under the responsible supervision of sanitary officers and special engineers.

Second, as regards the surface pavement of the carriage ways of streets such as those in the metropolis, by the right application of engineering science and art in the improved levelling and paving, the tractive force required for persons and goods may be reduced more than one-half, with a proportionate reduction of street dirt and dust.

Third, by the application of special engineering and mechanical art in hydraulic and drainage arrangements, the time and expense of the surface cleansing of streets may be reduced more than one-half, and injuries to goods and furniture, and clothes, as well as excessive dirt on the person, and serious injuries to the health, may be prevented.

Recent Applications of Engineering Science and Art to the Improved Construction and Cleansing of Street Surfaces.

With these last recited large conclusions—sanitary, mechanical, engineering, and economical—long clearly demonstrated as available for the public relief, the course of inquiry which followed was, "Why have they as yet fallen through? What additions have been made to them? and What are the existing conditions for their application in the metropolis?"

Amidst the conflict of large interests and opinions on the various materials and methods of paving, we found it difficult to obtain independent and satisfactory scientific or other testimony in relation to them. The occupations of the members of the Committee prevented them giving the time required for particular examinations. They therefore engaged the services of a gentleman, known to some members of the Council as competent, and of a position to make direct inquiries, Mr. Samuel Sharp, an architect. He was instructed to make direct observations and examinations of the different sorts of pavements.

We also obtained the important services of Mr. Amos, who has been accustomed to test the force required for various new agricultural steam ploughs and other machinery, to get us a dynamometer to test the tractive force required on different sorts of pavements. He has provided a machine with important improvements for the purpose.

Through Colonel Henderson, the Commissioner of the metropolitan police, we sought information from the police superintendents as to the conditions of the streets in which accidents are the most frequent.

We also considered it expedient to consult the experience of occupiers of houses and shops on the lines of street paved with new materials. We framed a set of queries on the different points, not including the sanitary points, on which it appeared probable they might be able to give answer (*Vide* Appendix).

We also consulted experience on some points in Paris, through General Morin and Mons. Tresce, of our sister Institution, the Conservatoire des Arts et Métiers.

As to the condition of the surfaces for the expenditure of different tractive forces, the trials with Mr. Amos's machine extended over two days over different portions of pavement, some in suburban districts, and some in the City and other parts of the metropolis. They were made at varying rates of speed, about three miles an hour for cart and wagon traffic, and six miles an hour for ordinary carriage traffic. Higher force is required for higher speeds, and for comparison of results they should be got for each description of surface at the same speeds, which with the first trials were found to be very difficult.

The following is a summary of these experiments:—

Road Material.	Speed in miles perhour.	Draught in lbs.	Fraction of Load.	[illegible]
Gravelly Macadam in a side street ..	6·945	126·6	$\frac{1}{45·3}$	[illegible]
	3·45	114·322	$\frac{1}{50·3}$	[illegible]
Granite Pitching by side of tramway ..	5·15	70·963	$\frac{1}{81·1}$	·0123
	3·196	41·932	$\frac{1}{137·3}$	·0073
	2·557	47·572	$\frac{1}{121}$	[illegible]
Granite Macadam "freshly laid" ..	4·239	262·886	$\frac{1}{21·9}$	·045[illegible]
	2·775	242·726	$\frac{1}{23·7}$	·0421
Asphalte Pavement	5·025	91·525	$\frac{1}{64·9}$	·0138
	3·56	69·753	$\frac{1}{82·5}$	·0121
	5·687	84·268	$\frac{1}{68·3}$	[illegible]
Wood Pavement ..	3·932	118·163	$\frac{1}{48·7}$	·0200
	3·278	102·412	$\frac{1}{56·2}$	·0177
	3·827	100·066	$\frac{1}{57·3}$	·0173
Macadam road, very good on Victoria Embankment....	6·65	109·06	$\frac{1}{52·7}$	·0132

Weight of omnibus 22 cwt. 0 qr. 16 lbs......	2,480 lbs.
Loaded with 22 sacks of oats, weighing 149 lbs. each	3,278 lbs.
Total load....................	5,758 lbs.

So far as at present can be ascertained, the first mean results appear to be as follows :—

	Mean speed per mile per hour.	Draught in lbs. per ton of load.
Granite by side of tramways..	2·87	44·752
Asphalte roadway	3·56	69·753
Wood pavement	3·339	106·880
Good gravelly macadam road	3·45	114·322
Granite macadam, newly laid	3·507	259·800

Though it is expected that the results would be varied by repeated trials in different conditions, as to cleanliness and in close uniformity as to speeds on the same lines, it is not expected that the values of the several materials and methods of pavement would be very widely altered. It is objected, as respects the asphalte, that though the trials place them in an advanced position, it is not in so good a position as that given by general previous trials in Paris. Mr. Sharp reported, on examination, that the laying of the concrete foundation in London had been very irregular, and that the asphalte had partaken of the irregularity of the foundations, and had, as is visible, compared with other pavements, and especially with well-laid asphalte foot-pavements, irregular undulations. These undulations produce the effect of inclines, as is felt in riding, and augment unduly the tractive force required, which ought not otherwise to be greater than on the granite trams.

Such as they are, however, the results at present obtained are corroborative of the first-recited conclusions as to the enormous loss of force occasioned by ignorance and inattention to the direct interests of the great vehicular traffic of the metropolis, and the indirect interests of the occupiers of the particular parishes to whom the charge of the streets and roads is confided. We have not learned of any the remotest local perceptions of these large results consequent on these different conditions, varying from one to five. Even the manifest barbarism of the common practice of the parochial authorities, of subjecting the vehicular traffic, with the fourfold extra labour of ploughing through loose and sharp granite stones, and often granite flints of the newly-laid macadam, appears in the present state of information to be tolerated as a necessity even by educated carriage riders in the metropolis. On some roads steam rollers have been brought into use to reduce the labour of compression, but their use has been attended by the evil of loosening gas and water pipes, and by frequent injuries to the premises along the roads.

A competent authority would apply proper engineering means over the entire area to ascertain the loss of force from the condition of the surface pavements, as also from unnecessary inclines, for their guidance in working for its reduction, as a primary object of the administration of a metropolis. One point remains for examination, namely, of instances where tractive force of pavements were nearly the same, but where there were very wide differences in what may be called the percussive forces, or in the vibration experienced in the carriages passing over them.

THE DANGERS TO LIFE AND LIMB FROM THE EXISTING CONDITIONS OF THE STREETS OF THE METROPOLIS.

The dangers to life and limb, and the painful sense of insecurity prevalent amongst a large proportion of London, created in the minds of the aged and infirm, and of females, from the constant casualties arising from the conditions of the street and of the traffic, formed a special topic of examination.

We obtained from the Registrar-General the following returns of the numbers annually killed in the streets :—

1869	192
1870	198
1871	208
1872	213
1873	217
1874	211
Total in six years	1,239
Average	206

The numbers maimed and injured in the streets are at least ten times the numbers of those killed. Last year 2,855 cases were brought under the cognizance of the police. From the frequency of fractured limbs, arising from falls in the street, it became an object of inquiry by the first General Board of Health to provide appropriate stretchers or carriages, to avoid the additional injuries from the jolting over the pavement of the common carriages in which it is the usual practice to place the injured for removal to their homes or to hospitals, often causing serious additions to the original injury. But the regularity of the numbers annually killed denotes the permanenceof the fatal conditions; and the regularity of their recurrence, that they are insurable. It is, moreover, to be noted that the engineering means of security for life and limb against casualties in the streets is at the same time the primary security needed for the protection of life and limb and property against the spread of fire in houses, as shown by the report on that subject, namely, the immediate application of water from street hydrants. It may be calculated that if there be no legislative and administrative interference to prevent it, and the conditions of the local administration are allowed as at present, more than one thousand persons are doomed

to be killed, and ten times that number to be maimed and injured in the streets during the next five years. And so from year to year. Added to which will be two out of every three persons who are burned alive or injured by fire, and two out of every three serious fires that now occur. (*Vide* Appendix VIII., on the demonstration sof statistical science on the conditions in question.)

The answers to our inquiries by the superintendents of the metropolitan police as to the causes of accidents in the streets, assign the "greasy" condition as the one in which the greatest proportion of accidents occur, whatsoever and howsoever good may be the condition of the pavements.

The superintendent of the G division answers:—"I beg to report that the condition of the surfaces of the carriage roads in which the greatest number of accidents occur to foot passengers in the division is good—when dry—being granite paving or macadam;—but in damp weather it becomes very greasy and slippery, and is the cause of many accidents through persons slipping down at crossings." The accidents to horses he describes as governed by the like conditions of damp or dry weather.

The Inspector, in transmitting the answers from the Superintendents of the A, B, and C divisions, states that "the paving with granite appears to me to become so very slippery at times that I am quite afraid to ride in those streets so paved. Charing-cross, being on a slope, is the worst place in my district, and very often it is absolutely necessary to put gravel down so that horses may be able to travel with any degree of safety. The objection to macadam at this and other places is, I imagine, the difficulty of keeping it in repair. The foot pavements, when dry and clean, are as good, in my opinion, as one could wish; but in wet and dirty weather they become greasy and unsafe for old and infirm people to walk upon, and a disgrace to a capital like London. I would strongly urge, therefore, that some means may be adopted for the proper cleansing of all foot pavements, which would be an immense boon to the public."

These answers, it is to be noted, refer to the old granite pavements over the great extent of the streets within the district of the metropolitan police. But a more particular inquiry was made as to how this common condition was varied by the new forms of pavement introduced in the largest proportion within the jurisdiction of the City Corporation.

On a comparison as to the slipperiness made between granite, asphalte, and wood pavements, on the observed number of falls during equal periods of time, taken by direction of Mr. Haywood, the City engineer, at the instance of the City Commission of Sewers, it appeared granite was rather more slippery than asphalte, and that the wood was, on the whole, the least slippery of the three. There is no doubt, however, that in certain conditions the smoother pavement is the most slippery of any—that is to say when, by neglect, it is made slippery by being made greasy.

The testimony of omnibus and carriage drivers and shopkeepers, and of the witnesses whose testimony was collected by Mr. Sharp, was concurrent and conclusive, that on "dry" days and on "very wet" days the asphalte is not slippery, and that then there is no special complaint against it; but that, on what are called "greasy days," and at particular times and conditions it is, as might be expected, the most slippery of any for part of the time, but not for the whole of the day. The conditions are the spread of unctuous dung, adhesive mud, which the broom does not remove, daubed over the surface of the pavement, and then left to dry. On a slight shower, or on a deposit of moisture from a fog, this mud is made semi-fluid, oleagineus, or "greasy," and the surface is made slippery, and it is then that the accidents occur in the greatest number on the smoothest pavement. All dung left upon the surface of the pavement, especially upon a smooth pavement, of the carriage way, and left dry, is a visible and culpable preparation for slipping, when it is moistened, as much so in its way as orange-peel left on the foot-pavement. A full fall of rain, which dissolves the lumpy surface matter, completely restores safety. As already stated, a thunder shower at night puts the pavement in a condition of security for the morning traffic. A jet of water properly applied at any time does the work of a thunder shower; and with a due and moderate appliance of water to prevent the conditions of greasiness, the more competent administration of Paris has achieved for eighteen years an increased security of the traffic over smooth asphalte road-ways, which the local authorities of London appear to assume to be impracticable. (Vide summary of answers, Appendix IV., as to the comparative advantages of asphalte and granite pavements.)

Sir Joseph Whitworth, in his evidence before the Health of Towns Commissioners, speaks of the impracticability of removing this greasy condition by the broom alone. "No kind of street or road mud can," he says, "be properly cleansed (meaning by the broom) when the dirt is in that sticky or clammy state which is produced by the presence of a certain proportion of moisture. The continuance of that unmanageable condition," *i.e.*, with the best of brooms,—"so unfavourable to traffic, depends on a great variety of circumstances, the state of the atmosphere pure, and direction of the wind, the influence of the sun, the nature of the materials of

hich the road is composed, their mode of construction, and more particularly the actual state the surface, as regards repair and cleanliness. it be full of holes and covered with dirt, the ntinuance of that particular condition of perficial matter above referred to will be infinitely prolonged, during which period all fectual cleansing will be impracticable."

It is to be repeated and enforced that water ust be systematically used to meet the difficulty. ssuming the streets to be properly cleansed by ater early in the morning, before the commencement of the traffic; after its commencement in the crowded thoroughfares, where e droppings are stated to amount to three four loads daily per mile, the effective means prevention, according to Sir Joseph, would to have a water-cart kept moving in the line the traffic, to liquify the dung as it falls, and have a light sweeping machine to follow it d remove it.

AL-ADMINISTRATIVE CONDITIONS PRODUCTIVE OF PUBLIC INSECURITY AND WASTE.

The mass of direct evils, annoyances, and inconveniences fall, not upon the two or three undred owners of shops on the line of Cheapside, but upon the owners of the twelve housand vehicles passing daily along it. They ll not upon the shopkeepers, but upon the passengers, who are estimated at three-quarters of million, a ten times greater number passing hrough the City daily than the total number of s inhabitants.

In answer to inquiries as to the experience n this line, one of the shopkeepers in Cheapside stated that he believed that asphalte was less slippery than the granite pavement. When the pavement was of granite, the falls f horses before that shop were about three day, whereas since the asphalte there had nly been about two in a day, that is to say, ut of some fifty accidents daily along that line. But as to that three or that two regular falls daily, had he made no representation to the local authorities, or to those who had charge of the roads? No, he had not. The horses were not his, and so neither he nor other shopkeepers appeared to have been moved by the scenes of daily animal suffering to make any effort for its prevention. Very recently it appears that the slipping along that line on account of its "greasy" condition, occasioned an outcry for better cleansing, when this outcry was met in a manner which, if it were culpably clumsy, might be malice, for the street was so flooded with water as to make the entire roadway "a slop." The security to the horses was, however, at once complete; but there was an inconvenience to the shopkeepers from that "slop," and on a petition from them it was discontinued, that is, the safety of the passengers and the horses were sacrificed, and continued excessive cruelty to horses was maintained, and a most valuable material, discredited, on account really, as it would appear, of a mere ignorance of administration and inaptitude in cleansing.

The greater vehicular interest, and the far greater interest of foot-passengers whose lives and property are exposed, and who are subjected to continued terrors and annoyances, are evidently unrepresented, and left without effective protection.

The case will be found to be clear for a wider and more skilled representation on the part of the public, and for a competent and more general responsibility than is practicable by non-scientific bodies like the overseers or vestrymen. Some of the surveyors and other officers appear to be in advance of their work, but when amendments have been suggested to them they have declared that it was of no use to propose them, as it was beyond the capacity of their boards to entertain them. But the administrative areas are in conditions of mere barbarism and ignorance as to road formation, *cleansing*, and maintenance, and in such small and fragmentary patches as to preclude economical applications of science and art requisite for the purpose. Not in clean-streeted Paris, as it has lately been designated, nor in any capital in Europe is there such an example of the *morcellement* and *frustration* of efficient means of amendment, as there is in London under the independent jurisdictions of *Vestries* and other local authorities. These conditions can only be maintained by reason of extreme apathy and ignorance, if not under sinister influences. Effective action for the saving of tractive force, in the manner described by Professor Butler Williams for example, with respect to the reduction of inclines, must for complete work be carried on over the entire area of the traffic. If complete work of that kind were attempted in parishes or in fragments, the result would be a series of misfitting sections. Independently of the inclines, it is desirable that uniformity should be maintained in the surface pavement of the chief thoroughfares, at the least. The Superintendent of the G Division of the Metropolitan police, where the differences of pavement are chiefly of granite and macadam, observes that "If the same sort of surface existed — uniformity in all thoroughfares—it would be beneficial to horses, inasmuch as horses are very nervous on going from one pavement to another, and accidents frequently happen in consequence." The humane feeling displayed in this view of the police Superintendent admits of much stronger expression, and it is a matter of surprise that, with the kindly feeling there is in this country towards horses, there are such constant scenes of cruelty inflicted on them in the streets, not

only by the use of the whip to get them up inclines and over difficulties that are removable, but by the violent and cruel use of the rein to stop the momentum of heavy carriages on smooth pavements, for which the break or "skid" might be used. Sir Joseph Whitworth shows, as to the work of street cleansing, that the removal of such solid matter as cannot be discharged by way of the sewers and places of convenient deposit, cannot, except at excessive disproportionate expense, be provided for numerous small independent sections, and that for efficiency in that respect, unity of administration over the entire metropolitan area is necessary. But the great thoroughfares are so cut up into petty and independent jurisdictions as to frustrate any systematic and economical action. The chief thoroughfare from east to west, from Old Ford to Hammersmith, about ten miles, is under ten independent authorities. The thoroughfare from Hammersmith to the East India Docks, about eleven and a-half miles, is under thirteen independent Boards, of which the City and Corporation of London, which is supposed by foreigners to represent the entire metropolis, is only one.

The incoherent and obstructive condition of the local administrative arrangements of the metropolis will appear on consideration of the tabular view, presented us below by Mr. Sharp, showing the division of the main thoroughfares amongst independent Vestries or other local authorities.

Thoroughfares from West to East.

From Hammersmith to Bow.

1. Hammersmith.
2. Kensington.
3. Paddington.
4. Marylebone.
5. St. Giles' } St. Giles'.
6. St. George's, Bloomsbury } St. Giles'.
7. Holborn.
8. City of London.
9. Whitechapel.
10. Mile-end Old Town.
11. Old Ford.

This route is about 10 miles, and passes through 10 local authorities.

From Hammersmith to the East India Docks.

1. Hammersmith.
2. Kensington.
3. St. Margaret's, Westminster.
4. St. George's, Hanover-square.
5. St. Martin's-in-the-Fields.
6. St. James.
7. St. Mary-le-Strand. } Strand.
8. St. Clement Danes. } Strand.
9. The Rolls.
10. The City of London.
11. The Tower District.
12. St. George's-in-the East.
13. Limehouse.
14. Poplar.

This route is about 11½ miles, and passes through 13 local authorities.

Thoroughfares from North to South.

From Stamford-hill to Tooting Graveney.

1. Hackney. } Hackney.
2. New Town. } Hackney.
3. Kingsland. } Hackney.
4. Hoxton. } Shoreditch.
5. Shoreditch. } Shoreditch.
6. Norton Folgate.
7. City of London. London-bridge.
8. St. Saviour. } Southwark.
9. St. George. } Southwark.
10. Newington.
11. Kennington. } Lambeth.
12. Lambeth. } Lambeth.
13. Clapham. } Lambeth.
14. Streatham. Tooting Graveney.

This route is about 10 miles, and passes through 9 local authorities.

From Highgate to Tooting Graveney.

1. Kentish Town. } Pancras.
2. Camden Town. } Pancras.
3. St. Giles-in-the-Fields.
4. St. Martin's-in-the-Field.
5. St. Margaret's, Westminster. Westminster-bridge.
6. Lambeth.
7. Streatham, Wandsworth.

This route is about 11 miles, and passes through 6 local authorities.

From Highgate to Norwood.

1. Holloway. } Islington.
2. Islington. } Islington.
3. Clerkenwell.
4. Liberty of Saffron-hill.
5. City of London. Blackfriars-bridge.
6. Christ Church. } St. Saviour.
7. St. George. } St. Saviour.
8. Camberwell.
9. Lambeth.
10. Wandsworth.
11. Streatham. Norwood.

This route is about 10 miles, and passes through 9 local authorities.

From Upper Clapton to Roehampton-gate.

1. Up. Clapton. } Hackney.
2. Low. Clapton. } Hackney.
3. Hackney. } Hackney.
4. Bethnal-green.
5. Shoreditch.
6. St. Luke.
7. Clerkenwell.
8. City of London.
9. Strand.
10. St. Martin's-in-the-Fields.
11. St. Margaret's, Westminster.
12. St. George's, Hanover-square.
13. Chelsea.
14. Fulham. Putney-bridge.
15. Putney.
16. Roehampton, Wandsworth. Roehampton-gate. Richmond-park.

This route is about 13 miles, and passes through 14 local authorities.

From Cricklewood to Putney-bottom.

1. Hampstead.
2. Marylebone, or Paddington.
3. St. George's, Hanover-square.
4. Chelsea.
5. Fulham. Putney-bridge.
7. Putney.
8. Wandsworth. Putney.

This route is about 12 miles, and passes through 7 local authorities.

Summary.

From Hammersmith to Bow is about 10 miles, and is under 10 authorities.

From Hammersmith to East India Docks is about 11½ miles, and is under 13 authorities.

From Stamford-hill to Tooting Graveney is about 10 miles, and is under 9 authorities.

From Highgate to Tooting Graveney is about 11 miles, and is under 6 authorities.

From Highgate to Norwood is about 10 miles, and is under 9 authorities.

From Upper Clapton to Roehampton-gate, Richmond-park, is about 13 miles, and is under 14 authorities.

From Cricklewood to Putney-bottom is about 12 miles, and is under 7 authorities.

That is to say, 77 miles of thoroughfare are under the charge of 68 Vestries or independent local authorities.

Some of these parochial or vestry jurisdictions divide the streets longitudinally, and one half of a street is paved at one time, and the other at another time, and sometimes by a different method; one half is swept at one time and the other half at another time, to the

detriment of both operations. Sir Joseph Whitworth found that he would have no less than four district authorities to deal with to effect the cleansing of the Strand by his machine. Having other things to attend to he was compelled, by the fragmentary condition of the administration in the metropolis, to abandon the attempt to deal with it. The Metropolitan Road Commission, of which Lord Lonsdale was chairman, comprised between one and two hundred miles of suburban road previously under small parochial jurisdictions, some of them not more than a mile each, and by that Commission were retrieved from a barbarous condition to one of the best of the time under the direction of Sir James Macadam, as engineer. It has been stated that persons in carriages might in the dark tell by the jolting when they had left the roads of the Commission and had passed on to any interior line under the care of the parish authorities.

To get rid of tolls from which the improved roads were maintained, the Commission was abolished, and the roads were thrown again in parcels upon the parishes. The measure is one example of an increasing number displaying the expediency of having the elementary principles of political economy, involving administrative economy, taught in superior as well as in secondary schools, to stay the wastefulness of ignorance. In this instance, waste from defect in principle would have been seen to be inevitable. If the roads were to be kept up to their previous good and economic condition, it must be at heavy disproportionate expense to the separate parishes, for each for its mile of road must obtain the services of a distinguished engineer of skill equal to that of the special engineer of the Commission, and also an equivalent staff and engine power. If the roads were left to relapse into their previous condition, they must lapse into a condition of waste of tractive force greatly more costly than the tolls saved. The proprietors of stage coaches stated to a Parliamentary Committee that upon gravel roads in the neighbourhood of London, so beautiful in appearance and so pleasant to the traveller, horses of superior strength were rendered useless in the short space of three years. As against such waste, the parishes have the least, to them, appreciable interest. It has not been within our means or province to cause an examination to be made of the present condition of the roads formerly under the Metropolitan trust, for which examination there would have been needed a more extended application of the dynamometer, properly to test the present expenditure of tractive force on the roads, than was at the disposal of the Committee; and also an investigation of the financial results of multiplied inferior establishments, chiefly under the direction of officers in private practice, with divided and inferior attendance. But we have had before us a careful examination, by a competent surveyor, of a length of a fair specimen of eight miles of tolerably well-kept suburban road, chiefly Macadam, at Mortlake, and of the cost of its improvement on principle, from which it appears that the expense of a smooth asphalted wheel track, which would save half the tractive force now commonly used, and of a concrete impermeable, macadam horse track, saving dust and reducing noise, would be £50 per mile per annum less than the cost of the existing road to the parish.

The immense traffic of the urban districts is subject to long interruptions, with which the present fragmentary authorities are utterly incompetent to deal, with efficiency and economy. Falls of snow, for example, occur yearly, and block up the main thoroughfares for a greater or less extent of time. Then arise public outcries and articles in the newspapers, blaming the local authorities for the miseries and losses endured, as a consequence of their mal-administration. To get the main thoroughfares into a passable condition, it will be seen from the tabular view how many independent staffs, utterly unaccustomed to any common control, must be brought to act in concert. The consequence is prolonged obstruction to traffic and disorder terminated only by a thaw. A case is stated, where in consequence of the complaints of the state of a city thoroughfare a contractor for the cleansing of the streets was summoned before the Lord Mayor for not cleansing the streets properly. The answer of the contractor was, that his contract was for the removal of mud alone in its ordinary condition, unmixed with snow, and that if his lordship would have the goodness to direct the snow to be separated from the mud, and the mud to be placed in its ordinary condition, he, the contractor, would then be enabled to fulfil his contract and remove it. But he had not sufficient force, and could not be put to the extraordinary expense of removing vast quantities of snow. As usual, there was no help for it but to leave the public to endure their miseries until they were abated, and the difficulties were resolved by a thaw.

Unity of administration, under a specially qualified authority, would necessitate some prevision and preparation for the occurence of such conditions, and give the means of a rapid concentration of force, with proper appliances of snow ploughs, to be worked from end to end of lines, and to effect clearances of footpaths as well as of the carriage ways, and give relief, in a small time, and at greatly less expense than must be incurred by any possible or practically impossible concert of the present multiplied local authori-

ties. Unity of administration would also reduce the prolonged great inconvenience and expense of irregular opening of the streets for gas and water pipes.

It may be mentioned here that as respects the horses' shoes, attention has long been called to its defects by Sir Frances Head and others, but Sir Joseph Whitworth now points out the achievement of a decided and important improvement, which will have a large effect in road conservancy, as well as the reduction of noise. The improvement consists in the fastening of a rim of hardened steel, of about half-an-inch square, to the horses' feet, and letting the frog grow to its natural size. One effect is to reduce by five-sixths the weight of the old shoe, or in other words to reduce by five-sixths the weight of the rim hammers constituted by the common horses' shoes, pounding the road surface, and creating road dust and dirt, and distributing it about. The saving in this respect, as well as the reduction of noise by the reduction of the weight of rim, and also the saving of road wear, would warrant the imposition of the stimulus of a tax, or a toll upon heavy horses' shoes to hasten this removal.

We now call attention to the information collected, specially in respect to the new materials and to the chief new methods of pavement lately introduced and tried in London.

It is to be borne in mind that the essential qualities for our urban pavement are perfect impermeability, cleansibility, smoothness, and tenacity for wheel traction;—granulated, roughness for horse traction, and noiselessness.

Sanitary Objections to Wood as a Material for Pavements.

The General Board of Health set aside wood as an ineligible material, for this amongst other reasons that street surfaces ought to be impermeable, and for roads of light traffic and cheap construction they looked to modifications of macadam, with bituminous binders of mineral tar. Since then wood has been reproduced for the purpose, and strongly pressed in improved forms for trial. It certainly offers the advantage of a great gain in noiselessness over granite, more especially from the horses' feet; though with some disadvantage from a dead rumble and vibration; and further, it has the advantage of being more available than smooth pavements for inclines. But hygienists object to its use on grounds which, in the absence of sanitary science, are overlooked, but which it is important to particularise, as showing the dangerous state of ignorance and incompetency of the authorities, by whom they are not entertained or are disregarded.

It is found that "hospital gangrene" frequently follows the washing of plain wood floors with water; and "dry rubbing" is prescribed to avoid the evil. Careful waxing of the wood, to diminish its absorbency, is also prescribed as a preventive.

On shipboard new timber, or moist timber, between decks is found to be very detrimental to the health of sailors, and "dry rubbing" is prescribed for their protection. When the timber on shipboard is saturated with bilge-water, or putrescent matter, it is found to be the source of fatal epidemics.*

Impregnation of the wood with mineral matters, to preserve it from decay, may diminish these evils, but nothing as yet tried prevents the fibres being separated, and the absorption of dung and putrescent matter by the wood being continued. The condition of absorbing mere moisture is of itself bad, but when the surface absorbs and retains putrescent matter, such as horse-dung and urine, it is highly noxious. The blocks of pavement with this material are separated by concussion, and are thus rendered permeable to the surface moisture. Mr. Sharp, who examined some blocks taken up for repavement, states that he found them "perfectly stained and saturated with wet and urine at the lower portions, while the upper portions were dry." Mr. Elliott, a member of the Society, and for many years a deputy of the Common Council of the City of London, has carefully observed the trials of new modes of paving there, objects to the wood that it is continuously wet or damp. "Wood is porous; it is composed of bundles of fibres. It absorbs and retains wet, foul wet especially. The fibres of the wood are placed vertically, the upper ends whereof fray out, are abraded, and become like painters' brush stumps, and are almost as permanently dirty, or they break like the handle of a chisel which has been struck with an iron hammer or wooden mallet. This fact is beyond all question. Wood is wet or damp, more or less, except during continued very dry weather. Its structure is admirably adapted to receive and hold, and then give off in evaporation very foul matters, which taint the atmosphere and so far injure health."

Sir Joseph Whitworth, in his evidence before the Health of Towns Commissioners, stated that "the wood most generally used for paving purposes, being very porous and the fibre vertical, or nearly so, the manure, when pulverised by the action of the wheels, becomes so imbedded in the fibre, and adheres with such tenacity, that it is impossible to remove it except when either very wet or dry. The power required for cleansing it is also much greater than for stone, and we

* Fonssagrives' "Hygiène Navale," p. [illegible].

nsequently find that a horse cannot cleanse equal number of yards per day on wood pavement. A much greater quantity of rain is re-ired to cleanse it well, and it is much longer drying, hence the time afforded for efficient ssing is of much shorter duration." But the surface cleansing of this material is visibly y of partial extent. The advantage of the od in giving a better foothold and more ety for the horses than very smooth pave-nt on steep inclines, is obtained by cham-ing the wood blocks and creating inter-es for the deposit of offensive dung and t which the broom does not remove, which could only be cleansed with great iculty. These interstices, usually thus filled, stitute about one-sixth of the whole surface. nitary authorities regard the existence of such ible conditions as denoting a low sense of ic decency and propriety, which is not of-ded by the sight of foul surfaces, and is anxious for their removal, nor gratified the sight of cleanliness, nor anxious its exemplary maintenance. They have doubt that wood pavement must supply important contribution to the ill-health of ns. They are certain that if any well-paved, ll-cleansed, and dry playground were taken up, a wood pavement were substituted for it, that effects experienced in hospitals and on ship-rd from the simple damp of the wood, would manifested amongst the children; but if that ol and that pavement were daubed with dung mud, and put in the common condition of wood pavement in the streets, they have no ubt that it would soon become, as it were, the re of a fever nest. Foreign sanitary autho-ies agree with those here on the question. hus Mons. Fonssagrives, the Professor of ygiene in France, already quoted, gives the lowing account of it:—

"The wood pavement has been frequently tried. The ssians seem to have been the first to do so, and have d blocks of wood with six sides for the paving of eral streets in St. Petersburg. The English have tried this system, and we may see specimens in rious streets in Paris, notably in the Rues Croix-des-tits-Champs and Richelieu, which have been par-lly paved with blocks of wood, laid on a bed of sand d lime; and only last year a small portion of the ulevard Saint Michel was paved in this manner. This vement is certainly very even, and by reason of its sticity it yields to the pressure of the horses feet, and us affords a foothold; but it has the double drawback at it wears off in fibres, and that it deadens the noise a degree which is dangerous for the foot passengers. oreover, the swelling of the fibres when wet dislocated e pavements, and the expansion of the wood by the tion of heat, produces a pressure which displaces the t-pavement.

"The hygienist cannot, moreover, look favourably pon a street covering consisting of a porous substance pable of absorbing organic matter, and by its own composition giving rise to noxious miasma, which, roceeding from so large a surface, cannot be regarded insignificant. I am convinced that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers. Happily, all the attempts have failed, and the method has been apparently finally condemned. Wood is therefore reserved for those rough pavements, which, as in Russia and in Wallachia, consist in covering marshy roads with hewn trunks of trees, over which the carriages pass; but this cannot be compared with a regular covering of all the streets with wood-pavement." — "Hygiéne et Assainissement des Villes," by J. B. Fonssagrives. Paris, 1874.

The account given of it by the Commissioners of Public Works in New York is unfavourable to it on economical grounds; as to the great expense of repairs, they state that "since decay has taken place in the wooden pavements many complaints have been made of the offensive and unhealthy effluvia emitted from it. This department has used its best endeavours, and all the means at its command, to remedy the evils; but it had only been able to do so to a limited extent."

The sanitary evidence on the subject will be found to be clear, consistent, and decidedly against it.

POSITIVE AND RELATIVE ADVANTAGES OF ASPHALTE AS A MATERIAL FOR PAVEMENT.

The summary of sanitary experience in France, as to the material most preferable, are thus stated by Professor Fonssagrives:—"L'absence du poussière, l'amoindrissement du bruit, le defaut de joints permittant une imperméabilité complete, et provenant ainsi l'infection putride du sol, sont des avantages précieux que realisent les chaussées asphaltes."

All the answers obtained as to the experience of the chief new forms of pavement display a new sense and a high appreciation of the gain obtained from noiselessness from the wood as well as from the asphalte pavements. The shopkeepers state that they can now hear and speak to their customers, and their customers can hear and speak to them, without raising their voices. It is now no longer necessary to keep their doors or their windows shut to get rid of the noise.

Preference was given to the asphalte first (if it were kept clean), for the wood next, and for granite, of whatsoever form, the last. Summaries of the answers, verbally and in writing, by occupiers in London, on the experience of asphalte pavements, as compared with granite, are given in the appendices, and also summaries of the experience of wood and asphalte in Paris.

The answers obtained to our questions from the occupiers of the chief lines of the most important trials of the new pavements in the City were, however, so few as to excite surprise at the apparent want of interest in the subject. But on inquiry it appeared that the civic condition has of late been largely changed, and that there are really very few resident citizens remaining there, living and sleeping there with their families. They had all removed to the purer

air and quiet of suburban residence. A quarter of a century ago the resident and sleeping population of the City was 127,000. Last year the number of residents estimated as sleeping in the City was 75,722. Only a small proportion of the reduction of the population has been occasioned by expulsions for the formation of new lines of railway or of streets. The great mass, or full 50,000, including all the aldermen (not one of whom is known to have more than an office in the City), the Lord Mayors and their families, and many even of the hotel-keepers, have gone for less impure air and greater quiet and rest in the suburbs. These influential persons care the less about the conditions of the streets on account of the shorter time they are there. The like change which has extended to other districts of the metropolis requires to be taken into account in any new administrative arrangement in respect to them.

Mr. Sharp observed carefully the wear of the asphalte material at the points of the heaviest traffic. At these points he examined the wear of pieces, after the pavement had been laid down for more than three years, and found that on an average they had been reduced from two inches and a quarter, to not more than one inch and three quarters. But it appeared that this reduction in bulk had been chiefly by compression, and not by abrasion, inasmuch as they did not appear, so far as could be ascertained, to have lost in weight. Some specimens of the Val de Travers, taken up after four years' wear in a street of the greatest traffic, were found to be reduced about one-ninth in bulk, but to have been increased in about the same proportion in specific gravity, showing that the reduction in bulk was due to compression, not to wear. Some of the same material, taken up after fifteen years' wear in the Rue de Bergère, a street of much traffic in Paris, was found to have been reduced from two inches to two inches and three-quarters in thickness, but had lost only five per cent. in weight. As an illustrative comparison, it may be mentioned that Mr. Redman, the engineer for twenty years of the East and West India Dock Trust, stated at a discussion of the Society (*vide Journal* for April, 1870, page 457), with reference to the granite tramway in Commercial-road, that the annual import and export of the tonnage connected with the docks passing over this tramway, was about 300,000 tons, and in addition to that there was a general vehicular traffic amounting to about 300,000 vehicles a year. He stated, that at that time the different qualities of stone were not so well known as at present, and the result was very remarkable. The larger portion was formed of Aberdeen granite, and the remainder of granite from Guernsey, or from Herm, another of th Channel Islands. The Aberdeen stone, whic was originally twelve inches thick, now averag only eight inches, having lost four inches in fou years; Herm granite had lost from two to thre inches; and the Guernsey granite had lost littl more than one inch in the same period.

Taking into account that the traffic und which these stone trams were subjected w apparently less than one-fifth of that to which th new material underwent in Cheapside, the extr ordinary result is presented that the asphalte w is greater than the hardest granite. If the redu tion in bulk were due solely to abrasion, wh is doubtful, and if it were to go on in the li proportions, the "life" of this asphalte pavem would be fifteen years. It is stated that in Pa it has lasted seventeen years. Mr. Haywo the Corporation engineer, stated at the Insti tion of Civil Engineers that the granite pavem in this same street, which was laid in 1846 w cubes of granite three inches thick, lasted, w occasional repairs, until 1856. The carriag way in the same line—the Poultry—after hav been down six years, was taken up in 1852. T "life" of other granite pavements in connec lines of heavy traffic appears to have avera about seven years. The longest example w one on London-bridge, which lasted nine yea

The absence of any returns of the traffic the lines paved with the Limmer and oth asphaltes, prevents the like comparison be made in respect to them, but they each pre examples of durability greatly in advance of t granite. At the same rate of wear as t granites, so far as they could be compa the chief specimens of the asphaltes would ha disappeared. The astonishing relative durabi of the chief of these materials is accompa by a relative reduction of the amount of abra dust such as is ground off the granite, a especially from the macadam roads in We minster-bridge, to the extent of upwards of inches annually, producing that dust which is peculiarly irritating and injurious to the respi tory organs. This tenacity of the material accompanied by a feeling almost of elasticity the tread of the foot, and yet a great non-co ductibility of vibration or of sound. There less of "sonority" than in the granite tra ways; the noise of the wheels is suppressed, a only a clack of the horses' shoes is heard.

A member of our Committee, who has give much attention to the construction of roads their sanitary as well as in their commerci aspect, has been led to propose a new form road, to obviate the difficulties as to th inclines, and effect considerable economy i road construction and wear and tear, reducti of dirt, and facility of cleansing. He forbea to develop it in its bearings on the present occa

ion, and prefers that it should be reserved for ndependent, and probably less partial, examiation than might be given to it in connection ith the present inquiry. It may, however, be vorable to state that it is based upon the lian principles of the smooth wheel tracks, stituting hard and smooth asphalte for the ooth stone or granite slabs, with the advange that the asphalte is without joints or jolts, d would be even less noisy, greatly less exnsive than slabs of granite or other stone; at the whole road, the horse track and the eel track would be impermeable and washle, and less expensive even than the ordinary urban macadam road; and that two miles of asphalte track of the proposed construction y be laid down at the expense of one of nite, and three miles at the usual expense one mile of the iron tramways. (*Vide* strated sketches, Appendix No. II.)

...re of Further Improved Applications of Steam Power for Road Traction.

The premature decease of the late Mr. John ntham, C.E., a member of the Society, ked the prosecution of an invention he had pleted of a steam-propelled omnibus carriage, e worked on the ordinary street tramways on these asphalte wheel-tracks, at half the ense of horse-power, and dispensing with se-power altogether, thus reducing the dung dirt, and the cleansing and wear of the roads. this invention the Society of Arts has just rded its Gold Medal.

Our late member, Mr. Bridges Adams, conered that the principle of the hot-air engine, much in use in America for the application of er from one to six horses, would be the most ible force for smooth road traffic.

ttention is also being directed in America he application of small powers to dispense h horses for carriage traffic. A "fireless" motive has been employed by Mr. Lumm the New Orleans tramway since the spring of 72. It consists of an ordinary steam-engine unted on the tram-car or on a separate truck, h a boiler having no furnace, and therefore okeless and less liable to explode. This locotive is supplied with water from certain ionary boilers along the route heated to a perature corresponding to twelve or more ospheres of steam pressure. As this water es off steam to the engine, its temperature d the corresponding pressure of the steam tinually diminish, until a new station is ched and a fresh supply of steam is taken in, ich is done in little more than a minute. s force will last for about an hour, and for a ce of between eight and nine miles. It is ted that with fifteen engines an economy was ected of 50 per cent. over the use of horses. On an entire line of well-asphalted road the fireless engines would work as well as on iron trams.

If one complete line of thoroughfare could have been laid down with smooth wheel-tracks, and maintained in a proper state of cleanliness and kept safe, instead of being made slippery and dangerous by neglect and filth, Mr. Grantham's and other important efforts for a much-needed improvement might have had fair trial. But if the City Corporation (or any one of the vestries) were disposed to the consideration of scientific improvement and anxious for its promotion, it could of itself do little for it, with authority over only some tenth part of a main thoroughfare, perhaps not above a tenth of the entire thoroughfare required for a proper trial of improvement, and most of the rest being in reality entrenchments of strong interests against it. The trials made in the City, much to the credit of the Corporation, defective though they were in respect to cleansing—were quite sufficient when properly attended to, and, studied with the obvious means of supplying defects, ought to have led to extensive adoptions of the improvements by common consent over entire lines of great thoroughfares. But they have met with no imitation except in mere small and insufficient patches.

The fragmentary administrative areas of irresponsible local bodies to which the metropolis is subjected will therefore continue to be, as they have been found to be, insuperable barriers to any considerable advances of science and art for the security of the health and lives, and the safety and comfort of the population. The first step to any effective amendment in this respect must, therefore, be to withdraw those fragmentary inadequate powers for efficiency and economy, and place them under unity of administration of a few persons specially qualified by engineering science and position to undertake the responsibility of the work, and to give it undivided attention. Such an authority, having the whole field of the service under their view, having large means at their disposal, and being responsible for their application, could not safely act obstructively. Such an authority would be expected to promote progress by scientific examinations, such as we have desired, but with the inadequate means at our disposal have not succeeded in obtaining, as well as by liberal trial works of different materials and different methods of fair promise. After all the complaints of inventors, some of them rivals in position and of opposing interests, and some of those complaints well-founded, it is nevertheless the fact that no such advances in science and art by experiment and trial work have been made as in the public departments under scientific control.

Applications of Special Science and Art needed for Improvement in Economy and Efficency.

On a retrospective survey of this field for the application of engineering and sanitary art and science to street and road formation, and maintenance and cleansing of the metropolis, as well as of other cities, it appears that that service has three periods of progress—1. Of entire ignorance and apathy. 2. Of empiricism, from which it has to be retrieved. 3. The period of science brought under view for competent treatment.

The conclusions of the Metropolitan Sanitary Commission as to the drainage works of the metropolis, appear to be applicable to its street and road works:—"The more the investigation advances, the more is it apparent that the progressive improvement and proper execution of this class of public works, together with the appliances of hydraulic engineering, cannot be reasonably expected to be dealt with incidentally or collaterally to ordinary occupation, or even to connected professional pursuits, but require a degree of special study, which not only places them beyond the sphere of the discussion of popular administrative bodies, but beyond that of ordinary professional engineering and architectural practice. In justification of this conclusion, and to show the evil of the perverted application of names of high general professional authority, we might adduce examples of the most defective works which have received their sanction. All the improvements which the public have yet obtained in this branch of public works have been the result of the special and undivided practical attention of well qualified paid officers; and it appears to us that further improvement must be sought by the same means, and that one of the chief objects of future administrative arrangements must be to secure, protect, and encourage the zealous undivided attention and efficient labour of such officers."

Strong allegations are rife as to the predominance of the sinister interests of contractors at local boards, making them intrenchments against improvements. It may be so, and in the absence of effective securities for a correct expenditure of the public rates, it is very likely to be so; but we have not the means, nor have we deemed it our province, to inquire as to the foundation for such allegations. Moreover, we have the conviction, that however pure may be the expenditure in intent, an efficient and economical administration is impracticable in such narrow areas as those to which it is left unaided and unguarded by any fitting experience.

Sir Joseph Whitworth and all disinterested scientific and competent witnesses concur in this conclusion. The observation is indeed, forced upon us that the intelligent and respectabl[illegible] members of the local boards who would exte[illegible] their views beyond their narrow, incongruou[illegible] and incoherent parochial jurisdictions to t[illegible] general wants of the metropolis, and who wou[illegible] consider the cramped and utterly inadequa[illegible] conditions in which they are placed to m[illegible] them, would themselves suggest the delegati[illegible] of their functions, for the establishment of [illegible] of management under one competent autho[illegible] with adequate power, as essential to economy [illegible] well as efficiency. But we regret to state t[illegible] the scenes in the streets, and the public [illegible] plaints appear to have excited no interes[illegible] in the recent examples of improvement, i[illegible] fect as they may be—placed before them by [illegible] City Corporation, or those that have [illegible] existed of improved wheel traction. T[illegible] immediate and present examples have ha[illegible] little effect in inducing improvement as the [illegible] demonstrations of science. Only small pa[illegible] here and there have been yielded with [illegible] reluctance to pressures of influential indivi[illegible] for relief from the noise of the common [illegible] pavements. The substance of a recent de[illegible] of the vestries in Parliament by the chai[illegible] of the Metropolitan Board of Works as rep[illegible] was how much money they had spent and [illegible] spending, and with the implied conclusion t[illegible] would go on spending in their existing [illegible] tions, without the slightest manifestation of [illegible] sciousness that there was anything to be a[illegible] in them. Their expenditure appears to [illegible] the rate of one million per annum for the [illegible] polis, being at the rate of £2 5s. per annu[illegible] house for "making, maintaining roads, st[illegible] and footpaths, and for scavenging and wa[illegible] the same,"—such as they are—and it is [illegible] beyond the widest approximate estimate w[illegible] get of the expense of an improved formatio[illegible] management, and it calls for investigation.

General Conclusions.

On a review of the information collecte[illegible] the Committee on the common methods of [illegible] ing, paving, maintaining, and cleansing the [illegible] faces of streets and roads in the metropoli[illegible] respect to the science and art conclusions [illegible] before stated, namely, that they powerfully [illegible] the health of the population to an extent [illegible] fore unknown and disregarded, and ought [illegible] brought within the cognizance of sanitary [illegible] that the street and road formation might [illegible] far improved on a long-tried principle [illegible] reduce the tractive force needed for traf[illegible] more than one-half, and that a threefold a[illegible] of street cleanliness was obtainable by impr[illegible] machinery, without any augmentation of t[illegible] usual rate of expense for hand-cleansing; [illegible] find that from want of science and art intro[illegible] tion, from ignorance and apathy, these de[illegible]

rations have been of little or no avail, and that e general condition of the streets, in excessive th, and noise, and disorder, are the reflex of general condition of an expensive local administration;—that the common defective conditions of the greater proportions of the surface, nstion, paving, and cleansing of the streets, th the increasing traffic of the increasing popuon of the metropolis, occasions much filth, sisting chiefly of pulverised horse dung and nite dust, to be deposited on the person, thes, furniture, and houses of the population; t the filth so deposited is highly injurious to alth, especially to an extent hitherto unrerded of the children of the wage classes of population, as well as the adults of those sses, who have little means of frequently shing themselves to remove it;—that such gravations of the conditions of personal filth d squalor, besides being detrimental to health, ve a pernicious effect in lowering the selfpect and the moral status of the wage sses of the population; that the exces- e noise occasioned by vehicular traffic over common pavements is a cause of suffering nvalids, occasions doors and windows to be t to keep it out, and ventilation to be obucted. We find, moreover,

That on an average upwards of two ndred persons are annually killed, and wards of ten times that number maimed or ured in the streets of the metropolis, the atest proportion of which injuries occur on at are called "greasy days," or days of cessive slipperiness, occasioned by defective ansing;

That such conditions of bad cleansing and defective methods and bad paving are the occasion excessive cruelty, accidents, and injuries to rses, and fractures to vehicles;

That the best means of preventing such accints, by better applications of supplies of water r cleansing the streets, are the same that are eded for the better protection of life and proerty from fire in houses;

That the economical and efficient application art and scientific means of relief is frustrated the conditions of the fragmentary areas of ependent, obscure, and virtually irresponsible al administrations, under which the metrolis is placed, which give, for example, one main roughfare from east to west to fourteen tries or independent authorities, of which e Corporation is only one, and another line m north to south to thirteen parishes, each ing charged with only one mile of the line, hich divide some streets longitudinally tween different parishes, one cleansing or ving the street at one time, and one at another, a manner detrimental to both; and

That the first and essential step to any effective and economical improvement is to get rid of these disorderly and discreditable administrative conditions—which exist at the expense of life and limb, and health, and comfort of the population, and the freedom of traffic of the metropolis—and to place the whole area under unity of administration by a specially competent and responsible authority;

That the attention of her Majesty's Government be solicited to these conclusions and to direct a more full examination of the facts on which they are based.

Unity of administration is the declared object of the agitation for a metropolitan municipality, which it may be assumed would include the administration of the roads. Without entering into that question, there can be little doubt that several years—four at the least—must elapse before that object could be obtained, and so large a body be got into working order. Such delay, it appears to us, would be unnecessary and injurious, and that a special provincial commission, or general metropolitan road trust, properly constituted, and giving its individual attention as it ought to the service, might get the streets in a fitting condition without the sacrifice of health, waste of life and property, and perpetual fatigue and annoyance. Any such general organisation as that contemplated could be reasonably expected to be constituted long before that time.

(By order)

P. Le Neve Foster, *Secretary.*

APPENDICES.

I.

REPORT ON STONE TRAMWAYS IN ITALY.

By P. Le Neve Foster, Jun., C.E.

Tramways consisting of blocks of stone laid longitudinally are in general use in Northern Italy, not only in the streets of the principal cities, such as Turin, Milan, Verona, &c., but even in the smaller towns, as Chivasso, Mortara, Vigevano, &c.

These tramways are not intended to suit one particular class of traffic, using specially constructed carriages, as is the case in London, Paris, Vienna, and many other towns on the Continent, but are intended to be used by every kind of vehicle, and for this reason must be regarded as a system of street paving rather than that of street railway, as would be understood in England.

This being the case, the cost of laying down these lines, and their maintenance, naturally belong to the municipality, and is paid for out of the town revenue obtained from octroi duties and other local taxes.

A street railway was opened for traffic a few months ago at Turin, by a company who have a concession from the municipality enabling them to lay iron rails in the street for the exclusive use of tramway cars with flanged rails. There are several other street railways in Italy, but these must be considered as quite distinct from the

stone tramways, or rather the system of paving which is adopted in almost every street in Turin and Milan.

The stone trams being used by every class of vehicle met with in towns, it is quite impossible to obtain any reliable data as to the superiority over other systems of tramways, or of paving, as regards amount of tractive power, wear and tear to wheel tyres, &c., but it is very evident that on a smooth, even surface, which presents no impediment to the passage of the wheels, the tractive force required to haul a given load a certain distance in a given space of time would be less than that required over an ordinary paved road, and the wear and tear to wheel tyres considerably reduced, as the ends of the granite blocks being accurately fitted together, and forming one continuous plane, present but little resistance to traction.

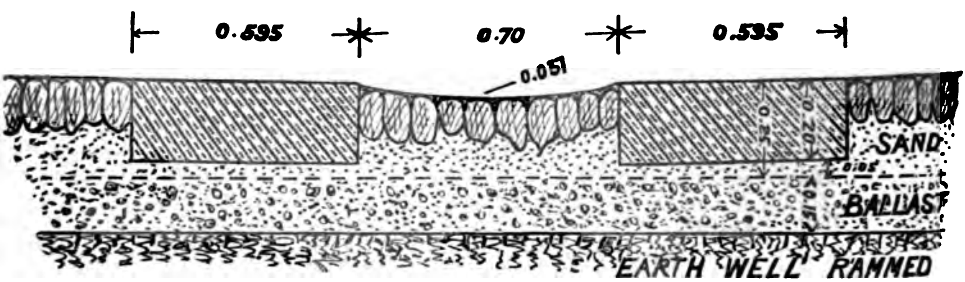
This is impossible to obtain in ordinary paving, and in consequence the joints between the stones present irregularities and impediments to the passage of vehicles.

There is no doubt that vehicles on a stone tramway run more freely than over the stones in London, as this is verified from the sound whilst riding, which is considerably less in a Turin or Milan *cittadina* than in a London cab, but greater than in a Paris *fiacre* over an asphalte surface, which reduces the vibration to a minimum.

The stone tramways have an advantage over the ordinary iron street tramways, as they can be used by every description of carriage, and can accommodate a far greater amount of traffic, by giving freedom to vehicles to leave the tram when needed; and these are not helpless when off the track, as is the case with the tramway car.

The stone tramways in Italy consist of blocks of granite, laid parallel to each other, at a distance of 0·70 (28 inches) apart, as shown Fig. 1. These blocks are usually 0·60 (24 inches) in breadth, and 0·20 (8 inches) in depth, and are bedded in a layer of sand. The space

FIG. 1.—CROSS SECTION OF ROADWAY, SHOWING DETAILS OF GRANITE TRAMS AND PAVING.



Scale—Five centimetres to metre.

between the blocks and remainder of roadway is paved with rounded river-washed stones (*ciottoli*) from the Po, Ticino, or other torrents.

The roadway is usually formed with a slight inclination towards the centre, and the space between the trams serves as a channel to receive the surface water, and is provided at suitable intervals with stone gratings to allow the free flow into the sewers, as shown Fig. 2.

The granite blocks are not laid perfectly horizontal, but should be set 0·01 (⅜ inch) lower on the inner side than at the outer. The intermediate channel should be slightly concave, forming an arc of circle, with chord of 0·07 (2¾ inches) and versed line of 0·037 (1½ inches).

The foundation of the roadway consists of a layer of screened gravel, not less than 0·15 (5¾ inches) in depth, which should be well rammed and watered to obtain a compact mass. A layer of sand 0·05 (2 inches) in depth, is spread over the gravel to form the bed for the granite blocks. The surface of this layer should be carefully smoothed down to the exact slope which it is intended should be given to the roadway.

The granite used at Milan is brought from the quarries of St. Fedelino, near Chiavenna, on the Lake of Como, and is specially adapted for the purpose from its hardness and durability. The granite of the Lake Maggiore and Mont Orfano is occasionally used, but is not so suitable for the purpose, being somewhat softer. As it is more readily worked it is cheaper, and also the cost of carriage to Milan is less. The granite is brought by water, and the cost of transport from the Lake Maggiore is 5 francs (4s.) per ton, and from the quarries on the Lake of Como 6 francs (4s. 10d.) per ton.

The specific gravity of the granite of St. Fedelino is 2624, and that of the Lake Maggiore 2660.

The blocks of granite, as specified by the municipality of Milan, should be 0·595 (nearly 24 inches) in breadth and 0·20 (8 inches) in depth, and in length of not less than 1·50 (nearly 5 feet), excepting on curves and junctions and crossings, where blocks of special form are required, as shown by Figs. 3, 4, and 5.

The upper surface of the blocks should be dressed perfectly even, and the ends accurately squared, so as to form a perfect joint with the next stone.

The stone gratings for the gullies, as shown in Fig. 2, are also of granite, and are 0·80 (32 inches) in length; their upper surface should be concave to correspond with the channel between the trams. They are pierced with two holes or slots, 0·30 (12 inches) in length and 0·04 (1½ inches) in width, and 0·242 (9 inches) apart.

After the granite trams are placed, the remaining part of the roadway, with the exception of the footways, is paved with river stones (*ciottoli*) from the Ticino or Adda. These stones should be egg-shaped, from nine (3½ inches) to twelve centimetres (4¾ inches) in diameter at one end, and from six to nine centimtres (2⅜ to 3½ inches) at the other, and from twelve (4¾ inches) to fifteen centimetres (5¾ inches) in length. Care should be taken in setting them in regular courses.

After being well rammed into place with a wooden rammer, the surface should be watered and covered with a blinding of sand about two centimetres in depth, so as to fill the joints by degrees.

When the blocks become worn, their surface should be redressed by the stonemason, and if any settlement has taken place they should be rebedded.

On steep gradients it is often necessary to add a series of diagonal grooves across the trams, to prevent the slipping of horses and the wheels of heavy vehicles.

The following shows the prices paid in Milan, according to the town schedule of prices, for all

rials and labour connected with stone tramways paving :—

	Frs.
nite blocks from quarries of St. Fedelino ·60 wide, 0·20 in depth, in length not less than 1·50, including labour for setting, per metre run	13·50
o of granite from Mont fano .... per metre run	11·00
o not including setting „ „	9·40
ing with river stones.. per square metre	1·30
sand................. per cubic metre	2·50
r sand from Ticino or dda .... „ „	5·00
ened pit gravel ...... „ „	1.90
o from Adda .... „ „	4·80
r stones (*ciottoli*) for ving, from Adda or mbo .... „ „	9·40
o from Ticino .... „ „	7·00
o from Lambro or vese................ „ „	8·00
nite according to size of blocks from 60 to	125·00
s gratings for gullies ....each	17·40
ges.—Stonemason..per day from 2·50 to	3·50
Labourer .... „ „ 1·10 to	2·00
Paviour .... „ „ „	2·00

Labour dressing ends of granite blocks to form perfect joint, per square metre from 3·00 to	5.00
„ Dressing sides of blocks, per square metre	1·50
„ „ upper surface of blocks, per square metre...........................	3·60

REPAIRS.

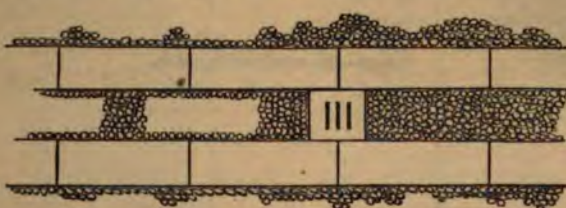
Removal and rebedding of stones including dressing upper surface and ends, per meter run	1·50
Ditto without redressing, per square metre	1.15
Cutting parallel diagonal grooves 0·10 apart and 0·01 deep on trams to prevent slipping of horses on steep gradients, per square metre	1·00

From the above prices it will be seen that the cost of a kilometre of a single line of tramway, including paving of space between blocks but not of remaining part of roadway, would be 27,780 francs, equal to £1,788 per English mile.

P. LE NEVE FOSTER, Junior,
Civil Engineer.

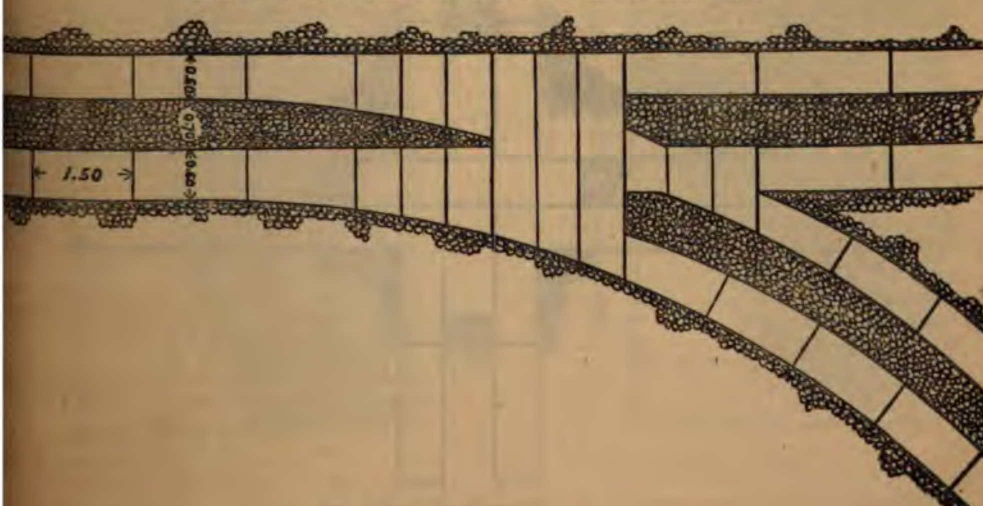
Mortara, 25th March, 1872.

FIG. 2.—PLAN OF TRAMWAY, SHOWING STONE GULLEY.



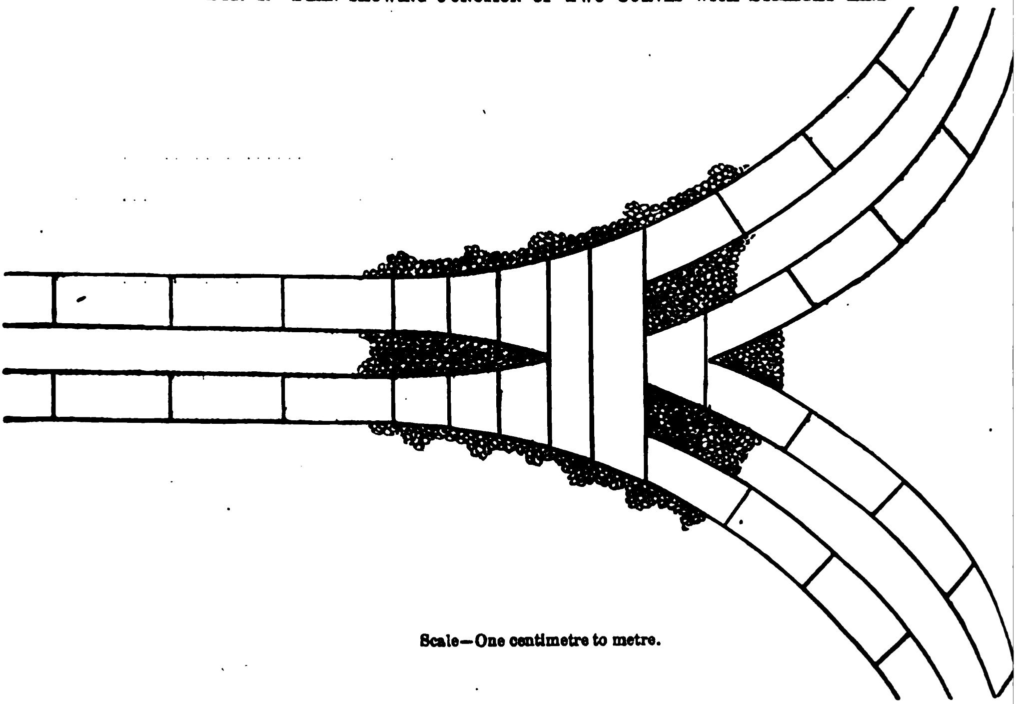
Scale—One Centimetre to metre.

FIG. 3.—PLAN OF JUNCTION OF CURVE WITH STRAIGHT LINE.



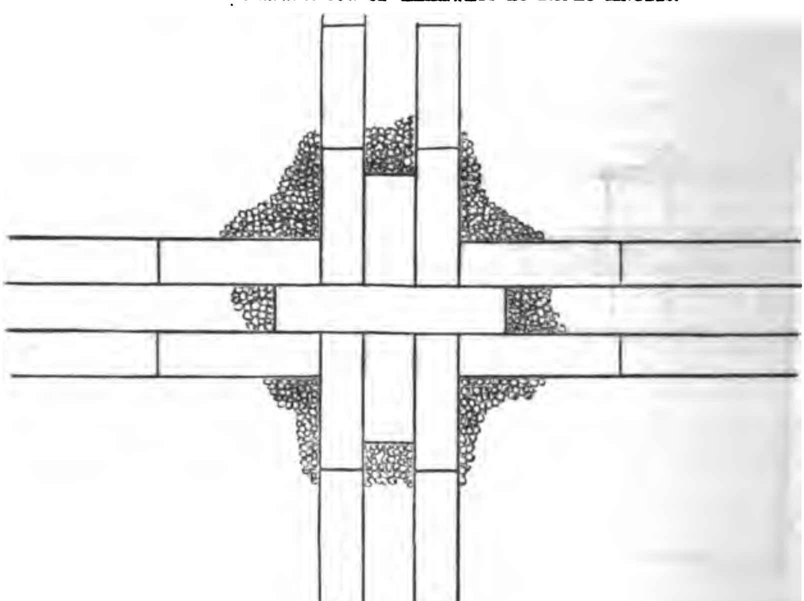
Scale—One centimetre to metre.

Fig. 4.—Plan showing Junction of Two Curves with Straight Line.



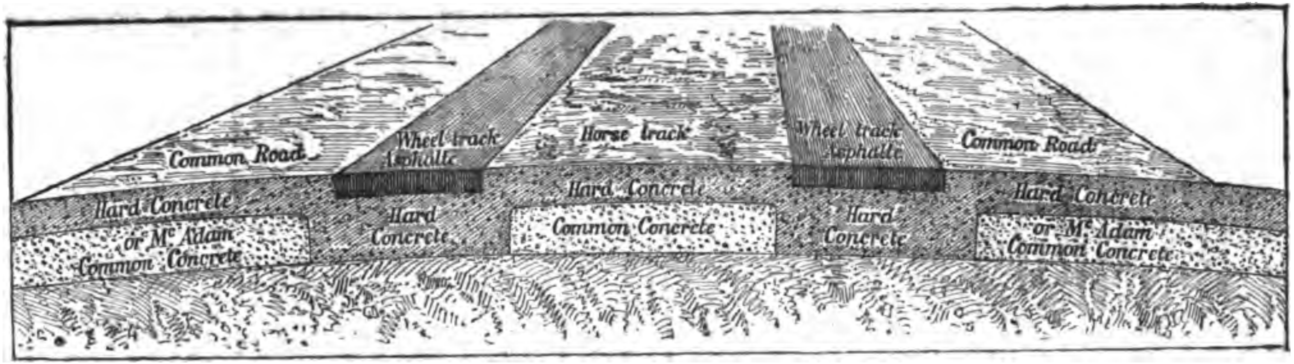
Scale—One centimetre to metre.

Fig. 5.—Intersection of Tramways at Right Angles.



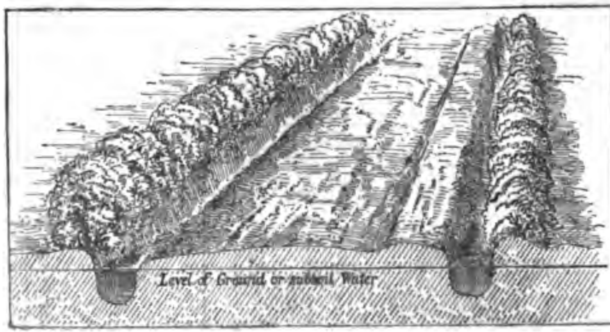
Scale—One centimetre to metre.

SECTION OF ROADWAY WITH ASPHALTE WHEEL TRACKS WITH TRACTIVE FORCE OF 2 TO 1 AS COMPARED WITH COMMON ROADS AND CONCRETE HORSE TRACK.

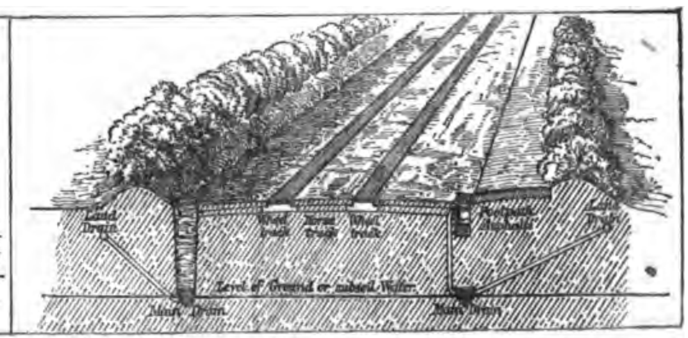


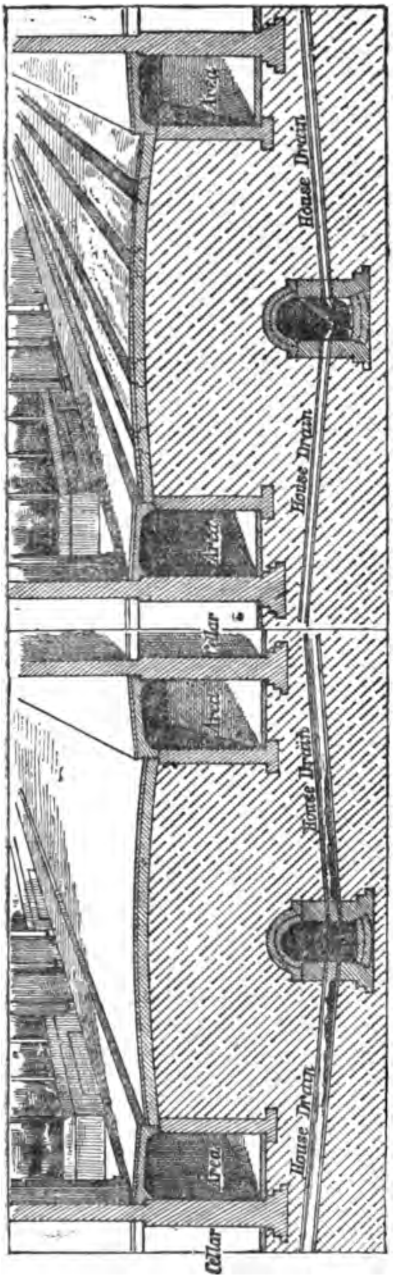
II.

SECTION OF OLD ROAD WITH OPEN DITCHES.



SECTION OF ROADWAY WITH ASPHALTE WHEEL TRACKS AND CONCRETE HORSE TRACK, WITH IMPROVED ROAD DRAINS ACTING AS SUBSOIL LAND DRAINS.





Section of one Street with entire covering of Asphalte, and of another with durable Wheel Tracks of Asphalte, and Concrete Horse Tracks, and improved Street Drains in Old Sewers.

III.

STREET CLEANSING.

Extract from the examination of Mr. T. Lovick (*now engineer to the Metropolitan Board of Works*), *before the General Board of Health*, 1850:—

You were directed to make experiments in cleansing by water by means of the hose and jet; will you state at what place you first carried them on?—Yes; the experiments were first carried on in Charles-street, Old and New Compton-streets, Church-passage, Dean-street, and Greek-street, Soho; subsequently in Church-lane, and four courts in St. Giles's.

Were you not able not only to cleanse the pavements by this means, but also to cleanse the walls from urine stains and other filth?—Yes.

You were directed to prepare a sketch to show how the same plan can be carried out in courts and alleys. Give it in?—The sketches which I now hand in show the jet in operation. No. 1, is an illustration of the mode of surface-cleansing; No. 2, of the method of using the jet as a shower in close courts and alleys.

State the quantity of water used each time, and the expense?—The quantity of water used was nearly one gallon per square yard; the cost was at the rate of 9d. per 1,000 yards, taking the cost of water on Mr. Wicksteed's estimate.

Then it is clear from your reports that, in respect to economy of time and of money, it is superior and is more efficacious in removing surface-evaporating matter or filth than any other method?—In a report to the Commissioners of Sewers I have estimated that the cost of the ordinary scavengering would be nearly double the cost of cleansing by the jet, and the jet has been shown to be far more efficacious in removing evaporating matter and filth.

You were directed to prepare an estimate of street cleansing by these modes, as applicable to two large thoroughfares?—Yes; I prepared estimates of the cost of cleansing by the jet in the Strand and High-street, Borough.

Within what time and at what expense did you estimate this could be performed, apart from the cost of the water used?—The estimates were framed on the supposition that the work should be performed in one hour. In the Strand the daily cleansing of the carriage-way would have cost 3d. per house per week; in the Borough 2¼d. per house per week. But this rate is for wide streets with a large amount of traffic, on data from experiments with very low pressures, and is greatly in excess of the ordinary description of works, and would by no means therefore be a criterion of the average expense.

What is the quantity of water required per square yard of pavement? The quantity of water required I have found to be rather less than one gallon per square yard of carriage-way; but this was with extremely low pressures.

Were not the experiments often made under what were considered other disadvantages besides those of low pressures?—They were; the pressures being very low, and the water having to pass through a great length of hose, decreasing the already limited power.

With a higher pressure may we not safely estimate that they might be performed with a less amount of water and in a shorter time?—Yes; I had occasion to compare some experiments in cleansing by the jet made by Mr. Lee of Sheffield, with very high pressures, with my own experiments with low pressures, and I found that he could perform the work in less than one-third the cost and with less than one-third the expenditure of water. From this it would appear that the economy of high pressures must be very great.

What is the quantity that would have been used for the Strand for each complete cleansing?—By the latest experiments 18¼ thousand gallons.

In a day of partial rain, when the streets are sloppy and muddy, would not the cleansing by jet be the most eligible mode of cleansing?—The cleansing by jet on those days I consider would be by far the most eligible mode.

What was the effect in hot weather and at other periods of this new mode of cleansing as compared with the mode of cleansing by scavengering? What was your general conclusion from those experiments as to the effect of this mode of cleansing?—The cleansing by water produced a most perfect state of cleanliness by the removal of all decomposing refuse, and the jet, when directed upward in the form of spray, appeared to

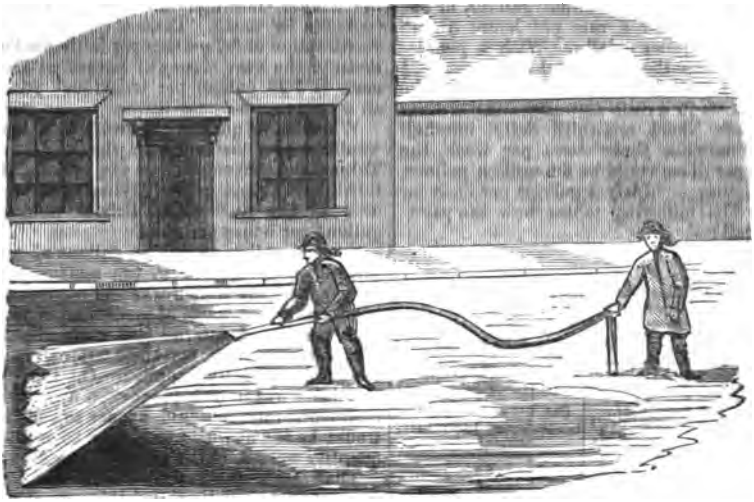


FIG. 1.

es the effect of a shower, the air being made much ier and fresher by it. The ordinary mode of cleang by scavengering would have failed in removing ch of the refuse, all of which the jet removed, and of se could not in any other way have improved the lubrity of the atmosphere. In hot weather these effects re more marked, the jet performing, but in a far more cient manner, the office of the watering-cart. The inary mode of scavengering, without possessing any the advantages of the jet, performed the work in a st imperfect manner. The system of cleansing by water eminently combined completeness with efficiency of action.

FIG. 2.

Even where it might be desirable to use a street cleansing machine to prevent accumulations of solid dun, and the like, would it not be of importance to use the jet also?—In a report upon this subject I have stated the general conditions wherein the combinations of the two would be of advantage for this purpose, but that the machine should be auxiliary to the jet, than conversely as implied, in the following passage:—"The frequency of application of this system (cleansing by jet) to the cleansing of the streets would be determined by their specific requirements, some, as the main thoroughfares, requiring daily cleansing, others cleansing at longer intervals. Thoroughfares having a large amount of traffic would require cleansing at an earlier part of the day; from this period to the cleansing on the following day the accumulations will have been going on, and the exhalations from them going into the atmosphere. It may be necessary to employ measures for the prevention of this condition in conjunction with the systematic operations of cleansing by water. To effect this there are two methods, by sweeping with hand labour and cartage of the refuse; by the cleansing machine; hand labour, when compared with the cleansing machine, would appear to be the least economical in the proportion, as stated in Mr. Whitworth's evidence, of about three to one. The machine therefore would appear to be the best adapted for this purpose, and with the least interference with the traffic of the street."

What is the total quantity of water, according to your estimate, that would be required for the purpose of street washing by means of the jet?—Assuming that there are 300,000 houses in the metropolis,* with an average to each house of paved carriage-way 28 square yards, of paved footway 16 square yards (on data afforded by an average district, in the absence of certain other data), the area of the carriage-way would be, in round numbers, 8½ millions, of footway 4¾ million square yards. With one gallon of water for each square yard of carriage-way (a proportion somewhat greater than I have found in practice with low pressures, and far greater than I believe would be the case with high pressures), and half a gallon for each square yard of footway, the

* That was of the then covered area; but within the Metropolitan Local Government jurisdiction it is there now 417,000 houses, and within the district of the companies water supply the present number of houses is 580,000.

quantity of water required for the daily cleansing of these areas would be nearly 11 million gallons, or 65½ million gallons per week, or a rate per house of 218 gallons weekly, or 36½ gallons daily. With a population of 7 to each house the rate would be nearly 5¼ gallons per diem for each inhabitant. Taking the cleansing of the streets in a ratio approximating to their specific requirements, about one-third daily, one-half twice, and the remainder three times per week, the quantity of water per diem would be 6·2 million gallons, or 20 gallons per house, or nearly 3 gallons per diem for each inhabitant. The following tables show the particulars more in detail:—

No. 1.—Of the Carriage-way.

Period of cleansing per week.	Quantities to be cleansed at each period.	Total quantities cleansed per week.	Water required, in gallons.			
			Per week.		Per diem.	
			For quantities cleansed.	Per house.	Per house.	Per individual.
No.	Square yards.	Square yards.				
6	2,750,000	16,500,000	16,500,000			
3	1,000,000	3,000,000	3,000,000			
2	4,750,000	9,500,000	9,500,000			
	8,500,000	2,000,000	29,000,000	96·7	16·1	2·3

No. 2.—Of the Footway.

Period of cleansing per week.	Quantities to be cleaned at each period.	Total quantities cleansed per week.	Water required, in gallons.			
			Per week.		Per diem.	
			For quantities cleansed.	Per house.	Per house.	Per individual.
No.	Square yards.	Square yards.				
6	1,536,000	9,216,000	4,608,000			
3	576,000	1,728,000	864,000			
2	2,688,000	5,376,000	2,688,000			
	4,800,000	16,320,000	8,160,000	27·2	4·53	0·65 (nearly)

No. 3.—Of the Carriage and Footways.

Period of cleansing per week.	Quantities to be cleansed at each period.	Total quantities cleansed per week.	Water required, in gallons.			
			Per week.		Per diem.	
			For quantities cleansed.	Per house.	Per house.	Per individual.
No.	Square yards.	Square yards.				
6	4,286,000	25,716,000	21,108,000			
3	1,576,000	4,728,000	3,864,000			
2	7,438,000	14,876,000	12,188,000			
	13,300,000	45,320,000	37,160,000	123·9	20·63	2·95 (nearly)

It is stated that the quantity of water pumped into the metropolis is 50 million gallons per diem, or at the rate of 200 gallons per house?—It has been so stated.

Have you seen the estimate made by Mr. Mylne of the actual quantity of water consumed per house, taking the average of houses of different classes, and does that estimate correspond with the results of your own observations?—I have. My personal observations would refer to classes of houses (supplied by the West Middlesex Company) on an average somewhat higher than the medium between what Mr. Mylne calls houses of the middle class and houses of the poor, having receptacles for water. These observations give an average consumption of 5·7 gallons per individual per diem. The mean of the two classes of houses in Mr. Mylne's estimate is 5·53 gallons per individual per diem, showing an accordance between them.

What is the quantity according to his returns, that would be used per house in the Earl-street district?—Taking the consumption as the mean of the second and third class houses in Mr. Mylne's estimate, the quantity used in the Earl-street district would be nearly [illegible] gallons per house per diem.

Supposing that 50 million gallons of water are at the present time supplied to the metropolis, would it not appear from the trial-works and observations that there is an amount of waste of more than one-half of the present system of intermittent water distribution?—The actual waste, from my observations, is three-fifths of the whole quantity supplied. On the supposition that the waste was in this proportion over the whole of the metropolis (and it would appear so), 20 million gallons would be the quantity used, and 30 million gallons the quantity wasted, of the 50 millions stated to be supplied.

Than from these trial-works and observations it appears that more is wasted than would suffice for the most profuse system of cleansing?—The system of cleansing must indeed be profuse that would require anything like the quantity wasted; but the application of the waste to surface-cleansing will best illustrate the point. The daily waste, or waste on the water day, in the Earl-street district is 187,000 gallons. This would cleanse the whole of the carriage-way on the area [illegible] and a-half times, or the one day's waste would cleanse nearly every day for six days in the week, or it would once cleanse a street 30 feet in width by 10½ miles in length. The weekly waste would cleanse daily the carriage-way of three such localities. Taking the same proportion of waste as applicable to the whole of the metropolis, the daily waste on the quantity stated to be supplied would be 30 million gallons. One-third of this waste would suffice for the daily cleansing of the whole of the carriage and footway paving, on the data before given, and about one-fifth where the periods of cleansing are proportioned to the specific requirements of localities; but the frequency of cleansing would considerably decrease thee proportionate expenditure of water, and would reduce these proportions, which are founded upon the experimental first cleansing of streets.

Supposing you provided for a general supply of water, including general street-cleansing by use of the jet in summer, and presuming a general substitution of the [illegible] pan apparatus for cesspools, do you think it probable that the entire demand would be for more than two-thirds the quantity of water now stated to be supplied to the metropolis?—The quantity of water stated to be supplied is 50 millions gallons per diem, at the rate of 200 gallons per house: this would indicate a supply to 250,000 houses. Taking the number of houses in the metropolis at 300,000, or 50,000 beyond the number which appears to be supplied, and a supply of 76 gallons per diem to each, as this appears to be the rate of consumption in the higher-class houses, we get the rate per diem of 22,800,000 gallons. For street-cleansing we have 36½ gallons per house per diem, or a gross rate per diem of 10,900,000 gallons, or for the domestic supply and for street-cleansing 33¾ millions nearly. Thus, with an average supply of 76 gallons per house per diem, the 300,000 houses would consume less than one-half the the present stated supply to 250,000 houses and with the addition of the quantity required for street-cleansing, about two thirds; but the supply for manufactories, which I presume is included in the stated quantity, would require to be known, in order to see what is absolutely due to the house (or domestic) supply, and so to estimate its influence on these proportions.

IV.

[SU]MMARY OF ALL THE INQUIRIES AS TO [A]SPHALTE IN COMPARISON WITH GRANITE.

[SOCIE]TY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE, JUNE, 1873.

STREET PAVING AND CLEANSING.

[Lett]er to be sent to the Householders in Streets paved with [d]ifferent sorts of Asphaltes and Wood Pavements.

[T]he Council of the Society of Arts have directed an [inqu]iry to be made as to the operation of the different [mod]es of paving and cleaning roadways and footways, [and] would be obliged by any statement of your experience [of] the new form of pavement before your house. [Wou]ld you be so obliging as to answer the following [ques]tions:—

[W]hat is your experience compared with granite or [maca]dam?

[1.] As to cleanliness.

(a). Is the wet mud greater or less than before?—Much less.

(b). Does the mud dry quicker that before?—Much quicker.

(c). What is the comparative time of surface evaporation, as near as you can guess?—Much quicker than granite. But note must be taken here that the granite pavement is much more *frequently watered than the asphalte.*

(d). Is there more or less of dry dust from the surface, and is it more or less injurious than before?—More, and of a more injurious kind; the asphalte forming an impervious surface, all the horse dung, &c., not taken away falling on it is ground to fine powder, and by the constant crossing of the traffic whirl about as high as the first floor—and sometimes higher—to the annoyance of the inhabitants; this all arises from want of *watering thoroughly with jets**.

(e). Are the means of cleaning greater or less than before, and are those means properly applied, or so well applied as they might be?—

(f). What do you find to be the effect and expense of street mud and dust upon clothing and upon your stock?—Very injurious to special stocks, and varnishing on paint, &c.

(g). Have you had any and what experience of street washing by jet?—A system of hydrants, as recommended by several tradesmen, would be the more effective mode of *thoroughly cleansing* the streets, especially if paved with asphalte, and well swept with india-rubber scrapers.—A system of high water carts with the delivery pipes as low as possible so as to get as much pressure as possible on the jets, has been suggested where the hydrants could not be obtained.

2. As to sound.

(a). What is your experience as to the difference of noise at night as well as in the day?—The noise is infinitely less, and therefore the comfort of business as well as residence infinitely increased.

(b). Are you obliged to keep doors and windows shut more or less to keep out noise?—All can now be thrown open without inconvenience from noise, the dry dust being a great nuisance causing in some cases the doors and windows to be still kept shut because the streets are so *badly watered.*

(c). Are customers more or less conveniently heard?—Heard with *great comfort.*

(d). Are the sick less disturbed?—Are greatly relieved.

3. As to vibrations.

What is your observation of the difference of vibration, and how does it affect your goods, your liquids, wine or beer, in cellars?—The vibration has ceased; before on granite it was very great, and little better on the old wood paving.

4. As to the carriage traffic.

(a). What is the difference experienced?—Greater comfort and ease to both riding and walking people, a great saving in wear and tear to horses and vehicles, one horse equal to two or three formerly.

(b). Are there more or less accidents to horses?—Less than before all the year round, but many more simultaneously at special times.

(c). Are the accidents more or less serious?—Less injurious in broken knees and bruises, but more serious to shoulders and legs and internal injuries.

(d). Under what conditions do accidents occur more or less frequently?—When slightly wet and when drying after a shower, from careless driving and over loading, and the great difficulty the horses have in getting up, having no foot hold; would not occur if *thoroughly cleaned.*

What form of pavement do you, on your observation and experience, prefer?—Asphalte, "Val de Travers," if kept *thoroughly clean.*

In respect to any of the forms used, what improvement, in construction or in use, as by methods of cleaning and keeping, do you suggest as desirable?—*Hydrants* with hose, or higher water carts, so that the streets may be thoroughly washed and cleaned by being well swept with india-rubber scrapers.

SAMUEL SHARP.

August, 1873.

* The answers on this head are equally divided, some saying that the annoyance from dust is less than granite, some saying that it is as bad, as having less grit in it, some saying it is worse, as being finer.

V.

SUMMARY OF ALL THE INQUIRIES AS TO WOOD PAVEMENT.

What is your experience—

1. As to cleanliness.

(a). Is the wet mud greater or less than before?—There is greater cleanliness, and therefore less mud.

(b). Does the mud dry much quicker than before?—Much quicker.

(c). What is the comparative time of surface evaporation, as near as you can guess?—

(d). Is there more or less of dry dust from the surface, and is it more or less injurious than before?—Less dry dust, because it is much better cared for.

(e). Are the means of cleaning greater or less than before, are those means properly applied, or so well applied as they might be?—Very much greater, indeed at present excessive.

(f). What do you find to be the effect and expense of street mud and dust upon clothing and upon your stock?—Very injurious.

(*g*). Have you had any and what experience of street washing by jet?—Only in Paris and a few courts, but highly approved.

2. As to sound.

(*a*). What is your experience as to the difference of noise at night as well as in the day?—A considerable reduction of noise, the noise now being a constant *rumble* instead of a *rattle* and *din* almost intolerable.

(*b*.) Are you obliged to keep doors and windows shut more or less to keep out noise?—The doors and windows are not obliged to be kept shut now for the noise.

(*c*.) Are customers more or less conveniently heard?—Much more conveniently heard.

(*d*.) Are the sick less disturbed?—Much less.

3. As to vibrations.

What is your observation of the difference of vibration, and how does it affect your goods, your liquids, wine or beer, in cellars?—The vibration is certainly less, although not done away with, and liquids are less disturbed than with granite paving.

4. As to the carriage traffic.

(*a*.) What is the difference experienced?—There is a great saving of wear and tear to the horses and vehicles, especially to the horses' feet and legs, but the peculiar sensation to riders is still disagreeable.

(*b*.) Are there more or less accidents to horses?—The accidents to horses are greatly reduced and less serious.

(*c*.) Are the accidents more or less serious?—Much less serious.

(*d*.) Under what conditions do accidents occur more or less frequently?—When the pavement is slightly wet.

What form of pavement do you, on your observation and experience, prefer?—Wood pavement as laid down in the Strand and King William-street near to London-bridge.

In respect to any of the forms used, what improvement, in construction or in use, as by methods of cleaning and keeping, do you suggest as desirable?—By jet and the india-rubber scrapers—one prefers the water cart to the jet.

Samuel Sharp.

VI.

Société pour l'Encouragement des Arts, Manufactures et Commerce, Juin, 1873.

PAVAGE ET NETTOYAGE DES CHAUSSÉES.

Circulaire à envoyer au propriétaires de Maisons dans les rues Asphaltées et Pavées en bois.

Le Conseil de la Société des Arts a ordonné une enquète à faire sur les différentes manières de paver et d'entretenir les chaussées et trottoirs. Il vous serait obligé de vouloir bien lui donner votre avis sur le nouveau système de pavage, actuellement en usage devant votre maison, et vous prie d'être assez obligeant pour repondre aux questions suivantes:—

Quel est votre avis—

1. Quant à la propreté.

(*a*). Y-a-t-il plus ou moins de boue qu'avant?

(*b*). La boue sèche-t-elle plus vite qu'avant?

(*c*). Le temps nécessaire à l'évaporation, est il plus ou moins long qu'avant?

(*d*). Y-a-t-il plus ou moins de poussière, et est elle plus ou moins nuisible qu'avant?

(*e*). Les moyens de nettoyage sont ils plus ou moins étendus qu'avant, et sont ils convenablement appliqués, ou aussi bien qu'on peut le faire?

(*f*). Quel effet trouvez vous que la boue et la poussière produisent sur vos effets et sur vos marchandises?

(*g*). Quel est votre avis sur l'arrosage des rues par la lance?

2. Quant à la sonorité.

(*a*.) Quel est votre avis quant à la différence du bruit, aussi bien le jour que la nuit?

(*b*). Etes vous obligé de garder vos portes et fenêtres fermées pour éviter d'entendre le bruit?

(*c*). Entendez vous plus ou moins convenablement ce que disent vos clients?

(*d*). Les malades, sont-ils moins dérangés?

3. Quant aux vibrations.

Quelle est votre appréciation sur la différence de vibration, et à quel point affecte-t-elle vos marchandises, vos liquides, vin ou bière, dans les caves?

4. Quant à la circulation des voitures.

(*a*). Quelle différence trouvez-vous?

(*b*). Arrive-t-il plus ou moins d'accidents aux chevaux?

(*c*). Ces accidents sont-ils plus ou moins sérieux?

(*d*). Dans quelles conditions les accidents se présentent ils plus ou moins fréquemment?

Quel système de pavage d'après votre appréciation et votre expérience, préférez vous?

En ce qui concerne les différents systèmes en usage, quelles améliorations dans leur construction ou leur emploi, aussi bien que dans le nettoyage et l'entretien, pensez vous devoir suggérer comme désirable?

On passera retirer la présente circulaire quand il vous plaira de nous transmettre toutes les explications que vous pouvez nous donner sur ces questions.

SERVICE MUNICIPAL DES TRAVAUX PUBLIQUES.

Directions des Ponts et des Egouts.

Reponses aux Questionnaires.

Chaussées pavées en Bois.

1. Quant à la propreté.

(*a*). Il est contestable que la boue soit moindre.

(*b* et *c*). Les pavages en bois étant perméables, sèchent moins vite que les autres chaussées. Aujourd'hui le pavage en grès de la rue du Dragon est sec, tandis que le pavage en bois est fort humide.

(*d*). Peu de différence avec les pavages ordinaires.

(*e*). Les pavages en bois ne présentant pas des surfaces plus unies que les pavages ordinaires, on les nettoie par les mêmes procédés. La boue y parait être plus adhérente.

(*f*) Pas de réponse.

(*g*). On évite d'arroser les pavages en bois.

Quant à la sonorité.

(a). La sonorité est très faible. Les roues des voitures ne causent aucun bruit; le pietinement des chevaux s'entend moins que sur les chaussées en asphalte.

(b, c et d). Réponses analogues à celles qui ont été faite pour les chaussées en asphalte.

Quant à la circulation des voitures.

(a). Toutes les voitures circulent volontiers sur les pavages en bois.

(b). Nous n'avons jamais vu d'áccidente; l'on ne nous en a jamais cité.

(c).

...rvations Générale.—Les pavages en bois ont été ... depuis près de quarante ans à Paris; mais ils ... jamais réussi lorsqu'ils ont été soumis à une ... circulation. Il n'en existe aujourd'hui à notre ...issance qu'à la rue du Dragon, à la place de l'École ...decine, et au boulevard St. Michel, près de la fon... Le plus grave inconvènient du système est qu'il ...prête pas à un entretien régulier. Quand la chaussée ... et deformée, il faut la démolir de fond en comble ...refaire en matériaux neufs. Ainsi l'essai tenté ...1867 dans la rue du Dragon a du être complétement ... 4 et 5 ans après. La chaussée, ainsi réconstruite, ...pelée à subir prochainement le même sort bien que ... pris la précaution de l'encadrer entre deux larges ... de grès, où s'écoulent les eaux du ruisseau. ... tenté au boulevard St. Michel en employant des ... de sapin posés sur un planchopage et votiges ... mieux réussis. Cela tient surtout à le que l'aera... très considerable. Mais on peut dire d'une manière ...le que dans les voies de largeur ordinaire les ... en bois sont trop souvent humides et couverts ... boue grasse, qu'ils ont une surface inégale et ne ... en conséquence faciles à nettoyer, enfin que ...ntretien est à peu près impossible. ... pavages en bois construits dans Paris l'ont toujours ... titre d'essai. Le prix de revient est difficile à con... car les entrepreneurs se sont toujours imposé des ... pour propager leur système.

Chaussées Asphaltées.

Quant à la propreté.

(a). La boue a diminué sensiblement.

(b). Elle sèche plus vite que sur les pavages à cause de imperméabilité de la matière, de l'absence de joints et de l'uni de la surface.

(c). Même réponse.

(d). La chaussée ne produit par elle-même ni boue ni poussière. L'on n'y ramasse que les crottins des chevaux et le détritus provenant des chaussées voisines. La quantité de poussière est moindre que sur les pavages attendu que les chaussées asphaltées sont fréquemment lavées et qu'elles peuvent être radicalement nettoyées comme il sera dit ci-après.

(e). Les asphaltes sont lavés à grande eau et nettoyés ensuite avec des balais à lame de caoutchouc. Cette double opération enlève tous les détritus et laisse la chaussée aussi propre que le parquet d'un appartement.

(f). Nous ne pouvons répondre.

(g). L'arrosage à la lance n'est praticable que dans les voies larges. On a essayé de l'appliquer dans des rues étroites, telles que le faubourg St. Honoré et l'on a du y rénoncer. Ce système a l'avantage de distribuer l'eau au moment utile et dans la proportion la plus convenable. Avec de bons ouvriers l'on peut éviter toute production de boue ou de poussière, resultat que l'on n'obtient jamais complétement avec les tonneaux. L'arrosage à la lance est économique en ce sens qu'il permet d'utiliser, pendant la sécheresse, le travail des cantonniers qui, sans cela, ne seraient pas assez occupés.

2. Quant à la sonorité.

(a). La sonorité est moindre; le seul bruit que l'on entende est celui que produisent les pieds des chevaux. On est unanime pour demander des chaussées en asphalte au long des églises, des écoles, etc.

(b). Dans la partie du bureau de M. l'Ingénieur Allard qui donne sur la rue de Grenelle, rue qui donne passage à une ligne d'omnibus et à toutes les voitures qui viennent aux Ministères de l'Intérieur, et de l'Instruction Publique, au Conseil d'État, à la mairie du 7me arrondissement et aux télégraphes, l'on tient les croisées ouvertes pendant l'été. L'on peut facilement causer et rejoindre aux visiteurs. L'on ne ferme les fenètres que pour faire des collationnements entre des employés travaillants à des tables éloignées l'une de l'autre.

(c). Même réponse.

(d). L'affirmative n'est pas douteuse.

3. Quant à la circulation des voitures.

(a). La presque totalité des voitures continuent de circuler sur les chausées asphaltées. Cependant quelques propriétaires d'attelages précieux evitent de passer dans les rues où cette mode de chaussée a été établi.

Les plaintes étaient autrefois nombreuses sur le danger de l'asphalte; elles deviennent beaucoup plus rares et se portent maintenant sur les chaussées et pavés de porphyre ou quartzite.

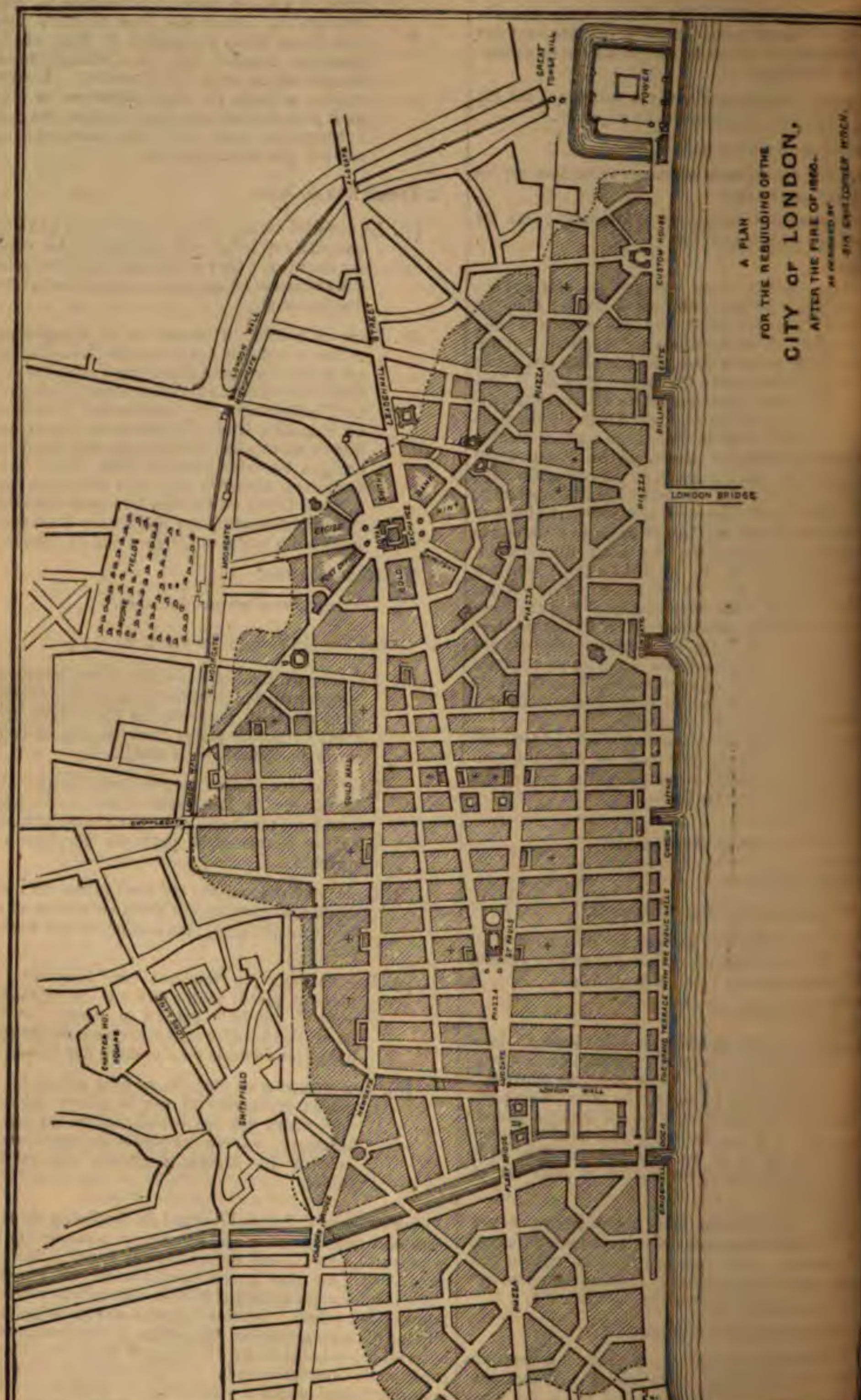
(b). Grâce aux précautions qui sont prises, les accidents sont rares depuis quelques années, et ne semblent pas être plus nombreux que sur les pavages.

(c). Les chevaux en tombant sur l'asphalte se blessent plutôt moins que sur les pavages; mais ils ont de la peine à se relever; on est obligé de répandre sous leurs pieds de grandes quantités de sable ou d'étendre des toiles.

(d). Les chaussées en asphalte ne sont glissantes ni par la sécheresse ni par la pluie; elles le deviennent par les brouillards et les temps brumeux. A ces moments les cantonniers doivent les arroser à grande eau ou les sabler.

Observations Générale.—L'emploi de l'asphalte dans le chaussées constitue un grand progrès au point de vue de la propreté, de l'absence de bruit, et de l'agrément de la circulation. Le plus grand inconvénient du système outre le glissement est la difficulté de réparations pendant la mauvaise saison. En hiver, quand des trous se produisent dans les chaussées asphaltées, l'entrepreneur est autorisé à les boucher provisoirement avec du bitume coulé ou de l'empierrement. Au printemps, il enlève les matériaux ainsi placés et y substitue de l'asphalte comprimé.

VII.


A PLAN
FOR THE REBUILDING OF THE
CITY OF LONDON,
AFTER THE FIRE OF 1666,
AS PROPOSED BY
SIR CHRISTOPHER WREN.
TOWER
GREAT TOWER HILL
CUSTOM HOUSE
LONDON BRIDGE
PIAZZA
LONDON WALL
GUILD HALL
ST PAULS
SMITHFIELD
CHARTER HOUSE SQUARE
FLEET BRIDGE
HOLBORN BRIDGE

VIII.

...TE OF DEDUCTIONS OF STATISTICAL ...D ECONOMICAL SCIENCE, AS TO THE ...SSES FROM IGNORANCE OR EMPIRICISM IN ...E GOVERNMENT OF THE METROPOLIS.

...tistical science foretels what will happen, ...h insurable certainty and regularity from ...r to year, under the same continued condi-...s. The numbers killed in the streets, chiefly ...er the conditions as described by the police, ...greasiness, which street-washing would pre-...t, were, according to the Registrar-General, ...follows :—

1869	192
1870	198
1871	208
1872	213
1873	217
1874	211
Total in six years	1,239

...he insurable mean may be put down as 200, ...greater proportion of whom will regularly be ...ed every year during the existing conditions. ...it is ascertained that the numbers maimed ...injured, and brought under the care of the ...ice, chiefly in these conditions, has been be-...en one and two thousand annually. Last ...r the numbers maimed and injured in the ...ets, within the jurisdiction of the metro-...tan police, was 2,381, and within the care ...he City police, 424, making a total of 2,805. ...ow the means required to remove the chief ...ce of the destruction of life and limb, and to ...e comparative safety to the public, namely, ...e for the complete cleanliness of the streets, ...also the chief means for the protection of life ...l property from fire, namely, the constant ...ply of water for cleansing the streets. On ...branch of administration, already examined ...the committee of inquiry as to the means of ...venting fires, it appears that whilst the evils, ...er the existing conditions, happen with in-...able certainty in amount from year to year, we ...the examples of altered conditions of improve-...t, where available reductions occur with the like ...rable regularity from year to year. In Lon-..., under the existing conditions of the inter-...tent water supplies of the trading companies, ...displayed in the report, water is only brought ...bear, and can only be brought to bear for the ...inction of fires, in 24 minutes. Under the ...nge of system proposed by that committee, ...might be brought to bear in little more than ...nth of that time. In Manchester, Liverpool, ...l other places, under the constant system of ...ply, but where the system of street cleansing ...not yet been sufficiently advanced, hydrants ...yet more closely placed, and water is brought ...bear, on the constant system, in about one-...rd the time that it is on the intermittent ...stem in London, with the regularly ascer-tained result of two-thirds less of loss of life and injuries to person and loss of property. The loss of life and injury to persons from occasional fires is considerably less than the loss and injury occasioned in thronged traffic from the conditions of the streets; but, nevertheless, the occurrence of what may be called a "suttee," a burning of persons alive, every other week under the existing administration of the metropolis, creates greater terror and more painful impressions amongst the population, and it really makes a large addition to the sum of evil due to unscientific and ignorant administration. The following numbers of persons yearly injured by fires, are taken from the report of Captain Shaw, of the London Fire Brigade. As against them are placed the insurable yearly numbers of losses that would occur on the system of constant supply of water, as carried out at Manchester, and the numbers of personal injuries that are certainly due to the existing conditions of administration in the metropolis :—

	Number Annually Injured by Fire under the Intermittent System.	Numbers that would have been Injured under a Constant System of Water Supply.	Total Injuries to Persons from Fire, due to the Administrative Conditions.
1874	157	52·3	104·6
1873	140	46·6	96·2
1872	182	60·6	121·2
1871	249	73	146
1870	166	55·3	110·6
Mean	172·8	55·76	115·72

	Persons Annually Burned Alive under the Intermittent System.	Numbers that would have Lost their Lives under the System of Constant Supply.	Total Annual Loss of Life due to the Administrative Conditions of the Metropolis.
1874	23	7·6	15·2
1873	35	11·6	23·2
1872	22	7·3	14·6
1871	38	12·6	25·2
1870	33	11	22
Mean	30·5	10·02	20·05

To those conversant with statistical science the general results above stated are beyond cavil. The elements in relation to the comparative proportions of serious fires in the metropolis are not so certain, or require testing. At Manchester, all the fires where a sixth in value of the property is destroyed are classed as serious. Mr. Tozer, the Superintendent of the Fire Brigade there, who had considerable experience in the fire service in the metropolis, states, that if the same classifi-

cation of a sixth of the value were adopted there, the numbers returned must be in far larger proportions, and any real decrease is questionable, whilst the total numbers increase as they do. Mr. Tozer observes that in a letter addressed to the committee of the London Fire Establishment, dated 31st December, 1865, Captain Shaw stated that—"The total number of calls received during the 33 years has been 35,155. Of these 2,649 were false alarms; 3,307 proved to be only chimney blazes, and 29,069 were for fires of which 9,635 resulted in serious damage, and 19,435 in slight damage." "Now this," observes Mr. Tozer, "gives about one-third of all the fires attended during the existence of the old brigade as serious; and this is no doubt correct, for Mr. Braidwood was very particular in having his statements as correct as possible." "I am of opinion, that at least one-sixth of all the bona-fide fires that are attended by the Metropolitan Fire Brigade result in serious damage; that is to say, that one-sixth of the property actually at risk is destroyed." However, taking the returns of serious fires in the metropolis as given in Captain Shaw's returns, the contrast of insurable results under a different system is as follows:—

	Number of Serious Fires under the Intermittent System of Water Supply.	Number that would have occurred under the Constant System of Supply.	Number of Fires occasioned by the Existing Condition of Local Administration.
1866........	326	108·6	217·3
1867........	245	81·6	163·3
1868........	235	76·3	156·6
1869........	199	66·3	132·6
1870........	276	92	184
1871........	207	69	138
1872........	120	40	80
1873........	166	55·3	110·6
1874........	154	51·3	102·6
Mean....	225·3	71·15	148·3

As to the numbers of persons killed and injured in the streets, there are not the same definite means of comparison, which could only be got by observations of the numbers of events of that class which occur on very dry days, or on very wet days, and on the "greasy" days, to which the greatest number are ascribed. More than one-half may probably be ascribed to them.

It follows, strictly, that to the delay of legislative remedies, as respects fires, must be ascribed two out of every three personal injuries; two out of every three lives sacrificed, two out of every three serious fires; that the cost of delay for a session is twenty persons burned alive, one hundred and fifteen persons injured, and a hundred and forty serious fires. Such will be the insurable cost of delay of remedy on [...] head for the last session, and it will be the co[...] delay for every session following. Add[...] this, there is foredoomed to be killed the gre[...] proportion of two hundred persons, and [...] be maimed and injured in the streets of [...] metropolis the greatest proportion of betw[...] two and three thousand persons during the [...] year. Of the persons alive and in strength [...] these numbers are foredoomed to be k[...] and to be maimed and injured in the street[...] year after that and the year following, so lon[...] the existing preventible conditions are contin[...] Added to these is a proved waste of water of [...] forty millions of gallons daily;—and a wa[...] multiplied useless establishment charges pr[...] to amount to upwards of one hundred thou[...] pounds per annum. Such is the waste of [...] and property (apart from injuries to health [...] supplies made impure by methods of distribut[...] that has gone on from year to year, after [...] demonstrations made by science and art tw[...] years ago. And in addition to all this, the[...] ascribed a waste of upwards of three mil[...] incurred for separate works that would have [...] unnecessary had the supplies been put on a p[...] footing as recommended, and as was adopte[...] Manchester and other towns.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, [...] should be forwarded by cheque or Post-[...] order, crossed "Coutts and Co.," and made [...] able to Mr. Samuel Thomas Davenport, Finan[...] officer.

THEORY OF MUSIC.

On Tuesday, June 29, at 3 o'clock, M[...] Rahn, Professor of Harmony in Paris, will giv[...] the Great Room of the Society, a practical de[...] stration of his method of Instruction in Music, ba[...] on the science of harmony and musical compos[...] Members and their friends are invited to atte[...]

MEETINGS FOR THE ENSUING WEE[K]

Mon. ...Royal United Service Institution, Whitehall-yard, [...] Mr. John Latham, "The Progress of Breech-Lo[...] Small Arms."
Royal Geographical Society, University of London, [...] lington-gardens, S.W., 8½ p.m. 1. Mr. John F[...] "Journey across the Western Interior of Aus[...] 2. Dr. W. B. Carpenter, "Recent Observations of [...] *Challenger* and *Tuscarora*, and their Bearings on [...] Temperature Theory of Oceanic Circulation."

Tues. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., [...] Mons. Rahn, "Practical Demonstration of his M[...] of Instruction in Music, based on the Science of H[...] mony and Musical Composition."
Birkbeck Scientific Society, Southampton-buildings, W[...] 8 p.m. Mr. William Glaisher, "Coral Reefs."

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4 p[...] Annual General Meeting.

Fri. ......Geologists' Association, University College, W.C., 8 p[...] Archæological Institution, 16, New Burlington-str[...] W., 4 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,180. VOL. XXIII.

FRIDAY, JULY 2, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TRAINING SCHOOL FOR MUSIC.

On Friday last, the 25th inst., a committee meeting was held at the Mansion House, the LORD MAYOR in the chair, to consider the propriety of co-operating with the Prince of Wales, as President of the Society of Arts, and the Corporation of London, with a view of assisting the establishment of the National Training School for music. The Lord Mayor said the present meeting was a preliminary one, for the purpose of electing the executive committee to carry out the suggestions made at Marlborough House, and that a public meeting would be called to further consider the subject then brought forward. Sir F. W. Truscott said he could not see, although a building had been provided for them, that there was any fund to furnish so large a house. Sir Henry Cole said it would be necessary, either by means of a guarantee or otherwise, to raise a fund for this purpose, in addition to providing the necessary scholarships. He calculated that £1,000 or £1,500 might be necessary for this purpose to start the school, and that an income of £12,000 a year in free scholarships would afford education for 300 scholars. After some further discussion the election of a committee was carried.

ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council and the Treasurers' Statement of Receipts, Payment, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Bye-laws, on Wednesday last, the 30th of June, at four p.m., Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council, in the Chair.

The Secretary having read the notice convening the meeting, the minutes of the last Annual General Meeting, and of the subsequent Special General Meeting, were read and signed.

The Chairman then nominated Mr. William Botly and Mr. Percival as scrutineers, and declared the ballot open.

The Secretary then read the following

REPORT.

In accordance with bye-laws of the Society, the Council now lay before the members the report of the proceedings for the year, together with the usual financial statement of receipts, payments, and expenditure for the same period.

POLLUTION OF RIVERS.

The Society has ever taken a deep interest in this subject, affecting, as it does, not only the health of the people, but the welfare and progress of the Arts and Manufactures of the kingdom. The water supply of our population has constantly been before the members for many years past, and the treatment of sewage has formed the staple of many papers and discussions at the meetings. Many and varied have been the plans for dealing with the sewage of our towns, some professing, not merely to render it innocuous, and thus render it harmless so far as the purity of our rivers is concerned, but at the same time, more or less, to diminish the cost of the undertaking, and even, in some instances, to ensure a profit on the operation. It is not for the Society to point to any one of these plans as above all others to be adopted in all situations and under all circumstances; the conditions of every locality are so varied and so different that it must be left to each to secure that best adapted for its purpose. With a view of gathering together the opinions of those interested in the question, and of affording useful information to the public, the Council called together a Conference upon the subject in December last, which was presided over by the Right Hon. Lyon Playfair, M.P. Numerous plans for dealing with sewage were laid before the meeting; and further than this, in a paper by Mr. Thom, himself a practical manufacturer, it was shown that the foul waste waters of factories could be dealt with effectually, so as to render them no longer destructive of the purity of our streams. After a lengthened discussion, in which visitors from numerous localities expressed their views to the meeting, a unanimous feeling was displayed and embodied in a resolution that the time had arrived when legislative measures might be taken to prohibit the fouling of the rivers, whether by sewage or by manufacturing refuse, and the Council were requested to point out to the Government the urgent necessity for prompt legislation, and that legislation was practicable, for considerably improving the condition of our rivers, though not for ridding them of all impurity even of most objectionable character. The Council placed the result of this Conference before the Government, and they have reason to hope that their views, backed as they were by a meeting so influentially attended, will take the form of law before the present Session of Parliament comes an to end.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The members are aware that for some years past the Council have been promoting the establishment of an institution of this character, and the action taken by them in furtherance of this object has been referred to in successive annual reports. The Council are happy to inform

the members that this project is now in a fair way of realisation, and by the commencement of the coming year it is confidently expected that the school will be opened. It may be interesting to remind the members, that so long since as 1864, a Committee of this Society was formed to consider and report on musical education at home and abroad. This Committee collected a large amount of information, obtained from eminent musical authorities and well-known amateurs in this country, and by correspondence from abroad, aided by the influence of the Secretary of State for Foreign Affairs, a report, with this information, was published by the Society, and the Committee in their report dwelt on the importance of establishing in this country a national institution, where the natural musical talent of the country might receive its practical development, in like manner as is afforded in France, Austria, Germany, Belgium, and other Continental countries.

It was at one time thought that the existing Royal Academy of Music might have formed the basis on which such an institution as above recommended could have been formed, but after prolonged negotiation with that body it was found that the principles on which the Committee recommended the formation of a national training school were not acceptable to the Royal Academy, or compatible with the principles on which it was established. The principles advocated by the Committee were that a free education in music should be given to those who might, after competition, be selected from various parts of the country, as showing great natural aptitude, whether in voice or otherwise, for musical study. It became, therefore, a necessity to establish the school on an independent footing, and to seek aid from the public to endow it with free scholarships. Assistance as to site was freely offered by her Majesty's Commissioners for the Exhibition of 1851, the Council of the Royal Albert Hall offered the use of the large hall and of one of the smaller theatres, and Mr. C. J. Freake, a vice-president of the Society of Arts, undertook to erect the necessary building for the school at his own risk, and place it at the disposal of the Managing Committee of the school for five years rent free. The building was commenced in December, 1873, the first stone being laid by H.R.H. the Duke of Edinburgh, and is now complete, and Mr. Freake, no longer confining himself to the limited promise of a five years' use, has, with a noble generosity, presented it as a free gift to the nation. Much support from the public has already been promised, in the shape of free scholarships; Birmingham, Manchester, Liverpool, Leeds, and other towns have come forward with offers of support, and, at the request of a numerous and influential meeting, convened by his Royal Highness the Prince of Wales, at Marlborough House, and attended by H.R.H. the Duke of Edinburgh, the Lord Mayor has undertaken to form a Committee in the City of London for promoting the establishment of free scholarships in connection with the metropolitan district. It is expected that the school will be in a position to commence its work by the beginning of next year. The members may be congratulated on this great work of the Society being brought so near to completion. The management of the school will be in the hands of a Committee, composed of three representatives from the Society of Arts, two representatives of the Royal Albert Hall, and two representatives of the Commissioners for the Exhibition of 1851, and likewise representatives from localities founding a certain number of free scholarships. The Committee of Management have already secured the services of Sir Michael Costa, Sir Julius Benedict, Sir George Elvey, Mr. Charles Hallé, Professor Ella, and Mr. John Hullah as inspectors and examiners of the school. With these gentlemen to assist and advise the Committee of Management in their organisation of the school, the confidence of the public cannot fail to be secured.

Drill in Schools.

The importance of drill as one of the branches of education for the young has, as the members know, been for many years past prominently urged by the Council, and endeavours have been made to promote its introduction into schools generally. It is unnecessary here to repeat what has been more than once urged in the reports of the Council as to its value not only in regard to health, but as to the habits of attention, order, and obedience, as well as suppleness of limb, adding materially to the efficiency of the man in after life. The Council have, as the members are aware, on three occasions endeavoured to show what may be done in this direction by holding reviews of the metropolitan and district schools, the first under the inspection of H.S.H. Prince Teck, the second under that of H.R.H. Prince Arthur, and the third under that of H.R.H. the Prince of Wales. On each occasion the efficiency of the lads was highly approved on all hands, and the Society gave flags to those schools which acquitted themselves best on these occasions. It was, however, felt that having shown what could be done, the time had arrived when the movement should become a National one, that it should be taken up both by the Military and Educational Departments of the Government. The Council have felt it their duty to press the matter on both these departments, and a deputation waited upon H.R.H. the Duke of Cambridge, the Commander-in-Chief, seeking his aid on behalf of this object. It was pointed out to his Royal Highness, that school instruction in military drill could be materially assisted and promoted if the authorities would sanction the employment of non-commissioned officers, in their several localities in various parts of the kingdom, as teachers in the schools in their several neighbourhoods. His Royal Highness entered warmly into the matter, and expressed his hearty sympathy with the object in view. The Council also waited upon the London School Board, not, indeed, to urge them to introduce the teaching of drill in the schools under their charge, for, happily, the Board at a very early stage saw its importance, and have already secured it as part of their system of instruction, but to express their earnest sympathies in the good work already accomplished, and to express their hope that the system would be still further extended. The Council hope that the School Board will give a further impetus to the system, and familiarise the public with it by continuing those reviews of school drill which the Society has inaugurated. They feel that by such means the public, both in the metropolis and

provincial towns, will be brought to recognise the value and importance of this training for the young. The Council have offered to the Board, on the part of the Society, to provide a handsome set of colours to be competed for each year, and held for the ensuing year by the school pronounced by military authority to be the best of the year, and to give to such school a sum of £20, to be divided among the boys as a prize. The School Board have referred the matter to the consideration of a committee.

STREET-PAVING AND CLEANSING.

This Committee, which has been continuing its labours during the session, has, after collecting much information both from those at home as well as from abroad, made a report, in which the results of their investigations are embodied, which was published in last week's *Journal*, and it will be seen from this report that the condition of our streets, whether as regards health, water supply, accidents, fire, or locomotion, needs the urgent consideration of all, and that early legislation is required for placing our streets in a satisfactory condition. The importance of an improved and consolidated system of constant water supply at high pressure, with hydrants at frequent intervals, under the charge of a public authority, is strongly insisted upon as absolutely necessary for safety from fire and cleanliness in the streets. Science and art, applied to this branch of administration, it has been shown, would in the metropolis cleanse the street surfaces well at half the existing expense of cleansing them ill; would reduce filth and foul air and lung diseases very considerably; and would lessen the present expenditure of tractive force by fully one-half. These great conclusions are applicable to other cities as well as the metropolis, as well as to the administration of the roads generally throughout the country. The use of the dynamometer will be extensively required to make known the waste of tractive force incurred by ignorant empiricism. The questions raised would justify a special organisation for their prosecution. It may be remembered that this Committee undertook experiments on the traction of vehicles over different descriptions of pavements or roadway, and that a recording dynamometer for this purpose had been specially constructed by Mr. Amos for the use of the Committee. The results of these experiments are given in the report, and further experiments are intended to be made.

FIRE PREVENTION, AND WATER SUPPLY.

The great labour bestowed on this subject was undertaken upon assurances from the Premier, as well as by the President of the Local Government Board, of legislative attention to it. The labour was such as the Local Government Board, preoccupied and overworked as it is known to be, could not have undertaken. In fullness, in the weight of the official testimony of the Government engineers, and others, including the chief water engineer of the metropolis, and the chief scientific officers of Manchester, Liverpool, and other cities, the report on fire prevention was acknowledged to be in advance of the last report of the Royal Commission on the supply of water to the metropolis, presided over by the Duke of Richmond. The conclusions of this report were embodied in a Bill brought into the House of Commons by a member of the committee, Col. Beresford, member for Southwark, supported by Sir C. Russell, the member for Westminster; Mr. Forsyth, the member for Marylebone; and Mr. Ritchie, the member for the Tower Hamlets. It was thrown out on standing orders by the unexpected opposition of the directors of the water companies. It has been renewed this Session by Colonel Beresford, under the original official promises of support, but has been yet delayed by the pressure of other measures of legislation. The cost of this delay is shown, by a statistical return appended to the report on street cleansing, to be—three-fourths of the regularly recurring losses of life and property from preventible fires; the injury to the public health from the impurity of the water supplies, arising from the intermittent system of distribution; the filthy condition of the streets from defective cleansing; a waste of water amounting to nearly one-half, or the greater part of that taken from the Thames; and lastly, a waste of multiplied establishment charges, sufficient, if economised, to accomplish the chief improvements needed.

POSTAL TELEGRAPH COMMUNICATION.

The subject of cheapening and extending ocean postal telegraphy by the practical application of economical and administrative science has been the subject of continued attention by a special committee. Mr. Reed, M.P., a member of the Council, has undertaken to bring the conclusions of that committee before the House of Commons, by a motion for the appointment of a Select Committee to examine them. When examined, it will be found that great losses have been incurred by legislative delay in the adoption of the conclusions elaborated on this subject by the Society's Committee. It is well known what difficulties had to be overcome by the Government in taking over the inland telegraphs, and the cost, in many instances excessive, at which this great public benefit was obtained. When the systems of the competing private telegraph companies were taken over, the number of telegraph messages averaged about six millions, on which the companies declared that no advance could be made; now they are, with uniform shilling messages, twenty millions, and are still advancing. With the official progress in economical science, and the adoption of sixpenny messages, it is confidently felt that the results to commerce will be yet greater.

PATENT LAWS.

The interest which the Society has always taken in this subject has not abated. A paper by Mr. Bramwell, dealing most exhaustively with it, was read before the Society, and the discussion which followed, occupying four successive evenings, showed the importance which the members attached to it. The Bill which has been brought into Parliament for the Amendment of the Patent Laws has met with much adverse criticism, and this Society has presented two petitions, one to the House of Lords, and the other to the Commons, pointing out such portions of the Bill as it is conceived require amendment. It is, however, considered by many that legislation at

the present moment is not needed at all; that under the Patent Law Act of 1852 there are powers which have not been exercised, and which if exercised by the appointment of one or more paid commissioners, responsible for the charge of and control of the work of the Patent-office, all or nearly all that is needed by way of reform may be accomplished. At all events a trial might be made, and if at the end of a few years it was found that legislation was needed, the aid of Parliament might then be invoked.

Museums.

Under this head the Council have not failed to urge upon the Government and Legislature, whenever a favourable opportunity has presented itself, the importance of placing all museums aided by public money under one responsible head, instead of their being as at present under every variety of management. The Council have memorialised the Government in this sense with reference to the East India Museum, urging at the same time that it is not India alone which is interested in its maintenance, but that the commerce of the Empire at large is deeply indebted to its teachings, and it therefore would be right that it should be assisted by Imperial funds so as to place it on a footing worthy of the nation.

Indian Section.

The action in this direction has been continued with much success. Sir George Campbell gave an able address at the opening of the Section, pointing out at considerable length the great variety of topics which might with advantage come before its consideration. "The Possibility of Adapting the Roman Alphabet for the Languages of India" was ably brought before the Section by Mr. Frederick Drew; a highly interesting discussion followed, in which Sir Charles Trevelyan, who presided, took part, pointing out the importance of the subject, both politically and socially. "Measures and Suggestions for the Advancement of the Wet and Dry Cultivation of India," were discussed in a paper by Mr. Robert H. Elliott, in which the subject was taken up from a practical point of view. "The Preparation and Uses of Rhea Fibre," were exhaustively treated by Dr. J. Forbes Watson. "The Growth of the Factory System in India, with especial reference to the Production of Textile Fabrics and the Relative Advantages of the British and Indian Manufacturer," was fully and elaborately treated in an important paper by Mr. Elijah Helm. "The Russian Advance in Central Asia, in its Commercial, Literary, and Social Aspects towards India and the East," was treated in a very carefully-prepared paper by the Rev. James Long, who, in addition to his own personal knowledge of the subject, was able to supply information from sources hitherto not available to the public. Looking at the great mass of subjects which may come under discussion, there is no fear that the interest of the Section is likely soon to be exhausted.

African Section.

In the various meetings of the African Section during this session, several practical matters came under consideration and discussion. The present state of the Gold Coast, the oil rivers, and the trading stations of the Bight of Benin, were described by Mr. W. Babington, Mr. A. Swanzy, and Mr. ex-Consul Hutchinson. A very interesting account of the capabilities of the natives of the Gold Coast was given by the Rev. Mr. Schrenk, of the Basle Mission, who has spent many years of his life amongst them, and who illustrated from his own personal experience the civilising power of industrial education, and the curious fact that artisans' work and trade are much more readily undertaken than agricultural occupations. Mr. Horace Waller gave a very instructive and exhaustive sketch of the influence of the labours of the late Dr. Livingstone, and argued from the importance of the rivers Zambesi and Shiré as a gate of admission for civilisation into the side of the continent, and of the occupation of Lake Nyassa by steam navigation. A valuable contribution was made by Mr. Theophilus Shepstone, the veteran Secretary for Native Affairs in the colony of Natal, on the early history of the Zulu Kafir race, which was enlarged upon by Dr. Mann, in illustration of the existing state of the relations of the European colonists to the native tribes of the eastern sea-board of the great continent, and in explanation of the difficulties that had recently arisen in Natal. Mr. Bergtheil especially urged the importance of breaking down the system of tribal authority among the natives, and of introducing in its place a plan of organisation which should be based upon individual responsibilities and rights. Mr. Arrott-Browning described the surveys that he had just completed for a trunk line of railway through the colony of Natal, and explained the results upon commerce and trade.

Chemical Section.

This Section has maintained its interest, and excellent papers, bearing on the practical application of chemistry to the arts, have been read and discussed. Captain Shaw, Chief Officer of the Metropolitan Fire Brigade, treated "Appliances for Enabling Persons to Breathe in Dense Smoke or Poisonous Vapours;" whilst "Air and Ventilation formed the subject of a paper by Mr. W. N. Hartley. "River Pollution, with Special Reference to the Work of the late Commission," by Mr. W. Thorp, B.Sc., Lond., F.C.S., elicited much discussion. "Recent Advances in Photographic Science" were brought before the Section by Mr. J. Spiller, Vice-president of the Photographic Society. "Alum Shale and its Application" was treated by Mr. Sydney Rich. An elaborate and complete paper on "Modern Blasting Agents," by Mr. A. Nobel, the father of the nitro-glycerine industry, brought the work of the Section to a close.

Examinations.

The general examinations of the Society continue to show an increased number of candidates; the particulars have been already laid before the members of the Society in the report of the Educational Officer, read to the Conference of the Institutions in Union held on the 25th inst. The Technological Examinations, which were held last year for the second time, have excited greater interest as they are becoming more known, and this year there has been an increased number of candidates. The number is still, however, small, but it is hoped

at as the examinations become more known the mber of candidates will increase.

Cantor Lectures.

The Cantor Lectures for the present year have racted large numbers to the Society's Rooms. . Richardson gave a course of six lectures on cohol; the Rev. A. Rigg a course of six, on Tools d in Handicraft; and Mr. F. J. Bramwell a urse of four, on the Modern Forms of the Steam gine. Dr. Richardson's lectures have already en printed in the *Journal;* the two other courses ll be printed during the vacation.

The Council, having regard to the Technological aminations, have thought it would be fitting at the Cantor Lectures for the coming year should ve reference to some of the subjects comprised in se examinations, and they have arranged that courses for next year shall be "On Paper anufacture," by Mr. W. C. Arnot; "On Steel anufacture," by Mr. Mattieu Williams; and Wool Dyeing," by Mr. George Jarmain.

It is intended that these lectures shall be printed as to form handbooks for the use of those dying these subjects.

Unhealthy Trades.

It was understood at one time that it was con- mplated by the Government to issue a Commis- n of inquiry into the condition of unhealthy des, but it does not appear that such is likely to be the case. The subject, however, is one eat importance, and worthy the consideration the Society. The Council have, therefore, de- mined to commence an inquiry into this subject, d with that view they have requested Dr. hardson, F.R.S., to institute an inquiry of this ure in connection with some of the trades ried on in, or in the neighbourhood of, the tropolis, and to lay before the Society the ults of these inquiries in the form of a course lectures, to be delivered during the next session. . Richardson has undertaken the duty. The uncil have to thank Mr. Benj. Shaw, one of the mbers, for a donation of £50 in aid of this ject.

Stove Competition.

It is with great regret that the Council have und themselves unable to award any of the zes offered under this head. A gentleman, o desired that his name might not be men- ned, liberally placed at their disposal a sum £500, in the hope that inventive genius would stimulated to produce something which should able coal to be economised both for heating and oking, in a manner superior to that offered by y contrivance already in use. The members are are that, under the direction of a highly com- tent committee, the various contrivances sent in re carefully tested in rooms specially erected for e purpose. This committee having reported at none of the contrivances shown were superior those already in the market, the Council had alternative but to withhold the prizes.

Merchant Shipping.

A Bill having been brought into Parliament with erence to this subject, it was deemed right to point a Committee to consider its provisions, d suggest, if needed, such amendments as might be thought right, and generally to watch the progress of the Bill through Parliament. This Committee, presided over by Captain Sir J. Heron Maxwell, Bart., R.N., and composed of mem- bers intimately connected with the subject—mer- chants, shipowners, builders, and others—had several meetings, and embodied their views in a report, which has been forwarded to the Board of Trade.

Railway Lamps.

The competition for the prize offered by the Society for an improved lamp for railway carriages has included lamps of various kinds, some for burn- ing vegetable oil, some for mineral oil, and some for gas. Unavoidable delay has occurred in bring- ing this competition to a conclusion. The mere testing of the light given by these lamps in the Society's Rooms has not been considered sufficient to enable an award to be made, and arrangements are now in progress for making an actual trial of such as are deemed worthy of it in a railway car- riage on a journey. It is expected that this will take place in the course of next week, and the Committee will then be in a condition to report.

Revolution Indicators.

The competition for this prize included 84 com- petitors in all, and the Committee, after very care- ful consideration, selected nine for actual trial on board ship, and made a request to the Admiralty for the use of a vessel on which to fit up the in- struments of the selected competitors, in order to make an actual trial. H.M.S. gunboat *Arrow* was kindly lent by the Admiralty to the Society, and notice having been given to the selected can- didates to place their instruments on board, five only fitted up their instruments, and these have been tried in the presence of the inventors; but on discussing the results it was found neces- sary that a further trial should be made. This has caused some delay, but it is expected that the Com- mittee will be able again to have the use of the gun- boat in the course of a few weeks, when a final trial will be made, and the Committee will be in a condition to make their report.

Albert Medal.

This medal, founded in 1863, to be awarded "For distinguished merit in promoting Arts, Manufactures, and Commerce," has this year been awarded to Mons. Michel Chevalier, the dis- tinguished French statesmen, "who by his writings and persistent exertions extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

Howard Medal.

Under this head, the Society has offered a Gold Medal or £25, "For the production of a traction engine of moderate power, capable of being employed as a substitute for horse power on tram- ways and in the streets of cities and towns. The engine to form one structure in combination with the tramway carriage. The power may be generated by any means, provided that noise, noxious fumes, or the discharge of refuse into the air or on to the road surfaces are avoided."

The late Mr. John Grantham, shortly before he died, built an engine which he intended specially to compete for this prize, and after his death his

widow sent in a claim for it to be taken into consideration. Accordingly an actual trial of the engine was made in the presence of the Council, and reports on its efficiency were received from Mr. F. J. Bramwell* and Mr. Woods of a highly favourable character. The Council have therefore awarded this prize to Mrs. John Grantham, in respect of the engine and tramway car above referred to.

Medals.

For the Papers read during the Session the Council have awarded the Society's Medal to each of the following gentlemen:—

Ordinary Meetings.

To F. J. Bramwell, Esq., F.R.S., for his Paper on "The Expediency of Protection for Inventions."

To George Fleming, Esq., Veterinary Surgeon, Royal Engineers, for his Paper on "Horse-shoes and Horse-shoeing."

To Clements R. Markham, Esq., C.B., for his Paper on "The Agricultural Statistics of India."

Indian Section.

To Frederick Drew, Esq., for his Paper on "The Possibility of Adapting the Roman Alphabet for the Languages of India."

To the Rev. James Long, for his Paper on "The Russian Advance in Central Asia in its Commercial, Literary, and Social aspects towards India and the East."

African Section.

To the Hon. T. Shepstone, for his Paper on "Early History of the Zulu Kafir Race of South-Eastern Africa."

Chemical Section.

To A. Nobel, Esq., for his Paper on "Modern Blasting Agents."

Memorial Window in St. Paul's.

The Council much regret that it is not in their power to announce any further progress with this window. The subscription, as the members are aware, was commenced shortly after the public thanksgiving for the recovery of the Prince of Wales, in March, 1873, and subscriptions to the amount of £345 have been received by the Society. The north transept window was allotted to the Society, and a suitable design was prepared by Mr. Moody; and the same having been submitted to her Majesty the Queen and his Royal Highness the Prince of Wales, had met with their approval. Owing, however, to the unfortunate delay which has occurred, arising from the protracted differences which have taken place among those who have charge of the general decoration of the Cathedral, resulting at present in an entire suspension of the work, the subscription has been stopped in its progress, and the Council are unable, for the present at least, to take any steps in this matter. The Dean of St. Paul's, in his last communication to the Council, under date of 23rd of April last, says:—"Everything connected with the decoration of the Cathedral is for the present suspended. I hope in due time that the consideration of it may be resumed. But the north transept window is so important a feature that the Committee would not, I think, sanction any treatment of it without reference to a general plan of decoration. I am extremely sorry that you should be kept waiting; we are all, unfortunately, in the same condition."

* See letter appended to the report.

The subscriptions received are standing at deposit with Messrs. Coutts and Co., and directions have been given for their investment in Three and a Half per Cent. Metropolitan Stock.

Memorial Tablets.

In addition to those already affixed, the Council have obtained leave for placing tablets on the houses wherein the following notabilities have at some period of their career lived, viz., Jeremy Bentham, John Milton, Dr. Samuel Johnson, Edmund Burke, George Canning, Michael Faraday, David Garrick, Lord Nelson, the Duke of Wellington, and Mrs. Siddons. These will be affixed as soon as they are received from the manufacturers.

The Late William Mulready, R.A.

The Council, at the request of the Committee for raising a memorial to the late William Mulready, have accepted the sum of £109 12s. 9d., which has been handed over to them in trust, to keep in repair the tomb of this illustrious painter at Kensal-green, and from time to time, as the interest unappropriated for this purpose may accumulate to a sufficient sum, to expend the amount in a medal to be awarded to that student in the Schools of Art in the United Kingdom who exhibits the best drawing from the nude figure, executed in black and red chalk, in the manner so successfully practised by Mulready. The money has been invested in India Four per Cent. Stock.

Finances.

In submitting the annual statement of receipts and expenditure already published in the *Journal*, the Council congratulate the members upon the continued advance which the Society has made during the past year, and the consequent increase in the amount of annual subscriptions, which is larger than at any previous period since the Society's incorporation. The Council have funded the life subscriptions and donations to the Endowment Fund received during the Session.

It may be well to explain that though by the accounts it would appear that the cost of the *Journal* has increased, the increase is apparent only and not so in reality, the Society having taken the advertisements into its own hands, which, while causing an increased outlay, has produced on the other side of the account increased receipts, in addition to which it will be seen that the assets under this head are also largely increased. Besides this, a portion of the charge for salaries has been transferred to the cost of the *Journal*.

The assets of the Society are upwards of £1,[illegible] in excess of the assets of last year, and the funded property of the Society has, as stated in the accounts already published, been added to by the purchase of £527 14s. 6d. Reduced 3 per Cent. Stock.

The following is Mr. Bramwell's opinion, referred to in the Council's Report:—

37, Great George-street, Westminster, S.W.,
June 8th, 1875.

Dear Sir,—As you are aware, I have for very many years past (in fact, since my boyhood) taken great in-

terest in the question of steam locomotion on common roads, I therefore listened with much attention to the statement you made more than a year since before the Institution of Civil Engineers, on your then projected steam car for tramways; and now that this project has developed into a completed steam car, I have gladly availed myself of opportunities of seeing it in work on the private line of rails at West Brompton. I have also examined carefully the detailed working drawings of the still further improved steam car, which you are putting to work in Vienna, and I have had the benefit of explanations from you upon those points (and they were very few) upon which, after an examination of the drawings, I needed any explanation.

I will now, as I promised, give you my opinion as to whether your steam car may be safely worked on the ordinary tram roads. The question of the safe working of steam carriages on common roads resolves itself into two distinct branches—the one, "Is there anything in the proposed machine which is in itself really a source of danger?" The other, "Is the machine likely to frighten horses, and in this way (although in itself perfectly innocent) be the cause of danger?" I believe your steam car would be practically safe with respect to both these branches. Most certainly it would be, as regards the first; and as to the second, it would be safe, except in those cases where it might meet with very timid horses, such as are at present startled by the sight of a puddle, or of a wheelbarrow, or even of their own shadows.

I will now give the grounds on which I base the foregoing opinions:—

First, as regards the machine being safe in itself—the intrinsic safety, so to speak.

It is scarcely necessary in the present day for me to say that any apprehension from danger from explosion is, with a properly-constructed steam-engine boiler, a perfectly idle one, so long as that boiler has common attention paid to it. Your boiler is small, is of the simple cylindrical form, the strongest form we have in use, and the means of knowing and regulating the pressure of the steam, and the state of the feed have been very fully provided by you. It is quite certain that if on the one side be put the dangers arising from the horses now employed to draw tramway cars, and on the other those arising from explosion, the balance of safety is very largely in your favour.

The steam car is under the most perfect control as regards starting and stopping. I have carefully experimented on this, and nothing can be more entirely satisfactory. The waste steam blast is properly tempered, so that there is no fear of throwing fire from the chimney, and with a closed fire-door and ash-pan there is no risk of dropping cinders on the road.

Looking at the foregoing facts, I have no hesitation in pronouncing your steam car in itself perfectly safe.

Next with respect to the question of frightening horses.

You must let me, on this branch of the question, be a little discursive. As I have already said, I have for years past paid great attention to the subject of steam locomotion on common roads. Nearly 40 years ago, when I was an apprentice, I became very intimate with Walter Hancock, and was in the habit of riding with him in his common road steam coaches or omnibuses that used to be driven from the factory at Stratford through Whitechapel, Leadenhall-street, Cornhill, and Princes-street (the Bank), and thence used to start on their journey backwards and forwards to Paddington, plying for hire like any other carriage, and in the afternoon (if they did not put up at the yard in the City-road) returned by the before-mentioned route to Stratford. These carriages had to contend with all the difficulties arising from going over the ordinary surface of the road, whether that surface were granite pitching, as in the City, gravel as in the Mile-end-road, or macadam as in the City-road; and the coaches had to pass over the gravel or macadam roads, even when they had been newly metalled, and were in such a state that in these more humane days a horse would not be put to work upon them, but they would be submitted to the action of the steam-roller. Yet all these difficulties were overcome by Hancock, and moreover the coaches, unguided by trams, were guided in and out among the traffic with more facility and with much more certainty than a horse vehicle is manœuvred by its driver.

These steam coaches did not send forth either smoke or visible steam, they did not exhibit any fire, nor any moving parts of the machinery (except the wheels), there was no noise of the puff of a waste steam draft, nor was there any sound of machinery. The utmost noise was an occasional slight hissing from any imperfect joint or tap, a matter far less likely to occur now, looking at the great improvement in workmanship, especially in the workmanship applicable to high pressure steam, which has been made since those days. Moreover, the coaches were shaped like coaches or omnibuses, or open *char-à-bancs* (for all these forms were used), and there was nothing frightful or even ungainly in their appearance. The result was that horses, unless very high spirited, paid but little attention to these coaches, even on a first acquaintance, and those horses which worked regularly on the same roads with the steam coaches disregarded them altogether.

If steam on common roads had been pursued in the careful spirit that Hancock exhibited, the use of such carriages would never have incurred the opposition that has been made against it; but the fact is, that after Hancock gave up his efforts to thus employ steam, the subject was practically in abeyance for many years, and when it was at length resumed, it was taken up, not for passenger traffic, but for heavy haulage, in the shape of traction engines, and of self-moving ploughing engines.

These machines were made by very ingenious mechanics, and as mere machines for purposes of locomotion or for hauling heavy loads, they possessed great merit, but as machines competent to travel on public roads without frightening horses they were about as ill-designed as it is possible to imagine. They emitted smoke and visible steam; they exhibited in full view crank shafts, connecting rods, and piston rods in all their motions; they not unfrequently had a fly-wheel whizzing round; they had the strong puff of the exhaust steam; they occasionally threw fire out of the funnel; and their general shape was such that instead of offering to a horse the appearance of some variety of an ordinary carriage, they must have presented to the equine mind the impression of some terrible monster, a sort of mechanical "bogey." It is not surprising that such engines as these frightened horses.

I have frequently had, in my position as one of the engineering judges of the Royal Agricultural Society, to attend the trial of such machines as I have described, and I have witnessed many instances of fear on the part of the horses we have met; but, as I have previously said, these causes of fright are not necessary accompaniments of common road locomotion; they did not exist forty years ago, they need not exist now, and I am glad to find that in your tramway steam car you have carefully attended to the doing away with the objections to the modern road locomotives, as seen in a traction engine. You do not make smoke nor emit visible steam, you do not make a noise, either with the exhaust steam or with the machinery, and you conceal all the working parts; moreover, your carriage is in appearance so like an ordinary tramway car that it requires notice, either of the little brass funnel, or of the screen hanging down by the wheels, to enable one to say that the carriage is not an ordinary tramway car, to which the pole is about to be attached.

If the horses were taken out of such a tramway car, and it were put upon a gentle hill of just enough

slope for the car to keep in motion at its usual pace, and if horses meeting the car were not frightened at it, then they would not be frightened at your steam car, for the only singularity in its appearance will be that it is self-moving, as a common car would be if suffered to go its usual pace down hill without horses. I cannot pretend to say what some horses of very nervous temperament may do, but I presume they would hardly take fright at the appearance of the back of a tramway car which was (whether driven by horse or by steam) moving away from them, and if not I do not see why they should fear a precisely similar object when coming towards them; but if they would not, then they would not fear either the ordinary car running at its usual pace (but without horses) down hill towards them, neither would they fear the counterpart of this appearance, viz., your self-moving steam tramway car.—Yours truly,

F. J. Bramwell.

John Grantham, Esq.,
17, King's Arms-yard, E.C.

On the conclusion of reading the report,

Mr. Botly proceeded to move its adoption, commenting in so doing on the wide scope included by the labours of the Society, and the importance of the several points to which attention had been devoted during the past session. Among the more important he drew special notice to the action of the Society in regard to the pollution of rivers, a subject of the very deepest interest, not only to the manufacturers who might be affected by legislation, but to the whole people of the country, for whom pure water and efficient drainage were of the highest interest. Again, it must be a matter of congratulation to all, who, like himself, had watched the endeavours of the Society through so many years to foster musical education, to see those endeavours crowned with success in the establishment of the National Training School. The valuable Report on Street Cleansing, and the efforts to introduce a system of Drill into Schools, also deserved remark. As to the internal work of the Society, it was indeed gratifying that the special Sections—Indian, African, and Chemical—were prospering as they were. This effort to meet the individual tastes of the members was most praiseworthy, and speaking of the one of which his studies had best qualified him to judge, the Chemical Section, he had much pleasure in expressing his high opinion of the papers he had listened to. The Cantor Lectures, too, were of even unusual excellence, and of the series delivered by Dr. Richardson, he might safely say that rarely, if ever, had he listened with more pleasure, or derived greater instruction, from any course of lectures he had attended. In conclusion, he congratulated the members on the financial position of the Society, and on the marked progress it had made as regarded numbers and funds.

Mr. Seymour Teulon seconded the motion, which was put and carried unanimously.

Mr. Hale wished to address a few remarks to the meeting, not so much in the way of criticism of the past, as for guidance in the future. He then proceeded to notice several points which, in his opinion, required reform. The hour at which the annual meeting was held (4 p.m.) was, he considered, very inconvenient, and he would urge on the Council the necessity for an alteration. Another matter he had pressed on the Council was the want of a printed catalogue of the Society's library. He considered that it would be much more convenient for members to have a catalogue they could take home and consult at their leisure, than that they should be compelled to come down to the library and consult the catalogue on the spot. Next he would advocate the establishment of a larger reading-room than the existing one, and the addition of a separate one for ladies, both to be supplied with the daily and other papers. A commodious lavatory was also an important requisite. As to the Albert medal, he complained that no notice was taken of his proposal that Mr. Gladstone should have it. He thought that that statesman had done quite enough for commerce to merit such an award, and now that he was out of office there was a good opportunity for giving him the medal. With regard to the papers that had been read, he had always found it a great hardship that he (Mr. Hale) was so rarely allowed to speak at the meetings, though he was frequently anxious to do so, while other gentlemen, who were not even members of the Society, had on several occasions been permitted, not only to make *viva voce* speeches, but even to read what he would term supplementary papers. He would ask whether he might be allowed to write a reply to a paper on some occasion, and read it at the next meeting?

The Chairman intimated that such a proceeding would not be permitted.

Mr. Hale continued by saying that he did not think members ought to be crushed out. He then proceeded to discuss the question of salaries. He thought the salaries paid to the officers were extremely high, and besides he had inspected the books, and found that the salaries actually paid were very much in excess of the sum put down for that item in the treasurers' financial statement. In conclusion he wished to say that the above criticisms were offered in a friendly spirit, and if his facts were inaccurate, he begged to apologise in advance.

Mr. Seymour Teulon hastened to offer an entire contradiction to the observations of the last speaker, remarking that, so far from the services of the officers being overpaid, he thought the Society was fortunate in getting the work done at the rate they did. There were no officers of any other institution he knew, who were compelled after their ordinary day's work, to continue their labours at meetings which lasted till late at night. The numerous meetings and lectures necessitated the attendance of the officers during many evenings of the week. He then proceeded to speak in very high terms of the officers, concluding by saying that he, and all his fellow-members of the Council, were thoroughly satisfied with the way in which every department of the Society's work was conducted. As to the question of a library catalogue, there already existed a very complete and excellent MS. catalogue, which any visitor to the library could use; and as for having one printed, he for one would not sanction such a waste of the Society's funds. It was unnecessary for him to say that the new Council would always be glad to consider any suggestions made by members, whatever they might be. He concluded by moving, "That the best thanks of the meeting be given to Mr. Le Neve Foster (secretary), Mr. Davenport (financial officer), and to the other officers of the Society, for their successful exertions during the past year," coupling with the resolution an expression of thorough confidence in that energy and ability to which the present high position of the Society was mainly due.

Mr. E. Chadwick, C.B., as one who had had long experience of public administration, gave a decided opinion that it would be hardly possible to conduct the business of the Society more economically than it was now managed. As an instance, he would refer to the admirable report on street cleansing. This alone would have cost the country £4,000 or £5,000 if it had been prepared by a Government Commission, and he was certain that it was far more complete than the report of any such Commission would have been. Yet this was only one out of the many undertakings of the Society, and it had been prepared by their Secretary as merely a part of his ordinary work. Turning to another point, improved Channel communication, members would remember that, at the instance of Sir Henry Cole and others, the Society had a committee to examine what might be done to mitigate

the inconveniences, and indeed the horrors, of the Channel passage from sea-sickness. He himself had observed the sanitary evils of the transit of passengers, and was led to take part as a director in the scheme of the steam-vessel proposed by their distinguished member Mr. Reed—who began his career in naval construction by a paper he read as a member in this Society, twenty years ago—and who connected with his proposed ship the swinging saloon planned by Mr. Bessemer. Whatsoever might be the outcome of other schemes, the result of one of Mr. Reed's vessels was certain, for he had recently ascertained it statistically. There are people of such susceptibility that they are made sick at the sight of the sea, they are sick whilst a vessel is aground, on railways, and in hotel hoists. In order to get some accurate statistical results, he asked Captain Pittock, who has been the chief commander of the channel packet-boats for twenty-four years from Dover to Calais, what were the number of basins usually put in requisition for the relief of the passengers in crossing? He stated that the regular provision of basins required was for two-thirds of the passengers embarked. Thus the chances of the passengers are as two to one of the horrors of a sea-sickness on the average. He had commanded Mr. Reed's ship in her late trials in various weathers, most of it moderate, some of it rough weather. He (Mr. Chadwick) asked him how it would have been in the ordinary packet-boats in the like moderate weather; what number of basins would have been required in that same weather? From one-third to about one-half the number of passengers would have required the use of basins, he answered. What number of basins were actually demanded on board Mr. Reed's ship in that same weather? Not one, Captain Pittock answered; not one was asked for. Did he anticipate that that would be the general result? Yes, he was confident of that from her great steadiness, which other nautical men had carefully observed with him. Her oscillation was about one and a-half degrees, or under two degrees. On the common passage trials the oscillation was between five and six degrees in the like moderate weather. How was it in the new ship in rough weather? It was about ten degrees; but she had no pitching. How was it in rough weather with common packet-boats? With them, he said, it was about thirty degrees, and there was much pitching. Sea-sickness was due not only to the extent of motion, but to the sort of motion, whether quick and violent, or slow and gentle. In the Channel the sea was short and strong. Now the motion on board was slow and gentle. As a rule, it might be said that the motion was less than one-third that of the common packet-boats he had commanded, and was slow and gentle, and there was no pitching. For these reasons he believed that there would now be no sea-sickness in that vessel in moderate weather, or in more than two-thirds of the passages, and very little in rough weather. Now this result must be held to be a most satisfactory and important achievement as regards the ship alone, apart from anything else. The power of crossing in ordinary weather without sea-sickness will be a subject of extreme congratulation, especially to our neighbours of the other side of the Channel. Of the saloon he was unable to give a satisfactory account. A great excess of expenditure beyond the estimate on which the enterprise was based had been incurred by Mr. Bessemer without definite results up to this time; but it is hoped and believed that he will, as he declared he would, stick to the work to the last, and redeem his promise to the shareholders, and achieve results equivalent to the expenditure. In that case we might expect to have the passage entirely cleared of sea-sickness in rough weather. In respect to the speed obtained by the ship, it had now achieved seventeen miles an hour; but its draught had been increased by over-weights, which it is declared may be reduced, in which case a confident belief is entertained that her promised speed of twenty miles an hour will certainly be attained. The abolition of sea-sickness during ordinary weather, its reduction to a minimum during rough weather, and a reduction by one-third of the time of the endurance of any unpleasantness, with an increase of one-third in speed above the ordinary passages, is certainly an advance in the science of naval construction specially promoted within these walls, on which congratulations are due to our distinguished member. In conclusion he wished to second most heartily the vote of thanks to the officers.

Mr. A. Cassels proposed a vote of thanks to the Chairman, who was now about to retire from the office he had held during three years, that of Chairman of the Council. Only those who had given special attention to the management of the affairs of the Society, know how earnestly and unremittingly General Wilmot had devoted himself to the duties of the office he had so ably filled. He did but express the feelings of all the members of Council, when he offered him their thanks for the time he had devoted, and the thoughtful care he had given to the work of the Society.

Mr. Chadwick seconded the motion, adding that the great scientific knowledge of the Chairman, and his long practical experience of engineering matters, had been of the greatest service to the Council, and had always been most freely given.

The motion was put by **Mr. Cassels**, and carried unanimously.

The Chairman returned thanks, alluding to the gratification he had felt in having been nominated for a third term of office after the expiration of his first two years.

The Chairman then proceeded to set right some of Mr. Hales's misapprehensions. Of course, if any such feeling were expressed on the part of the members generally, the Bye-laws of the Society fixing the hour of meeting could readily be changed, but there was no reason to believe members wished for such an alteration. As to the conduct of the ordinary evening meetings, that rested with the chairman on each occasion, who must use his own judgment as to the class of speakers likely to interest the meeting. Besides, each meeting had it in its own hands as to whom it would hear; there was no means of forcing an audience to attend to speakers they did not like. For the Albert medal, the Council were always glad to have names suggested to them, and besides they were at considerable pains to search out names of suitable persons. As the duty of making the award rested with the Council, they must be allowed to discharge that duty to the best of their powers.

A vote of thanks to the scrutineers, proposed by the **Chairman**, and seconded by **Mr. Teulon**, was then put, and carried unanimously.

The vote of thanks to the officers was then put, and carried in the same manner.

Mr. T. R. Tufnell, who, as a former treasurer, had of necessity obtained an intimate knowledge of the Society's accounts, wished authoritatively to tell Mr. Hale that he was entirely under a misconception as to the amounts of the salaries paid. He was utterly and hopelessly incorrect in his whole statement.

The Chairman then intimated that it was necessary to elect a trustee for the Soane Museum, in the place of Mr Redgrave, whose five years of office had expired. This had already been announced in the notice convening the meeting. He begged to propose Mr. Samuel Redgrave for re-election.

Vice-Admiral Erasmus Ommanney, C.B., F.R.S., seconded the motion, which was carried unanimously.

Mr. Le Neve Foster, on behalf of himself and his colleagues, briefly acknowledged the vote of thanks, and the proceedings terminated.

The ballot having remained open one hour, and the scrutineers having reported, the Chairman

declared that the following had been elected to fill the several offices. The names in *Italics* are those of members who have not, during the past year, filled the offices to which they have been elected:—

COUNCIL.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Edinburgh, K.G.	C. J. Freake.
F. A. Abel, F.R.S.	Captain Douglas Galton, C.B., F.R.S.
Sir George Campbell, K.C.S.I.	*Right Hon. Lord Hampton, F.R.S.*
Andrew Cassels.	Wm. Hawes, F.G.S.
Edwin Chadwick, C.B.	Vice-Admiral Erasmus Ommanney, C.B., F.R.S.
Lord Alfred Churchill.	Admiral the Right Hon. Lord Clarence Paget, K.C.B.
Hyde Clarke.	Rev. W. Rogers.
Sir Henry Cole, K.C.B.	Seymour Teulon.
Right Hon. W. F. Cowper-Temple, M.P.	E. Carleton Tufnell.
Major Donnelly, R.E.	
Major-General F. Eardley-Wilmot, R.A., F.R.S.	

ORDINARY MEMBERS OF COUNCIL.

G. C. T. Bartley.	James Heywood, F.R.S.
F. J. Bramwell, F.R.S.	Edwin Lawrence.
Major-General Fred. C. Cotton, R.E.	Robert Rawlinson, C.B.
Colonel A. Angus Croll.	E. J. Reed, C.B., M.P.
The Hon. Dudley Fortescue, M.P.	Lieut.-Col. A. Strange, F.R.S.
Peter Graham.	T. R. Tufnell.

TREASURERS.

Edward Brooke. | John Murray.

AUDITORS.

J. Oldfield Chadwick. | *B. F. Cobb.*

SECRETARY.

P. Le Neve Foster.

FINANCIAL OFFICER.

Samuel Thomas Davenport.

At the conclusion of the General Meeting a Special Meeting was held, when the following candidates were balloted for and duly elected members of the Society:—

Acland, Dr., F.R.S., D.C.L., Oxford.
Adams, Read, St. Ives, Hunts.
Anderson, Sabastian, 24, Crutched-friars, E.C.
Bejar, Luis M. de, C.E., Richmond-house, Lillie-road, West Brompton, S.W.
Bennett, Harry, 24, Crutched-friars, E.C.
Boyd, Alexander Charles, 7, Furnival's-inn, E.C.
Burnes, Mrs., 40, Ladbroke-square, W.
Calver, George, 20, Tufnell-park-road, Holloway, N.
Calvo, Josè M. V. y, 31, Sussex-square, Brighton.
Child, Dr. Gilbert W., 11, Northam-gardens, Oxford.
Clemence, Samuel Quick, Royal Aquarium, Westminster, S.W.
Cobb, F. Stewart, Savings Bank Department, 27, St. Paul's-churchyard, E.C.
Cox, Colonel, 84, Onslow-square, S.W.
Elliott, Robert Henry, 38, Park-lane, W., and Clifton-park, Kelso, N.B.
Horn, Thomas W., C.E., Stoke-on-Trent.
Hughes, Thomas, 108, Harley-street, W.
Kurtz, A. G., Liverpool, and St. Helens, Lancashire.
Manlove, Joseph Ernest, Holy Moor Mills, near Chesterfield.
Marshall, Alfred, C.E., Perseverance Iron Works, Heneage-street, Whitechapel, E.
Newry, Viscount, 6, Waterloo-place, S.W.
Ormiston, Frederick Aldridge, C.E., 3, Clifton-villas, Gipsy-road, Lower Norwood, S.E.
Park, John Carter, Blenheim-house, Bow-road, E.
Petch, Richard, 16, Westbourne-park, W., and 8, John-street, Bedford-row, W.C.
Ponsonby, Edward, R.N., Hamilton-house, Arlington-street, S.W.
Prescott, Sir George, Bart., Isenhurst, Mayfield, Sussex, and Clarges-street, W.
Scherzer, Chevalier Charles de, 29, St. Swithin's-lane, E.C.
Seward, Thomas, Petworth.
Thomas, William Henry, C.E., 15, Parliament-st., S.W.
Thompson, Alfred Boyle, M.D., 18, Serjeants'-inn, E.C.
Tooke, William Arthur, 2, New-square, Lincoln's-inn, W.C., and Pinner-hill, Watford.
Tooth, Frederick, The Briars, Reigate.
Walker, Charles Ritchie, C.E., 9, Holden-terrace, Grosvenor-gardens, S.W.
Youl, J. A., Waratah-house, Clapham-common, S.W.
Young, Robert M., 17, King's Arms-yard, E.C.

ANNUAL CONFERENCE.

The Twenty-fourth Annual Conference between the Council of the Society and the representatives of Institutions in Union, took place at the Society's House on Friday, the 25th of June. Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, presided.

The following is a list of the Institutions and Local Educational Boards represented at the Conference, with the names of the representatives nominated by them:—

Aldershott and Farnham District	Mr. H. Poppleton.
Bolton Church Institute	Rev. J. W. Candey.
Bromsgrove Institute	Mr. A. F. Godson. Mr. T. E. Walker, M.P.
Carlisle Mechanics' Institute	Major Ferguson, M.P.
Crewe Mechanics' Institute	Mr. R. C. Stapley.
Faversham Institute	Mr. J. A. Anderson.
Hertford Local Board	The Hon. Baron Dimsdale. Mr. O. H. Wagner.
Keighley Mechanics' Institute	Mr. B. S. Brigg.
London, Birkbeck Literary and Scientific Institute	Mr. Thomas Lyle. Mr. G. M. Norris. Mr. G. A. Smith.
„ City of London College	Mr. G. D. Hooper. Mr. J. Husband. Mr. J. H. Levy. Rev. C. Mackenzie. Rev. R. Whittington.
„ Kentish-town Literary Institute	Mr. S. P. Moore. Mr. R. Wilson.
„ Quebec Institute	Mr. P. Christie. Mr. F. Pope. Dr. Stocker.
„ Tonic Sol-fa Teachers' Association	Mr. W. R. Bourke. Mr. G. F. Chapple. Mr. E. G. Hammond.
„ Walworth Literary & Scientific Institute	Mr. J. S. Noldwritt. Mr. F. Wood.
Macclesfield Useful Knowledge Society	Mr. W. Bullock.
Yorkshire Union of Mechanics' Institutes	Mr. Frank Curzon.

The following Examiners were present:—Dr. John Anderson, Mr. G. N. Hooper, Professor Tanner, Rev. Alexander Wilson, and Dr. Yeats.

Mr. George Howell, of the Parliamentary Committee of the Trades Union Congress, also attended.

The Educational Officer read his report to the Council as follows:—

To the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce.

GENTLEMEN,—I have now the honour, for the sixth time, to submit to the Council, for the information of the Conference, a report of our educational proceedings during the past year.

With reference to the General Examination, it is satisfactory to be able to announce a decided advance in the number of candidates. You will remember that, three years ago, an impression arose in the minds of the Council that so many other public bodies, following the example set by the Society, had undertaken the work of examination, as to render the Society's examinations almost superfluous, and a resolution was passed for their discontinuance. This having been rescinded, however, in deference to the strongly expressed wish of several leading institutions, the examinations were continued, and although the number of subjects was, some years since, considerably curtailed, those that remain have attracted, in many instances, a larger number of candidates than ever, showing, as I have observed in former reports, that these examinations supply a want which no other public body has, as yet, been able to satisfy.

The tables show that, in 1874, the number of candidates examined was 1,073, of whom 908 obtained certificates; while this year there were 1,236 examined, of whom 1,016 were successful—an increase of 163. The number of papers worked was 1,558, as against 1,452 last year; the certificates obtained having been 1,244 and 1,195 respectively. It will be seen that the per-centage of successful candidates has not been so high this year, being something over 82 per cent., as against nearly 85 per cent. in 1874.

The most popular subjects are still Arithmetic and Book-keeping, and next to them comes the French language, in which there have been 250 candidates. The number of failures in this subject is too great, and the examiner, in his report, draws special attention to the fact that "the good and the bad papers run very much in groups," showing how much the quality of the teaching varies in different institutions.

One of the changes made in this year's programme was the union of the two subjects, Floriculture and Fruit and Vegetable culture, under the general head of Gardening. This arrangement does not appear to have been successful, for the number of candidates in these subjects, which was always small, has on this occasion dwindled to two, and it will probably be a matter for the consideration of the Council whether the subject should not be discontinued altogether. The new subject introduced into the programme for the first time at the suggestion of Dr. John Yeats, under the title of Commercial History and Geography has attracted no less than twenty-three candidates, a large number for a first occasion, and one amply justifying the addition of it to our list.

In German and Spanish there has again been an advance; in the latter there were only six candidates three years ago, while this year there are no less than thirty—a proof that the class of persons who avail themselves of our examinations are gradually beginning to realise the commercial importance of this language, so largely spoken on the South American continent. On the other hand, notwithstanding the remarkable advance that the kingdom of Italy has made, and is still making, in its political and commercial position, the Italian language seems to be comparatively neglected, only seven candidates having appeared in it. This, however, is an advance on former years.

The Prince Consort's Prize of twenty-five guineas, graciously placed by Her Majesty at the Council's disposal each year, has been awarded to Henry Beer, of the City of London College, who obtained in the last four years six first-class certificates. This number may appear small, as compared with some former years, but it should in fairness be borne in mind that the number of subjects in the programme is now so limited, that candidates have not the opportunity they formerly had of obtaining numerous certificates and prizes in the specified period.

I am happy to announce that this year the Council has again felt justified in awarding the Council Prize for Female Candidates, which, until last year, had not been taken for some years. It has been gained by Mary Elizabeth Rudd, of the Carlisle Mechanics' Institution, who obtained two first-class certificates within the specified period. In addition to these, she obtained in a former year the female prize in Arithmetic. The special prizes offered to females have been taken in Arithmetic, French, German, and Music.

I cannot but again express my regret that the *viva-voce* examination in modern languages, as proposed in a memorandum furnished by Mr. Hyde Clarke, is not more widely taken up by the institutions. This year it was held at only one, the Manchester Mechanics' Institution, where two candidates obtained certificates of proficiency in French conversation. The large number of candidates that I have already referred to as having worked the paper set by our French examiner, shows how extensively this language is cultivated, and this makes it all the more remarkable that more are not anxious to show that they can not merely write but speak it.

The prizes for writing from Dictation, for Writing and Manuscript Printing, and for the best specimens of Handwriting, as shown in the papers generally, have all been awarded, and the report of the examiner speaks of "a marked improvement this year in the general character of the handwriting. The specimens of printing are not so good as those sent up last year."

I now pass to another branch of our educational scheme, the Technological Examinations, proposed by Major Donnelly, R.E., a member of the Council, and inaugurated at a Conference held in 1872, presided over by H.R.H. Prince Arthur. In the first year's programme there were five subjects—Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, and Carriage-building, but in only three of them did can-

didates appear. Last year the five subjects above-mentioned were retained, with the addition of four more, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas; and this year five more have been added, as follows:— Agriculture, Silk Dyeing, Wool Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

The following table shows the number of candidates that have appeared in each of the three years, in the various subjects:—

	1873.	1874.	1875.
Cotton manufacture	1	10	13
Paper "	..	..	..
Silk "	..	..	..
Steel "	2	14	16
Carriage-building	3	3	4
Manufacture of Pottery and Porcelain	..	..	1
Gas manufacture	..	7	6
Glass "	..	..	..
Cloth "	..	2	3
Agriculture	..	..	2
Silk-dyeing	..	..	..
Wool-dyeing	..	..	1
Calico-bleaching, dyeing, and printing	..	..	..
Alkali manufacture	..	..	..
	6	36	46

It will thus be seen that in the first year, with five subjects, three of them were taken up, the number of candidates being only six. In the second year, with nine subjects, only five of them were taken up, but the total number of candidates increased to thirty-six; while in the third year, with fourteen subjects, eight of them were taken up, and the number of candidates advanced to forty-six.

I cannot but express some disappointment that the increase in numbers has not been greater. The advance from six candidates the first year to six times that number in the second year, encouraged the hope that on the present occasion I should have been able to announce a far larger increase. At the same time there is no cause for discouragement. The scheme is a new one, and we have yet to make it more widely known, and to induce employers of labour to give it their warm support and encouragement. This can only be done by convincing them of the real practical benefit that accrues to their workmen from being examined.

It is interesting to look at the above table, and notice what subjects have and what have not attracted candidates in anything like numbers. At the head of the list, as might have been anticipated, stands Steel Manufacture, in which it is evident that workmen of great technical knowledge and skill are required, and where the standard of knowledge is necessarily high. The sixteen candidates in this subject are furnished almost entirely from our great centres of industry in the north, Leeds, Oldham, and Manchester, with a few from Crewe and Wolverhampton, where rolling stock for railways is so largely manufactured. It is a matter for surprise that this year there are none from any of our great engineering workshops in the east of London, nor from the leading Scotch works.

The next subject in the scale of popularity is Cotton Manufacture, in which thirteen candidates appeared this year; and here, again, the northern manufacturing towns, especially Oldham, furnish the larger proportion. Gas Manufacture brought seven candidates last year, and six this year, and there are a few in Carriage-building and Cloth Manufacture; but it is a remarkable fact, and one showing the comparatively slight influence exercised by the offer of large and brilliant prizes, that in the latter subject, in which the Clothworkers' Company have, with great liberality, offered a scholarship of one hundred guineas, the number of candidates is still quite insignificant. As I observed in my last year's report, what we really want is that one of the first questions asked by an employer of a workman applying for a situation should be, "Have you the Society of Arts certificate in the technology of your craft?" When this state of things is brought about, we shall find the number of our candidates largely increase; but until the system receives the warm encouragement of the employers of labour, we must be contented with small numbers and moderate results.

Although reports have been received from most of the examiners in the Technological subjects, I am unable at present to state what certificates will be awarded, as the returns of the Science examinations of the Department of Science and Art have not yet been received. I think it better, therefore, to say nothing about the examiners' reports, beyond stating that, on the whole, they may be regarded as favourable.

With the view of aiding the Technological Examinations by every means in their power, the Council have resolved that arrangements should be made that some of the Cantor lectures, to be delivered here next session, should bear especially upon the subjects to which these examinations relate. Courses of lectures will therefore be delivered as follows:—On "Steel Manufacture" by Mr. Mattieu Williams; on "Wool-dyeing," by Mr. George Jarmain; and on "Paper Manufacture," by Mr. W. C. Arnot, F.C.S. Mr. Williams has also expressed his willingness to devote some extra evenings to direct teaching in the subject of his lectures.

In concluding this portion of my report, I cannot help expressing my obligations to Mr. George Howell, Secretary to the Trades' Union Congress Parliamentary Committee, who was kind enough last year, at my request, to undertake the circulation of our programmes amongst the various organisations of artisans most likely to avail themselves of the examinations, a matter in which his special knowledge was of the greatest value. He also inserted notices in some of the journals particularly read by workmen, a mode of publicity that seemed to me the best that could be devised. An important result of Mr. Howell's efforts is shown in the fact that the Council of the Amalgamated Society of Carpenters and Joiners have laid before their members a proposal that the society should devote a portion of its funds to the establishment of an "annual scholarship of 100 guineas in connection with these examinations, the scholarships to be awarded to the member of the society most proficient in architectural drawing, building construction, and the practical application of scientific principles to the trade of a carpenter

and joiner." The Amalgamated Society of Miners have also had an interview with our Secretary, with the view of adopting some similar measure.

Should these societies, or any others of a similar kind, finally decide to offer scholarships for workmen in particular trades, the Council will, I have reason to believe, consent to add these subjects to the programme for next year. In any case I have no doubt that all the present subjects will be retained, but on this or any other point the Council will, I am sure, be glad to receive suggestions from any of the representatives present. An examiner will not be asked to set a paper in a subject unless candidates appear in it. This has in most cases been done hitherto, in order that the papers when published might give those intending to become candidates an idea of the sort of questions they would have to answer, and specimen papers in most of the subjects are now in existence. I cannot but hope that the representatives present will each, in his own locality, do their utmost to make these Technological Examinations known, and to point out the advantages they offer to skilled workmen.

Those who have interested themselves in the progress of music in this country for the last quarter of a century, cannot fail to have been struck with the immense advance that has been made in musical taste during that period. Five and twenty years ago it may be said that music of a high order was little cultivated in England, and that the appreciation of the works of the great masters was confined to a few.

A gradual and salutary change has, however, taken place in this respect, and now the concerts commonly known as "popular" are amongst the best and most classical given in London. Notwithstanding this improvement in public taste, and with a population as capable of entering into music of a high order as any people in the world, we are still far behind many other countries in facilities for musical instruction. While much has been done by the State for the encouragement of the arts of painting and sculpture, that of music, whose influence upon the masses of the people is very generally acknowledged to be far greater than that of the sister arts, has been left virtually unaided.

The question of extended musical education has now been before the Society for several years, and the establishment of a National Training School for Music has been one of the objects to which the efforts of the Council have been earnestly directed. I will not now trouble you with the details of this movement, which was actually commenced so far back as 1854, but I will merely say that, in 1865, the Society of Arts appointed a Committee to report on the state of musical education in this country, of which our Royal President, the Prince of Wales consented to act as chairman. Various negotiations were entered into, with the object of extending the existing Royal Academy of Music, and making it a national institution, but without success. In 1872 his Royal Highness the Duke of Edinburgh joined the committee, and negotiations were re-opened with the Royal Academy. These were again unsuccessful, and ultimately it was decided to establish a new institution, to which free scholarships, so valuable an aid to poor students, should be attached. At the recent meeting at Marlborough-house the Prince of Wales announced that Mr. C. J. Freake, who had previously most liberally undertaken to erect a building for the school, and to allow the free use of it for five years, had now presented it as a "free gift, for the cultivation and development of the art of music, in which both the Prince of Wales and the Duke of Edinburgh were known to feel so much interest, as had also been the case with the late Prince Consort, whose name would always be remembered with gratitude for the powerful influence he had exercised on the intellectual advancement of the country, and to whose efforts might be traced in great measure the important place which music now held in the estimation of all classes." He also presented a scholarship to the school, in the name of Mrs. Freake.

The school will have accommodation for 300 students, and steps have already been taken to interest the great towns in the movement, with the view to the establishment of scholarships; the meeting at Marlborough House was convened by the Prince of Wales to enlist the cooperation of the City of London and metropolis generally. Thus this really great scheme may be said to be fairly started, and there now seems reason to hope that before long we shall have a musical school in England, not unworthy to be compared with the great institutions of the Continent, and that those having real musical aptitude, however poor, may have their talents cultivated and their powers developed. I venture to hope that some of the larger institutions represented here to-day may be able to devote a certain portion of their funds to the establishment of one of these musical scholarships.

Although it is a subject bearing indirectly upon our own educational proceedings, I must not omit to draw the attention of the Conference to a report recently issued by the Syndicate of Cambridge University, appointed "to organise and superintend courses of lectures and classes in populous places." From this it appears that during the past winter courses of lectures and classes have been held under their superintendence in Nottingham, Derby, Leicester, Lincoln, Chesterfield, Sheffield, Leeds, Halifax, Bradford, Keighley, Liverpool, Birkenhead, Stoke-on-Trent, Newcastle-under-Lyne, Hanley, and Burslem, in the following subjects:—Political Economy, English Constitutional History, Social History, English Literature, Logic, Astronomy, Light and Spectrum Analysis, Geology, and Physical Geography. These courses have extended in some cases over six months, and in others over three months.

An examination has been held in connection with each course of lectures and classes at the termination of the course, open to any of the pupils who attended the course, and the numbers presenting themselves were, in Political Economy, 361; Physical Geography and Geology, 221; English Literature, 196; English Constitutional History, 142; Light and Spectrum Anaylsis, 29; Astronomy, 18; Social History of England, 9; Logic, 8; making a total of 984.

As indicating the classes of society who avail themselves of the teaching provided, it may be mentioned that, out of 58 persons who presented themselves for examination in Political Economy

and Literature in Nottingham, 31 were men and 27 women; of the men four were students, five artisans, four warehousemen, nine clerks and shopkeepers, six large manufacturers, one schoolmaster, two unknown; of the women, seven were daughters of manufacturers, two of ministers, twelve of tradesmen, and six were of the milliner class.

The Cambridge Syndicate consider the educational results of the experiment, so far as it has gone, to be very encouraging, and the Society of Arts cannot but feel a warm sympathy with a movement which to so large and valuable an extent seconds its own efforts for the promotion of education. I am sure that the representatives present will do all in their power to aid this admirable scheme.

In concluding my report, I cannot but refer, for a moment, to the sorrow we must all feel at no longer seeing amongst us one who for several years took a warm interest in our proceedings, and whose loss we all deplore, Mr. Thomas Lawton, the agent of the Lancashire and Cheshire Union. His efforts certainly largely contributed to the success of the Society's Examinations in that district, and at our annual conferences here, he had generally some useful suggestion to make, or some judicious proposal to bring forward. We all miss him much, and I feel that I should have failed in my duty if I had omitted to pay this brief tribute of respect to his memory.

I have the honour to be, Gentlemen,
Your obedient Servant,
CHARLES CRITCHETT,
Educational Officer.

APPENDIX.

EXAMINERS' REMARKS.

The Examiner in *Arithmetic* says:—"As a whole the average merit of the papers very much exceeds that of any which I have examined for some years."

The Examiner in *English Language* and in *Dictation* says:—"I do not think the average merit of the papers differs much from that of last year. A reasonable proportion of the candidates stand high in the first class, but a rather undue proportion of them have failed altogether. I should fain have marked a larger second class. I have had, as usual, no slight difficulty in arranging the best six Dictation papers. I would venture to suggest that the Dictation should, in future years, be written on paper not ruled."

The Examiner in *Commercial History and Geography* says:—"Though most of the papers were good, and several excellent, there were certain questions that seemed to be answered imperfectly by all the candidates; yet those questions or similar ones are necessary, and sure to recur, as tests of general knowledge. (1.) As to the importance of an acquaintance with the roads, rivers, canals, and railways that constitute the highways of traffic. Students will do well to reflect that such facilities for intercommunication are indispensable; and to remember that while there is a growing tendency towards equalisation in the costs of production in different countries, the costs of distribution prior to consumption must vary very considerably according to distance, means of locomotion, &c., The navigation of the Suez Canal has effected many changes in shipbuilding; it has also occasioned new depôts, and it must open up new markets with new roads to them, bringing older ones into disuse, and towns into decline. (2.) Though the destruction of Antwerp by the Spaniards and the capture of Constantinople by the Turks might at first sight appear to be political rather than commercial events, yet their consequences to industry cannot be overlooked or underestimated. The impoverishment of the Flemish merchants, and the dispersion of the skilled artisans of the country, effected the ruin of Flanders for ages, and fostered the rising power of rival communities in Holland and in England. The intrusion of an Asiatic race into the former capital of the Roman Empire was resented throughout Christendom; and a series of efforts to regain possession of the direct trade with India was commenced immediately, culminating in the discovery of a new route round the Cape of Good Hope and the ultimate transfer of commercial supremacy from Constantinople, Venice, and Genoa, to Lisbon, Antwerp, and Amsterdam. (3.) In the matter of money and the rate of exchange. Commercial reports can hardly be understood without constant reference to the currency of countries mentioned, and without due consideration of our own fixed standards of value, whatever may be the standards elsewhere. (4.) Mere lists of imports and exports are easily obtained; but unless a student accustoms himself to the inspection of them in the order of their national importance and of their pecuniary value, they will be of little service for sound information. So also in naming varieties of produce, such as rice, sugar, wheat, or wool, it is very good to display the technical knowledge of sorts and staples that a broker may impart, but it is nevertheless vastly superior to show the skill of a technologist, by describing botanical peculiarities and properties, chemical analyses and nomenclature—latent worth, in short, that escapes ordinary observation. Lastly, let me recommend students to set about the investigation of a country pretty much as they would that of a farm, by looking into its capabilities of yield, and into the characters of the men who have laboured upon it and controlled it. A nation is only a large family and one of many. Its date of appearance on the stage of history, the difficulties it had to encounter, the density and the quality of its population, deserve more minute attention than is commonly given to such points. The Imperial census of 1871 is now available and especially valuable in the study of the civil condition of the inhabitants of the most distant parts of the British Empire."

The Examiner in *French* says:—"I regret to say that I have not been very favourably impressed by this year's papers. Mediocrity is the prevailing feature, and even the best papers are not remarkable for accuracy. I cannot help noticing again this year the significant fact that the good and the bad papers run very much in groups. Now, this cannot be a mere matter of chance, nor can it be the result of a decided superiority of aptitude or intellect among the candidates of this or that town or centre, as compared with those belonging to some other locality. The quality of the teaching can alone explain the great difference in the results obtained."

The Examiner in *German* says:—"I have much pleasure in noticing that there has again been an increase in the number of candidates over that of the preceding year. Not less than seventy-seven candidates have this time taken up the subject of German, which is about five times the number of those who presented themselves for the examination in this subject some years ago. The fact that the proportion of failures was this year smaller than on former occasions is likewise very gratifying. It is true that several candidates who passed, will not receive the exact certificates to which they aspired; nevertheless, the result of the examination, in general, may be considered very satisfactory. Most of the candidates seem to have paid attention to the advice I gave in my former reports, viz., 'that they should first make themselves thoroughly acquainted with the theory of German grammar, that they should avoid the so-called 'easy and practical methods' of learning the language, and finally, that they should have as much practice as

TABLE I.

RESULTS OF THE GENERAL EXAMINATIONS OF 1875.

NAME OF LOCAL BOARD.	No. of Candidates Examined.	No. of Candidates who Passed.	No. of Papers Worked.	No. of First-class Certificates awarded.	No. of Second-class Certificates awarded.	No. of Third-class Certificates awarded.	No. of Prizes awarded.	No. of Unsuccessful Candidates.
Aberdeen	57	49	63	8	22	22	2	8
Aldershot and Farnham District	8	6	9	1	2	3	...	2
Ashford	8	8	8	2	5	1	1	...
Bacup	18	12	24	...	3	13	...	6
Belfast Working Men's Institute	16	7	17	3	4	...	...	9
Birmingham	52	46	72	19	18	25	...	6
Bolton, Church Institute	4	3	8	1	3	3	...	1
" Mechanics' Institution	4	3	6	1	1	2	...	1
Broughty Ferry	3	2	3	...	1	1	...	1
Burnley	15	13	24	3	4	7	...	2
Carlisle	19	18	21	6	11	3	2	1
Carmarthen	2	2	4	1	2	1	...	...
Cork	8	7	15	...	5	7	...	1
Dublin	4	4	6	...	2	4	...	...
Dudley	8	4	10	1	...	4	...	4
Dundee	38	28	41	2	6	22	...	10
Edinburgh	2	2	3	...	1	2	...	...
Glasgow, Anderson's University Popular Evening Classes	90	72	95	22	25	30	3	18
" Athenæum	48	44	57	11	11	30	2	4
" Mechanics' Institution	26	21	30	6	4	14	1	5
" Young Men's Society	5	5	5	...	1	4	...	...
Glossop, Freetown Working Men's Institution	7	6	7	...	...	6	...	1
Halifax, Mechanics' Institution	3	1	3	...	1	...	...	2
" Working Men's College	29	26	33	3	9	16	...	3
Hanley, Potteries Mechanics' Institute	3	3	3	...	...	3	...	...
Hertford	5	4	10	...	1	5	...	1
Huddersfield	12	8	16	...	2	9	...	4
Hull, Church Institute	12	11	12	6	1	4	...	1
" Young People's Institute	62	43	67	5	7	31	...	19
Ipswich	13	10	13	1	2	7	...	3
Irwell	1	1	2	1	...	1	...	...
Leeds Young Men's Christian Association	12	8	13	1	1	7	...	4
Leicester	49	23	55	2	5	20	...	26
Lichfield	1	1	3	...	...	2	...	...
Liverpool	20	17	24	1	11	8	...	3
Lockwood	5	5	5	...	1	4	...	...
London, Birkbeck Literary and Scientific Institution	121	108	170	52	53	44	7	13
" Bow and Bromley Institute	3	3	3	...	...	3	...	...
" City of London College	89	82	132	38	32	49	10	7
" Kentish-town Literary Institute	3	3	3	1	2	...	...	...
" Quebec	9	7	15	3	4	5	...	2
" Royal Polytechnic College	32	28	38	7	9	17	2	4
" St. Stephen's, Westminster	12	9	20	5	2	9	...	3
" Tonic Sol-fa Teachers' Association	8	8	8	2	3	3	...	...
" Walworth Literary Institute	2	2	6	1	1	2	...	...
Lynn (King's)	13	13	13	2	2	9	...	...
Manchester	81	76	114	27	29	42	4	5
Mossley	11	11	12	1	2	8	...	...
Newcastle	6	6	8	1	4	3	...	...
Oldham	13	12	13	3	6	3	...	1
Paisley	4	4	4	...	1	3	...	...
Pembroke Dock	4	4	5	5	...	...	...	...
Penzance	12	9	12	...	2	7	...	3
Rugby	12	9	21	1	3	8	...	3
Salford	48	32	55	3	15	18	...	16
Sheffield Church Institute	20	19	29	5	6	14	...	1
" Young Men's Association	10	7	17	1	4	6	...	3
Stockport Sunday School Society	3	2	3	...	...	2	...	1
Stourbridge	6	6	6	...	4	2	...	...
Sunderland	7	7	13	1	4	7	...	...
Swindon	14	12	19	1	7	8	...	2
Wakefield	6	4	9	1	...	5	...	2
York	18	10	23	2	1	8	...	3
Totals	1,236	1,016	1,558	270	368	606	34	220

NUMBER OF LOCAL BOARDS, 63.

N.B.—Fifty-three Candidates came forward in Writing from Dictation, and Eighteen in Writing and Manuscript Printing. As Certificates are not given for those subjects, they are not included in the above Table, but the Prizes awarded in those subjects, also the Prizes awarded for Handwriting generally, are included in the list.

TABLE II.—Number of Papers Worked in each Subject in the Present and Three Past Years, with the Results for the Year 1875.

SUBJECTS.	1872.	1873.	1874.	1875.				
				No. of Papers Worked.	No. of First-class Certificates.	No. of Second-class Certificates.	No. of Third-class Certificates.	No. of Papers in respect of which no Certificate was awarded.
Arithmetic	431	430	404	459	70	128	161	100
* Metrical System	56	..	..	..	..	..	..	..
Book-keeping	254	265	290	311	80	68	150	13
* Mensuration	48	..	..	..	..	..	..	..
* Floriculture	6	9	6	..	..	..	..	..
* Fruit and Vegetable Culture ..	7	10	7	..	..	..	..	..
Gardening	..	..	..	2	..	1	1	..
Commercial History and Geography..	..	..	..	23	8	2	4	9
* Domestic Economy	13	..	..	..	..	..	..	..
Political Economy	23	28	34	33	2	14	11	6
* Geography	91	..	..	..	..	..	..	..
* English History	103	93	111	..	..	..	..	..
English Language	174	183	162	212	18	55	97	42
* Logic	30	21	8	..	..	..	..	..
* Latin	16	..	..	..	..	..	..	..
French	213	177	227	250	14	29	105	102
German	60	41	61	77	22	18	25	12
Italian	3	2	4	7	1	1	2	3
Spanish	6	9	26	30	10	7	9	4
Theory of Music..	109	93	112	154	45	45	41	23
* Elementary Musical Composition	46	..	..	..	..	..	..	..
Totals	1,689	1,359	1,452	1,558	270	368	606	314

* Examinations in these subjects have been discontinued.

possible in translating from English into German.' In addition to this advice I would especially remind intending candidates for first-class certificates, that a colloquial and practical knowledge alone will not suffice for the attainment of their object, and that before presenting themselves for the examination they should go again through the theory of German grammar in a systematic manner. On the last occasion several candidates who had produced, on the whole, satisfactory translations from English into German, would have obtained a much higher number of marks if they had not neglected or partly forgotten the grammatical theory of the German language. Of those candidates who took up German Commercial Correspondence, two only were unsuccessful. I should advise intending candidates for this branch to master in the first instance the German commercial vocabulary, and to have considerable practice in reading genuine commercial letters in the German handwriting. To those candidates who have been successful enough to obtain certificates in correspondence I cannot help addressing the warning, that if they do not keep up the practice of writing and reading German commercial letters, they will in a short time almost entirely lose the qualification of serving as German correspondents."

The Examiner in *Handwriting* and in *Writing and Manuscript Printing* says:—"There is a marked improvement this year in the general character of the handwriting. A considerably larger number of the papers are written well and not a few excellently. The examiner would again press upon the candidates the importance of absolute legibility. No handwriting, however elegant in character, is commendable, unless it can be read with perfect ease. The letters should not only be well formed, but the spacing between lines, words, and letters should be good, and the whole appearance of the writing clear, open, and firm. The specimens of printing were not so good as those sent up last year."

DISCUSSION.

The Chairman said it was proposed to take as the first subject for discussion the question:—

"What steps can be taken to further the system of Technological Examinations, and whether any improvements in it can be suggested."

Mr. G. N. Hooper (Examiner in Coach-building) said he was invited to attend the Conference in a double capacity, first, as an examiner in the technology of carriage building, and also as the Master of one of the City companies. It had been a great pleasure to him for some years past to be able to advocate the principles the Society had at heart as regarded the improvement of manufactures, and the cultivation of the talent of workmen. The Coachmakers' Company some ten years ago adopted the system of holding an exhibition of productions of workmen in connection with their own craft, and during some years they offered two prizes for drawing, one in connection with carriage building, and another for freehand drawing. For mechanical drawing prizes were awarded from time to time by the Company itself, but those offered for freehand drawing, which were to be awarded by the Science and Art Department, were very rarely claimed, and a difficulty arose between the Company and the Department in this way: the Company insisted that the drawings should have some application to the construction of carriages, but the Science and Art Department said their teachers had no special knowledge of that particular form of manu-

facture, and could not teach what the Company seemed to desire. In consequence of that difficulty the Company took the subject out of the hands of the Science and Art Department, and appointed judges themselves to award the prizes for freehand as well as mechanical drawing, and this year prizes had been awarded in both subjects, and some excellent specimens had been sent in. Great progress had of late been observable, not so much in the number of the candidates as in the quality of the work performed. Since the technological examinations were established by the Society of Arts, it had been thought desirable that the City companies should aid the Society as far as their funds allowed in this way, and it seemed to him that, as there was often a feeling on the part of workmen that they did not know what was required of them (although that want was met, to a certain extent, by the former questions being published year after year), still it appeared to him that some further steps might be taken, and this year he had offered a prize of twenty guineas for the best treatise on the manufacture of carriage bodies. It was to be given, supplemented by the Company's silver medal, for the best essay or treatise on the subject he mentioned, without restriction on the employment of the writer. It might be a translation or an adaptation from a foreign work, and his principal object was to facilitate the training of candidates for the technical examination in carriage building, held yearly by the Society of Arts. The prize essay was, therefore, to be the property of the company, unless the writer published it within 12 months. Nine or ten essays were sent in, and the judges, who were all practical men, declared that four of them were so excellent, and so nearly equal, that they had some difficulty in awarding the prize. Ultimately, however, they came to a unanimous decision that one was the best, and they recommended certificates of merit to be given to the other writers. He thought if a series of essays of this sort, on the various subjects in which the Society examined, were written and published, they would form text-books of the different trades, which would much facilitate the acquiring of that knowledge which the workman required. It occurred to him that if the principal companies would offer prizes of this sort, the Society of Arts would find experts who would prepare these treatises, and so in time a series of text-books would be obtained, which if they were circulated at a cheap rate, would lay the foundation for that information which at the present time was not to be had in any collective form.

Major Donnelly, R.E., said the examiners had prepared very full syllabuses of the subjects, which no doubt gave the candidates a good idea of the scope of the examination, and the examination papers had been also published with the same view, but really good text-books in almost all the subjects were still wanting. There were several examiners present, and he could appeal to them to confirm him that there were no such things in England as text-books on these technical subjects, except in a few cases. There had been an idea, referred to in Mr. Critchett's report, that the gentlemen who had consented to give lectures during the next session in these special subjects might afterwards publish their lectures, and that these would form text-books, but at the same time Mr. Hooper's suggestion of prize essays was a very valuable one, and might lead to great advantages, because the essays would be written by experts, and from the point of view of men who knew what kind of work they had to specially get up for the examinations.

Dr. Yeats (Examiner in Commercial History and Geography) remarked that many text-books on technological subjects, excellent in their way, existed both in the French and German languages. Reference had been made to this subject by Mr. Thomas Twining, in his work on technological instruction, where he pointed out nearly all the books that could be required in an extended course of study of this kind. One work he might specially refer to, "Der Schulmässige Kaufmann," which was in use nearly all over the Continent, and dealt with each raw product not only from a technological point of view, or that of the science of observation, but also from the point of view of the science of experiment or investigation, and that of transformation or application. In these books you had first of all the treatment of the raw product, and then what the Germans called the "ennobling" of the product, or its utilisation for social and economical purposes. Some brief sketches from those works were published by himself some years ago, and were now in the library of the Society.

Professor Tanner (Examiner in Agriculture) said it must be rather discouraging to those who were anxious to promote these technological examinations to see that they were not attended by the success they certainly deserved, and which they might reasonably have calculated upon; but, as a matter of fact, there was one difficulty attending all technical examinations, namely, establishing the connecting link between science and practice. Persons qualified themselves by the examinations of the Science and Art Department, and showed satisfactory knowledge of the pure sciences which bore on the industries on which they were occupied; but, on the other hand, to utilise that knowledge, they required practical experience, and where help was really required was in connecting these two together; and, in order to attain this, the persons concerned required to be educated up to that point at which they would see the intimate connection that existed between successful practice, on the one hand, and that knowledge of science which might be obtained in the schools, on the other. In the department with which he was particularly connected, that of rural economy, this was particularly remarkable. A vast number of schools of science were established throughout the country, in which all the foundation work was laid, and these were available to those connected with the agricultural industry. But one great reason why farmers' sons and others did not take advantage of them was that, on the one hand, they had got pure science, and on the other they had the practice of their farms to attend to. It would be a great assistance, therefore, to these technological examinations if any arrangement could be made under the Science and Art Department for blending these two sources of instruction, and what applied to his own department he felt was equally applicable to other branches, and he trusted something might be done in that direction. The arrangements that had been made for scholarships no doubt tended to promote the attendance on these technical examinations, and he hoped more might be done in that way. The Society of Arts had kindly interested themselves in the matter, but other subjects were so prominently before the agricultural mind at present that they absorbed all their interest and extra energies. He hoped before another year had passed over, however, that in that section some scholarships would be founded by the different agricultural societies, and as the people became acquainted with the advantages of education they would gradually respond to the appeal made by the Society.

Mr. Frank Curzon (Yorkshire Union) said the results of these technical examinations seemed rather inadequate, and some persons might be astonished that there had not been a greater number of candidates. He thought however, if the Society would repeat the experiment made in 1857, and come down to the provinces, they would meet with much greater success, and would stimulate much more competition amongst the various institutions. In that year examinations were held for a week, Huddersfield being the centre, and if the same thing were repeated, going one year to one centre, and another to another, he thought that very good results would be produced. They had now at Leeds an exhibi-

tion contributed to by the authorities at South Kensington which was doing a great amount of good, and the particular matter which had just been urged, that of connecting practice with science, was being accomplished, explanations being given to parties of 30 or 40 workmen of the various industrial processes and machines. In some matters he thought they would do much better if they tried to do rather less. For instance in the woollen manufacture there was only one candidate, and he (Mr. Curzon) took the trouble to submit the questions to a number of the most intelligent masters, when he found as he expected that they were utterly ignorant of the science of the trade, and if that were so with the masters, it must be so with the men. When he asked them what was the best mode of dealing with this difficulty, they said at once that if the parties were not quite so clever at headquarters, and if they tried to cover less ground it would be covered more completely. They had some very fine specimens of wall decoration from some of the pupils in the Yorkshire Union, and he thought if freehand drawing were encouraged very good results would follow. Another class of industry which was not at all dealt with was lace; it was a very valuable and important industry, but the designs at the present moment were perhaps worse than at any other time, notwithstanding the magnificent specimens in the various exhibitions. The great difficulty in connection with these examinations was the want of preliminary culture, for it constantly happened that there might be a very competent and skilful dyer or designer who was scarcely able to write his own name. He concluded by again urging the desirability of the Society holding the examinations in the provinces.

Mr. Critchett remarked that it might not be generally known that before the present system was adopted, the sending out papers to any centre where a local board was formed, the plan was to hold examinations in London only the first year, including a certain amount of *viva voce* examination. As a sort of experiment in the second year of the examinations, another centre was added, namely, Huddersfield, but it was afterwards thought that it would be more advantageous to the candidates to whom the expense of travelling was of great importance, that they should introduce the examination paper system, and that any one who wished to be examined in any of the institutions wherever a local board could be formed (and they had been formed all over the country), should be able to attend on certain evenings to be examined in any subject he chose. That was why they did not now hold local examinations.

Mr. George Howell said that Mr. Curzon had touched on a subject which lay at the root of this question, the imperfect education of workmen. It was, perhaps, natural that the Society should feel discouraged at the apparently small amount of success which had hitherto attended their efforts, but one thing to be borne in mind was the timidity of the workmen in placing themselves in a position to be tested by the examination papers, for this feeling was well-known to exist at any rate to those who had associated with workmen. They had a vague apprehension of something like a critical scholarship examination in the science of the raw materials with which they were connected, and did not like to subject themselves to such a thing. There was a large amount of practical skill and technological knowledge of all the processes of manufacture, in the hands and minds of the workmen, as was pretty well known, but the men were somewhat timid with regard to facing these examination papers. When that difficulty could once be got over, and when the men saw it really was a practical application of their own skill, aided by that which they could only obtain from reading or attending classes, then there would be a very much larger number of candidates, but that must be a work of time. Education in this country was still in its infancy, especially amongst working men, for many of the most skilled were brought up at a time when education was very limited, and even when those who had an opportunity of attending a school only received a very elementary instruction. In the school which he attended himself there was a very absurd rule which prevented the schoolmaster taking the boys beyond the first four rules of arithmetic, however desirous or capable they might be of learning more; and as for geography they never heard of such a thing. Still, he was not so old as many skilled artisans. Taking these things into consideration it would be seen that for some time they must go on quietly, and await the period when artisans would be more inclined to come and submit themselves to these examinations. He did not quite agree with Mr. Curzon with regard to limiting the number of subjects.

Mr. Curzon did not mean to limit the subjects, but to simplify the examinations.

Mr. Howell thought the subjects should be rather extended, so as to embrace a greater variety. Last autumn he was asked by Mr. Critchett to communicate with the workmen with regard to this question, and to place it before them in a simple and practical light, and the result of his so doing had already been attended with greater success than might have been anticipated. The building trades were altogether left out of the list of subjects, but the secretary of the Amalgamated Carpenters and Joiners wrote to him and asked if he thought there would be any objection to including carpentry and joinery. He replied he thought not, and subsequently an interview was arranged with Mr. Le Neve Foster, when the subject was talked over, and this amalgamated society now proposed to give an annual scholarship of £100 to the candidate who should pass the best examination in the subject, if it should be agreed to by the Council. There was one condition which he hoped the Society would agree to, namely, that the candidates should be limited to the members of that society. That might appear an unjust limitation in one sense; but it was difficult to get workmen to vote funds for special purposes outside their own organisations, and he thought, as it was, it was a great step in advance. Mining, again, was not included in the list of subjects, though a great deal of England's greatness, both at home and abroad, depended on her mining operations. He had brought the matter before the trade, and he had no doubt that the National Society of Miners would take a similar step to the carpenters, and offer a scholarship of £100 for the best candidate in that subject if it were added to the list. Now when you find associations taking steps of this kind it showed they were already making great progress. He might say, having as great a knowledge of the working men of England as almost any man could possess, that they were progressing very fast—faster than many persons were aware of, for it was impossible that this progress should be seen in all particulars. It was being made, however, and it appeared to him it was the peculiar business of the Society of Arts to combine that practical skill, which he believed Englishmen possessed over all other nations in the world (though he might be wrong, for his experience with regard to other countries was limited), with that scientific knowledge which scientific men had accumulated for their use. With regard to text-books for workmen generally, he might test this question by his own particular trade. There had been a great number on building, of various descriptions; with regard to joinery he was not in a position to say how far some of these elaborate treatises did contain that amount of scientific and practical knowledge which was necessary, but with regard to bricklaying he never met with one which contained anything like the proper application of scientific skill to bricklaying until the reports were published by the Society of Arts after the Exhibition at Paris. He thought the suggestion made by Mr. Hooper, if carried out, would be very valuable, and if some competent men were appointed to go over

e papers, and amend them, with regard to phraseology or chnicalities, an amount of information would be colcted, which, he believed, was not possessed at the prent time.

The Chairman said what had been advanced would be eighed by the Council, and he had no doubt that some eps would be taken on the subject. It had been their ject lately to obtain lectures of such a character as uld on publication become text-books on the various bjects treated of.

Major Donnelly remarked that he believed the Council d not in any way consider the present list of subjects be exhaustive, but others were added from year to ar as it was believed they would be taken up. He did t know whether any members of the Council were sappointed at the result, but for himself he had such feeling, and three years ago if he had been ted he should not have expected to see half so many ndidates. Any such work as this must take a long me, not only in getting the examinations known, but getting the subjects studied. This examination was t simply in technology, but included a certain amount pure science, and in order to pass in this, the canlate must attend night classes for say two or three ars, before he was properly qualified. Therefore, conlering that several of these subjects had only been ded in the last year, he was really surprised to see so any candidates. The subject of mining had been ggested, and no doubt it would be a good subject, but occurred to him that the Science and Art Department ready held examinations upon it. The great point hich had come out from Mr. Howell's speech, was that e workmen themselves were taking an interest in the atter, and that must really be the backbone of the whole ing, for unless they took an interest in it, and felt was for their benefit, it would not prosper, and would t be worth going on with. Employers might do great deal by giving encouragement to the movement, some no doubt did, and he hoped more would. But ey must not look at the matter from an employer's int of view. They need not blink the fact that in ything of this kind there must naturally be a certain mount of jealousy on the part of employers of labour nerally, though fortunately there were many who had such feeling. Still they could not expect employers nerally to push it to any great extent, and the great pe of any such scheme prospering must be the workmen themselves taking it up and feeling it was for their n advantage to further it to the utmost of their wer. In that point of view the remarks which Mr. owell had made were the most cheering he had heard r a long time.

Mr. Curzon next brought forward a suggestion of the orkshire Union made at a district conference in the uth-West Riding, attended by delegates from 150 stitutions, that the elementary examinations should be ld in February instead of March. The first suggestion d been that they should be held in December, but they d subsequently decided upon February, and the object changing the date was that there might be a longer terval between the date of the various examinations, as to make it easier for the committees to properly ttend to them. There was now the elementary xamination in March, the Whitehall examination in pril, and the South Kensington in May, and it was xceedingly difficult for small institutions to give the equisite attention.

Mr. Critchett said this would not affect the Society of Arts in any way. These examinations might be held at any period most convenient.

Mr. Norris (Birkbeck Institution) thought it would be very advisable to change the date of the Society's General Examinations if possible. Of course they only made the suggestion, believing it might be possible for the Society o make a change; if not, of course they would withdraw it. In the first place, the session commenced the beginning of October, and at the commencement of the following March the elementary examinations were held, and about six weeks afterwards the general. There was, therefore, a very short space of time between October and April for the students to prepare themselves in as thorough a manner as could be desired. They were mostly engaged during the day, and had but a short time to give to study, and if the examinations were deferred till the beginning of June they would gain six weeks, which would be of great importance to them; the teachers would be able to prepare them better, and the students would have more chance of success. Another reason was that examinations, as a rule, should be relegated to the end of the course of study; and inasmuch as the courses of the different institutions went on till June, the examinations should take place about the time the courses finished. A further argument was that the attendance on the examination caused an absence of students from classes by which they often lost valuable instruction. The last argument was that the arrangements of the institutions were very much interfered with by the examination coming so early. He was satisfied that if they could be held later better results would ensue, the students would be more successful, and the examiners would be better pleased by having far better papers handed to them. He would therefore propose that the Council of the Society of Arts be respectfully requested to change the date of the general examinations to the first week of June.

Mr. J. H. Levy (City of London College) seconded the proposition. As one who had worked for a great number of years in two of the largest institutions connected with the Society of Arts, he had felt the great difficulty that resulted from the present practice of holding the examinations so early. In his own case it had resulted in this, that he had been obliged to curtail the course, so as to crowd it between October and April instead of between October and June, because if he arranged it to extend from October to June, as the examination was to be held in April, one of two things must have happened, either the pupils would have gone over only part of the subject, and therefore would have been unable to answer the questions in that part of the course which was to come, or if they had gone over the whole of it, he would have to give recapitulatory lessons, or would have no class at all. The effect of holding the examinations before the session was over was to take all the life out of the remaining part of the session. The matter was one of some importance, but of course, if the arrangements of the Society of Arts were such that it could not make the desired change no more was to be said.

Mr. Curzon said the two questions were quite distinct, namely, the changing of the time for the elementary and for the general examinations. He did not see why the dates October to June should be so often mentioned, for in their largest institutions the classes were open all the year round, and 75 or 80 per cent. of the students attended throughout the entire summer.

Mr. Norris said that was a happy experience which could not be expected in London.

Mr. Noldwritt's experience led him to oppose the proposition of Mr. Norris. He spoke of the practice and habits of students in the central parts of London, but with reference to those in the suburbs he thought any change in the time of the examinations so far from benefiting the institutions would have the contrary effect. The fact was that as soon as the evenings began to be long they would not attend the classes, and he very much doubted whether they could get half of them to continue their studies up to so late a period as Mr. Norris spoke of.

Mr. Stapley (Crewe) thought it would be most detrimental to the students generally to alter the time. In their institution the same class of students went in for the general examination of the Society of Arts as went

in for the examination of the Science and Art Department. It took them all their time to prepare for those examinations, and he was afraid that if the time were altered, as was proposed, to the end of May, or the first week of June, their studies would be seriously interfered with. At present they got over the Society of Arts examination before preparing for the other.

Mr. Poppleton (Aldershott) said a postponement of the date would probably do away altogether with the examination of the troops who were now about starting for the autumn manœuvres, and were therefore obliged to get all the work of the examination over as soon as possible in order that the results might be made known before they were dispersed all over the country.

Mr. G. A. Smith (Birkbeck Institution) said it was only proposed to hold the examination the first week in June, and he thought it might be got over in time to meet the objection of the last speaker. With regard to the general argument, his experience was similar to that of Mr. Levy. The students had to go up for examination before the course was much more than half completed.

Dr. Yeats said some attention would have to be paid to the convenience of the examiners, who might at a later period be so overwhelmed with work as to be unable to attend to these duties.

[At this point Major-General Eardley-Wilmot was obliged to leave, and the chair was taken by Major Donnelly.]

Mr. Norris's resolution was then put, and was carried by a majority of one.

Mr. Smith (Birkbeck Institution) then moved that Logic be restored to the list of subjects. He said this proposition required very little to be said upon it, because the subject stood upon its own merits. He thought it very important that these higher subjects should be encouraged by certificates and prizes being awarded for them.

Mr. Norris seconded the proposition, saying that if the Society advised the teaching of Logic it was only a natural consequence that they should examine in it. He did not suppose the expense of the examination would be very great, and he believed there would be a sufficient number of candidates to make it worth while.

The Chairman said the subject seemed in rather a languishing state when it was taken off the list, the number of candidates in 1872 being 30; in 1873, 21; and in 1874 only 8.

Mr. Norris said if it were continued the number might again be 30 or more. Mr. Smith had six pupils ready to go up in his own class.

Mr. Levy thought he could throw a little light on this subject with regard to the falling off in the numbers. His own experience was that the Examiner in Logic was to a great extent responsible for that result, because some of the examination papers appeared to be set with a view to finding out whether the pupil agreed with the examiner on some controverted questions in philosophy rather than with a view to find out whether he was a logician or not. This was objected to by some of the candidates, and had certainly contributed to the falling off in the number of candidates.

The resolution was then put and carried unanimously.

Dr. Yeats proposed the addition of Shorthand to the list of subjects. The use of shorthand was very much on the increase in large counting houses and mercantile establishments, and now-a-days, a confidential clerk or correspondent was required almost of necessity to be a shorthand writer.

Mr. J. H. Levy seconded the proposition. It appeared just one of those subjects which ought to be examined in, for there was hardly any branch of knowledge in which there was more quackery. Books were advertised, which professed to teach the most perfect system within the smallest possible space of time, and many persons after enthusiastically wasting a deal of time and trouble over such books, gave up the subject in disgust. One of the functions of the Society was to point out in what direction sound knowledge could be obtained, and he thought they might do a great deal of good in this way. He felt sure that there would be no lack of candidates for the Birkbeck Institution and the City of London College alone would send up a considerable number.

Mr. Norris, in supporting the proposition, said he did not see any great difficulty in conducting the examinations. The Society of Arts might select certain passages which should be printed and sent round in the ordinary way, in the same manner as those used for writing from dictation; they might be of different degrees of difficulty, and might be read at different rates of speed, say 80, 100, and 120 words per minute.

Mr. Curzon said they had had a large experience of shorthand in the Yorkshire Union. If they could connect with the examination in shorthand its application to practical purposes, it would be very useful.

Mr. Noldwritt thought the addition of this subject would be very popular, but he did not see how they could connect shorthand with its application to particular purposes; that must rest with the students themselves.

Mr. Levy said there was no subject in which no special knowledge was required, because the abbreviations which were applicable in some callings would be useless in others.

Dr. Yeats thought there was one important element in shorthand which should not be lost sight of, viz., secrecy. He had learned shorthand, Harding's system, even before he learned longhand writing, being taught by his father, and by a slight interchange of the signs it could be made either to be legible to another person or not as might be desired.

The Chairman said the one great advantage of shorthand was that you could dictate to a clerk in a few minutes a letter which it would take a long time to write. The great point in shorthand was that the writer should be able to read his own notes, and therefore, whether in the examination the original shorthand was sent up for examination or not, it would be important that it should be translated by the writer. It seemed pretty evident, however, that it would be very desirable to add this to the list of subjects.

Mr. Norris thought many difficulties would be overcome if the Society adopted one system, say Pitman's system, and required all candidates to be examined in that. By that means, and by insisting on a translation of the shorthand being sent up as well as the notes themselves, he thought all difficulties would be overcome. He did not attach any importance to secrecy in shorthand.

Mr. T. R. Wright (shorthand writer) said there was no doubt it was becoming universally used, not entirely for reporting, but in mercantile and legal offices, and it would doubtless therefore be of great advantage if a thoroughly practical examination could be introduced, especially as it often came under his notice that young men after studying it, fancied they were tolerably proficient, and could write a certain number of words per minute, when in truth, on putting their abilities to the test they could not accomplish more than half as much, and had great difficulty in reading what they had written. Although he used Pitman's system himself, he must protest, however, in the general interest against that or any other being insisted upon in the examinations, because a person who used another system might be quite as competent, nor did he see that shorthand had anything necessarily to do with cipher writing or secrecy. The two requisites were to write with rapidity, and trans-

with accuracy, and any candidate who could fulfil onditions ought to be entitled to a certificate.

proposition, on being put to the vote, was carried imously.

Poppleton (Aldershott) brought forward a propo- which he had several times suggested, that sur- and levelling should be included in the examina- His principal object in doing so was to afford an nity to the Royal Engineers to give some proof ir ability to do their work. Many of the men were intelligent, and as great satisfaction had arisen them from the officers encouraging their attend- the Society's examinations, he wished to make as useful as possible to the men. He had promised, ore, to bring this subject forward, and the feeling the men was unanimously in its favour. He ay, also, that he regretted the Society had dis- ued examinations in those subjects which were up by the Science and Art Department, the latter inations being in some respects not so suitable to didates who wished to present themselves. For ce, there was a great deal of routine about some of gulations, and he had known many instances candidates, who had been rejected for some slight in matters of form, had been so disappointed as to again present themselves.

Chairman thought it would be almost a work of rogation for the Society to introduce this subject sake of the Royal Engineers, inasmuch as they already provided for by the rules of the service. was the Surveying School at Chatham, where the were not only taught but examined; from they were passed on to the General Ordnance at Southampton. They were continually em- in surveying, and were promoted and paid accord- their abilities as surveyors. He did not want to in the way of the men having any opportunities might be of service to them, but he did not really the examinations of the Society would be of any dvantage.

proposition was withdrawn without a division.

Poppleton said there was another matter on which rather strongly, viz., candidates in the elementary inations were allowed to pass if they obtained 25 ent. of the total number of marks, a proportion than that adopted in any other examination he equainted with. They had adopted at Aldershott ystem of marking used by the Science and Art De- ent, and the total number of marks being 120, if a date obtained 90 his paper was marked "Excellent," he received a prize; if he got 60 it was marked d;" and if he got 30 it was a mere pass; but he ered the latter number too low, and suggested the minimum should be raised.

Curzon said Aldershott might be ahead of the rest country, but it certainly would not do in Yorkshire ise the standard at present. The national system of ation was as yet of so meagre a character that he ered they were much indebted to the Society of for their generous treatment of the candidates.

Poppleton, as a Yorkshireman, could not allow remarks to pass without question. His object was the certificates granted under the sanction of the ety should be looked upon with respect, and he this would not be the case unless some change introduced in the direction he had mentioned.

Levy said if the proposed change had any effect it would be to shut out some of the candidates at present went in for the general examination, and one particular case present to his mind, where result would have been to exclude from the general ination a candidate who obtained a first prize. He deem it very unwise on account of the com- atively neglected state of elementary education in England to take any action which would shut out persons from the higher culture because their education was somewhat deficient. Such a course as was proposed would be beneficial some years hence, but at present he considered it premature.

The Rev. J. W. Cundey (Bolton) said if it were desired to raise the standard so that the certificates might not compare unfavourably with others, it might be done by increasing the percentage of marks required for a pass, at the same time if necessary making the whole paper easier.

Mr. Curzon did not see how that would alter the case. He was anxious to encourage a large number of candidates to present themselves, and, therefore, hoped no change would be made.

The Rev. J. W. Cundey said it was a well known fact that at Oxford the hardest papers were not set in those colleges where the blue ribbon was most difficult to obtain. Far easier papers were set at Balliol College, where scholarships were very difficult of attainment, than those set at some of the halls.

Mr. Poppleton said he had had experience of a great many different examinations, and he thought if 40 marks were adopted as the minimum, the standard would more nearly approach that of similar examinations elsewhere.

The Chairman said the Society only suggested a minimum, but unfortunately there was always a tendency in such cases for the minimum to become a maximum.

Mr. Levy asked if the number of candidates attending these examinations was so far increasing as to warrant a raising of the standard.

Mr. Critchett replied that they had no complete returns this year, these elementary examinations being entirely outside the Society. They simply issued the examination papers for the convenience of the institutions, and did not dictate how they should be used, merely suggesting in a note that they thought 30 was the lowest number of marks which could justify a pass. There was not the slightest reason why at Aldershott, or anywhere else, the minimum should not be fixed at 40, or even higher.

Mr. Poppleton remarked that with such a suggestion before them the examiners did not like to refuse any candidate who obtained 30 marks. He would move, therefore, that the suggested minimum should be 40 instead of 30.

The proposition was lost on being put to the meeting.

The Chairman next invited discussion on the question—

"How far can the Institutions co-operate with the University of Cambridge in the new scheme for extending University education at populous centres?"*

* In connection with this subject a circular has been issued by Dr Parkhurst, Hon. Sec. of the Lancashire and Cheshire Union, to the institutions, from which the following is an extract:—The Council desire to call your attention to the advantages offered to such institutes as yours under the Cambridge University Extension Scheme. For the sum of about £50, either paid in advance or guaranteed by a local committee, the University will supply a lecturer who will deliver a course of weekly lectures, in association with weekly classes, for a term of 12 weeks, on such literary or scientific subject as may be agreed upon between the local committee and the University. The sum paid to the University covers the cost in respect of the lecturer and of the examination and certificates. All other expenses, such as rent of rooms, printing, advertising, &c., are borne by the local committee. The amount charged as fees to the pupils by the local committee has varied at different places from 3s. to 21s. for a course of lectures and classes. As the ability of the University to supply teachers at the rate mentioned depends in some degree upon the teacher's time being fully employed, it is very desirable that two or more neighbouring institutes should agree to employ the same teacher in the same subjects on different days of the week. In such a case the travelling expenses of the teacher to and from these institutes would be defrayed by the local committees. Where no concurrent system can be adopted with other institutions, it may be possible to institute a course of teaching addressed to a special class, an arrangement which would be found especially applicable to ladies.

Mr. Curzon said the Yorkshire Union had decided on offering twelve nominations to twelve candidates, recommended by the various committees existing in the centres, where the lectures were to be delivered. They were endeavouring, in connection with the unions, to utilise every organisation which could be brought to bear on the work of education, commencing with the elementary examination of the Society of Arts, and concluding with the College of Science at Leeds. He had been informed that the same idea of giving free tickets for the University lectures was being adopted at Exeter, and if this were carried out elsewhere, it would doubtless give vigour to the movement. He should also recommend some central course of action. In the North of England the work had been almost entirely done by ladies, and he recommended their co-operation being invited in this branch of the work, for they knew more about it than anybody else.

Mr. Stapley said the greatest difficulty was to raise the guarantee fund required by the University. The Crewe Mechanics' Institution was one of the first to memorialise the University with respect to this scheme, and he was disappointed that the University had not been more liberal. In such a place as Crewe, where there were no great capitalists, there would be a great difficulty in raising a guarantee fund for £150 for three subjects, £50 for each, and if the Society could devise any scheme for getting over this difficulty they would be conferring a great boon.

Mr. J. H. Levy thought the question in its present shape was almost a sarcastic one; it should rather be—"How far could the University of Cambridge co-operate with the Institutions in the new scheme for extending University education at populous centres." So far as London was concerned, at any rate, what they proposed seemed very like a joke. They said, "If you will guarantee us the money we will send you teachers;" but he had not the least hesitation in saying that the same offer might be retorted on the University. There was no difficulty in London in finding teachers; the difficulty was the money. In provincial towns, no doubt, things might be different, and there might be a great demand for intellectual culture without proper teachers. To such places the University might very well extend its operations without interfering with existing organisations, but it was altogether different in London. He had always urged upon the Society of Arts not to diminish the number of their subjects, and he believed if they would only try to hold the societies together, and to send lecturers amongst them, they had still a great work to perform.

Mr. Norris did not think they were in a position to take any action with reference to the proposed University scheme until the Mansion-house committee, formed on the 10th June, had put forward some proposals. In the provinces he thought the institutions could co-operate by requesting that the lectures should be delivered in their own buildings, by which they would save expense and be able to offer advantages to their members.

Mr. Noldwritt lamented the falling off in the interest which the various institutions seemed to take in each other's welfare, as shown by the manner in which they responded to requests to forward their reports. When the Union of Institutions was first formed, he sent out a syllabus to every one, requesting an exchange, and received a reply from nearly all, but the number gradually fell off year by year, until now he did not get replies from more than 25 per cent.

Mr. Curzon said there had been a general decay in the organisation of institutions in the provinces, several unions, such as the Midland Counties, and the Hants and Wilts, having been dissolved, and if they were disorganised amongst themselves, they could not expect union with the centre. He thought, however, that the Society might do a little more than it had done lat[ely], especially by inserting more frequently in the *Journ[al]* reports of the different institutions. If the busines[s of] the Conference were over he should have much pleas[ure] in proposing a hearty vote of thanks to Major Donnell[y] as well as to Major-General Eardley-Wilmot, for th[e] conduct in the chair.

Mr. Norris seconded the motion, which was carri[ed] unanimously.

The Chairman in acknowledging the compliment, sa[id] he had no doubt the officers of the Society would [do] anything they could to promote the circulation of th[e] reports which had been referred to, but there was a ve[ry] general idea that such documents were not read, a[nd] perhaps that had something to do with the shortcomin[gs] alluded to.

CONVERSAZIONE.

The annual conversazione of the Society w[as] held, as usual, by the kind permission of the Co[m]mittee of Council on Education, at the South Ke[n]sington Museum, on Friday, June 25th.

The Art Library, the Raphael Cartoons, th[e] Sheepshanks and the National Gallery's Pict[ure] Galleries were open, and the visitors were abl[e to] make the tour of the Art-Schools both on the fi[rst] and second floors. The courts and corridors of th[e] ground floor were also open, including the Arc[hi]tectural Courts at the south end of the buildi[ng]. The reception was held in the South Court, [by] Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman, assisted by the following Vice-Presid[ents] and Members of Council:—Mr. E. Brooks, M[r.] Andrew Cassels, Mr. Edwin Chadwick, C.B., M[r.] J. O. Chadwick, Mr. Hyde Clarke, Colonel A. [J.] Croll, Mr. C. J. Freake, Mr. I. Gerstenberg, Vi[ce-] Admiral Erasmus Ommanney, C.B., F.R.S., M[r.] Robert Rawlinson, C.B., Mr. E. J. Reed, C.B., M.P., Lieut.-Colonel A. Strange, F.R.S., Mr. Sey[mour] Teulon, and Mr. E. Carleton Tufnell.

A Promenade Concert was given by the Band [of] the Grenadier Guards in the North Court, and [a] Vocal Concert, consisting of glees, by the Lond[on] Glee and Madrigal Union, directed by Mr. La[nd], in the Lecture Theatre.

All the other arrangements were as usual. Th[ere] were in all 3,341 persons present.

AFRICAN COMMITTEE.

A meeting of this Committee was held [on] June 24. Present:—Sir T. Fowell Buxton, Bar[t.] (in the chair), J. C. Blaine, A. Cassels, Lord Al[fred] Churchill, Hyde Clarke, Colonel Harley, T. [J.] Hutchinson, J. Jackson, J. J. Pratt, General C. P. Rigby, T. A. Rochussen, with Dr. Mann, secre[]tary of the African Section. The Committee de[]cided on the terms of an address to H.H. the Seyyid Barghash, Sultan of Zanzibar.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Entomological, 12, Bedford-row, W.C., 7 p.m.
Tues. ...Sculptors of England, 7, Gower-street, W.C., 7 p.m.
Wed. ...Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.
Fri. ......Quekett Club, University College, W.C., 8 p.m.
Sat. ......Royal Botanic, Inner Circle, Regent's-park, N.W., [illegible]

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FRIDAY, JULY 9, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CHAIRMAN OF COUNCIL.

On Monday last, at their first meeting after the annual election, the Council chose Lord Alfred Churchill as Chairman for the ensuing year. The various existing Committees were then re-appointed.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A meeting will be held this day (Friday, July 9), at 2 p.m., at the Mansion-house, by permission of the Lord Mayor, to which the members of the Society of Arts and their friends are invited. The meeting is for the purpose of establishing free Musical Scholarships for the City of London and the Metropolis, in connection with the National Training School for Music.

RAILWAY LAMPS.

This Committee met on Tuesday last, the 6th inst., at the Baker-street Station of the Metropolitan and St. John's-wood Railway, for the practical trial of certain selected lamps. By the kindness of the Directors of the Metropolitan Railway, a carriage had been placed at the disposal of the Committee, and this carriage, in which the lamps were fitted, was attached to a train running between "Swiss Cottage" and Baker-street. The trials continued from 2 p.m. to 4.30 p.m., and included comparative tests of the lamps while the carriage was standing in the tunnel, and running in the train with the ordinary traffic.

The *Bessemer* is now lying in the Millwall Docks, and likely to remain there for another two months at least, waiting her turn to go into Smith, Pender, and Co.'s graving dock, in order to repair the damage done to some of her outside plates in her collision with Calais pier. It is probable that she will follow her rival, the *Castalia*, who is also awaiting her turn in the dry dock.

The Liernur system of town sewage, which was described in a recent paper before the Society, is now being applied to St. Petersburg. In the first instance one district containing 12,000 to 15,000 inhabitants, is being treated, and if this is successful the whole city will be drained in the same way.

MISCELLANEOUS.

NOTES ON MEDALS AND SOCIETIES GRANTING MEDALS.

By P. L. Simmonds.

In the fifth annual report of the deputy-master of the Mint recently issued, there are some brief but interesting details furnished as to the history and progress of medals, which will furnish as it were the keystone for some observations on the subject of the various medals now issued by different societies, &c. The engraving of dies is an important branch of art, and one that requires great care and skill in its perfection.

> "The medal, faithful to its charge of fame,
> Through climes and ages bears each form and name."
> *Pope's Epist. to Addison.*

The number and variety of medals private and official issued in this country is more extensive than is generally supposed. The London Corporation, various colleges, societies, and schools distribute medals occasionally or annually, some few of gold, a large proportion of silver, and a limited number in bronze. In addition to the medals awarded every year by the War-office and Admiralty for good conduct, &c., and those required by the India-office as war medals for good service, &c., and for scholars in Indian schools, the Royal Mint has for some time past been, and still is, engaged in the issue of the war medals, likely to be about 10,000 in number, which are ordered for distribution to the troops engaged in the Ashantee war. These medals are somewhat more elaborate in design than has usually been the case with war medals, and especial care has been taken both in striking them and preparing them for issue. In order to trace briefly the phases through which medallic art has passed in this and other countries since the Middle Ages, a few typical medals illustrative of this branch of art at different periods are given in the Mint report. And in order that the more ancient examples may not be altogether unrepresented, there is placed at the head of the plate a Syracusan coin representing Philistis, wife of Hiero the Second. According to Pinkerton ("Essay on Medals," London, 1789), no medals appear in any country in Europe till the 15th century, with the exception of the gold medals of David II. issued in Scotland between 1330 and 1370; but as early as 1439 mention is made of a gold medal of the Council of Florence, and from that time the art continued to flourish in Italy.

The medals of this period were modelled in wax first, in fine sand, and were afterwards, in some cases, finished with the graving tool. A couple of these, one by Albrecht Durer, are excellent examples of early Italian and German art, but the most beautiful series are the Papal medals, commencing in the pontificate of Paul II. (1464), many of which were designed by Raffaele, Giulio Romano, Francia, Cellini, and other great artists. From the close of the 15th century, medals were struck, instead of cast, and greater finish of workmanship was, no doubt, thereby attained. Next to Italy, France was the country most remarkable for medals, but the French medals were neither fine nor numerous until the reign of Louis XIV., which produced many works of good design and execution.

The oldest known English medal bears date 1480 ("Medallic History of England," London, 1790, page 7), and is the work of an Italian artist; but in the reign of Henry VIII. medals were still uncommon in this country. Several examples, however, are extant of medals struck in the reign of Queen Mary, and of these, one of the best is that by Trezzo of the queen herself. In the reign of Elizabeth many medals were struck, but none which

deserve special mention, except one to commemorate the defeat of the Spanish Armada, bearing the device of a fleet scattered by the winds, and the legend, "Afflavit Deus et dissipati sunt." This, however, is not extant. Medals became numerous in the reign of Charles I., whose artistic tastes are well known. In this reign, and subsequently under the Commonwealth, the works of Thomas Simon, the greatest of English medallists, form an important era in the history of medals. A fine example is that representing the head of Thomas Wriothesley, Earl of Southampton. After these, no remarkable medals occur till the reign of Queen Anne, in which a series appeared commemorating the victories of Marlborough. In the medals of succeeding reigns the style gradually tended towards a revival of Roman types, and this style has survived, with few exceptions, until within a comparatively recent period. As an instance may be mentioned the Crimean war medal, the reverse of which represents Victory crowning a warrior equipped in Roman armour. The Napoleonic medals are pseudo-classic in design, but are generally creditable to French art. The small head of Queen Caroline, beautifully modelled by Pistrucci, chief medallist of the Mint from 1827 to 1851, is a successful imitation of Greek art. It is hardly necessary to refer to the work of William Wyon, R.A., late engraver of the Mint, whose numerous medals, some of great merit, are well known, and whose coins are still in circulation.

The medal for "distinguished conduct in the field, long service, and good conduct," designed by Pistrucci, well represents the degraded state of art which for a time prevailed, and which was followed, as in the case of the medals for the New Zealand and Abyssinian wars, by designs of decorative and geometrical ornament. In the medal annually given since 1870 to the "best shot" in the Army, and the Ashantee medal, an attempt has been made, and successfully, to give good examples of contemporaneous English art. With this view the designs for the reverse of both medals were entrusted to Mr. E. J. Poynter, A.R.A., the obverse, bearing the effigy of her Majesty, being in each case the work of Mr. Leonard Wyon, engraver to the Mint, by whom also the dies for both medals were engraved.

Addison in his "Dialogues upon the Usefulness of Ancient Medals," published in 1726, observes—"We ought to look on medals as so many monuments consigned over to eternity, that may possibly last when all other memorials of the same age are worn out or lost," and pleads that medals shall represent as accurately as may be the dress and customs of the time of their issue. Evelyn contends also, in his "Discourse of Medals," for accuracy in portraiture and types of race, as of great importance from an ethnological point of view, and urges that medals should be truthful in these respects. In the design for the "best shot" medal it was impossible, owing to differences of uniform, to adopt a dress common to the whole army, and it was necessary therefore to treat the subject allegorically; but in the case of the Ashantee medal care has been taken to represent the actual garb of the combatants on each side.

Irrespective of a number of provincial agricultural societies, private colleges, schools, &c., which award medals, the number of important and influential societies which issue medals is very large; and as I am not aware that they have ever been collectively brought together with this special object, I shall furnish a list for reference, not only of the societies, and of the special medals issued, but also add a few descriptive notes classifying them under the several heads in which they may in a manner be grouped.

EDUCATION, SCIENCE, MANUFACTURES, AND COMMERCE.

By the Department of the Committee of Council on Education, the Queen's medals are offered for competition through the United Kingdom at the general examination of Science schools and classes, held each year in May; they consist of one gold, one silver, and two bronze medals for each subject. Anybody may compete, but the medals cannot be taken by middle-class students who are more than 17 years of age, nor by persons who are not students of science classes, nor by those who have taken the same medal before. Such persons receive an honorary certificate instead of the medal itself.

To attempt to give a list of the various medals given at schools would be too wide an undertaking, and besides, as the competition is in all cases confined to a comparatively small number, the same public interest does not attach, as in the cases where a wider range is included. After, therefore, merely alluding to the fact that at most of the large public schools prizes are given for proficiency in various studies which take the form of medals, it may be permitted to pass over this part of the subject without further notice. Among the list of medal-granting bodies, it would hardly be proper to omit the Universities, though the rewards they offer are not open to the general public, the competition being confined to their own members. Also it may be noticed that the prizes in their gift (including, of course, those of the separate colleges) generally take the form of fellowships or grants of money, the latter, in some cases, to be expended in books. The following are the medals offered at Cambridge to graduates and undergraduates of the University:—

The *Chancellor's Gold Medals*, value 15 guineas each, to the best classical scholars of each year who have taken the degree of Senior Optime at least in the Mathematical Tripos. These were established in 1752, by the then Duke of Newcastle, and have been continued yearly by succeeding chancellors. Till the establishment of the Classical Tripos in 1824, they were the principal classical honours in the University, and down to the present date they have always been esteemed a very high distinction.

In 1775, *Sir William Browne* founded three gold medals, value five guineas each, to be given yearly for an exercise in (1) Greek verse, (2) Latin verse, (3) Greek and Latin epigrams, by resident undergraduates.

The *Powis Medal* was originally founded by the Marquis Camden, in 1841, and called the *Camden Medal*; since 1866 it has borne its present title. It is for Latin hexameters, and is open to second year undergraduates.

The *Chancellor's Medal for Legal Studies* was founded in 1855 by the late Prince Consort. It is open to Bachelors of Arts or Law under the standing of M.A.

The *Norrisian Prize* for a Prose Essay on a Sacred subject includes a medal, value £7 4s. It is open to graduates of not more than 13 years' standing, and was first given in 1781, under the will of John Norris.

The *Chancellor's English Medal* is given annually for English verse. It is open to undergraduates, and has been given yearly (with a few omissions) since 1813. Among the winners are the names of Whewell, Macaulay, Praed, Bulwer, and Tennyson.

Curiously enough the only medal given in the list of University Prizes in the Oxford Calendar is the *Johnson Gold Medal*, founded in 1862 for an essay on an astronomical or meteorological subject. This is open to the whole University.

At the University of London the following medals are granted in examinations for honours.

Preliminary Scientific Examination.—First and second candidates for honours and experimental physics, the Niel Arnott bronze medal.

First M.B. Examination. — First and second candidates, gold medal of the value of five pounds.

Second M.B. Examination.—The same.

Bachelor of Surgery.—The same.

Master in Surgery.—The candidate who shall most distinguish himself, a gold medal of the value of £20.

Doctor of Medicine.—The same.

At King's College the Jelf and one or two other bronze medals are awarded annually.

The Royal Society awards four medals, three

nually and one biennially. The Copley medal, ell-known throughout Europe, was founded in 1736 by bequest from Sir Godfrey Copley, Bart. Though comparatively small intrinsic value (£5), it is nerally considered the highest distinction which it in the power of the society to confer. It is not limited any particular science or sciences, or to individuals any particular country, but bears as its legend inscription "Dignissimo." On his death, Sir dfrey Copley left £100, the interest to be aped to a medal. The medal weighs 1 oz. 2 dwts. of gold, and bears on one side the name of the giver d a seated figure, and on the reverse the arms of the yal Society. There is hardly a name eminent in ence that does not appear as the recipient of this nourable testimonial of appreciated merit during the t 130 years. The two other annual medals are titled Royal medals, being given by the Sovereign on award of the society, for the encouragement of ence in the British dominions. These medals are of d, and of the value of 50 guineas each. They were ginally awarded by the Council for the most important overies or series of investigations completed and de known to the Royal Society in the year preceding day of their award. They are open to learned and enious men of all countries, and were founded in 1825. e medals bear on one side the head of the Sovereign, the reverse the celebrated statue of Sir Isaac wton, which is placed in the chapel of Trinity College, mbridge, with such emblematical devices as indicate objects and researches of that great philosopher. ey are now awarded on the anniversary meeting each year, for the most important discoveries series of investigations on any one principal ject or branch of knowledge which shall have been ciently established or otherwise completed to the isfaction of the Council, within five years preceding day of such award. These medals are termed binary dals, because, like the Rumford medal, each consists a silver and a gold medal, struck in the same die, an rangement which enables the recipient to convert the re precious medal into money, while he preserves the ser one in commemoration of his success. In the e of these two medals, but in neither of the others, award of the Society requires the sanction of the own.

The biennial medal, entitled the Rumford medal, of value of £60, was founded in 1796 by Benjamin mpson, Count Rumford, and is limited to discoveries light and heat, but unlimited in respect to the ntry to which the individual to whom the award is ongs. The recipient of the prize receives two medals, in gold, of the value of £60, the other silver, of value of £4, and the balance in money, amounting about £80 or £90. The medal is of a large size, and device on the obverse is a tripod altar with a flame on it, with an inscription round it of part of the 773rd ne of the Fifth Book of Lucretius ("De Rerum Natura) "Noscere quæ vis et causa." On the reverse is— Præmium optime merenti ex instituto Benj. A Rumford S. R. I. Comitis adjudicatum a Reg Soc Lond."

The Society of Arts, Manufactures, and Commerce of ndon, during its long existence, has distributed a ge number of rewards in gold and silver medals, well as pecuniary awards.

Medals were first given on the motion of Mr. Baker, March, 1756. The first gold medal, which was deed and presented to this Society by Flaxman, was arded in 1758, to the noble president, Viscount d Folkstone, for "eminent services," and the ciety's first silver medal was presented in 1757, to dy Louisa Grenville, "for a drawing."

Formerly there were several separate medals granted the Society. These were the Ceres for agriculture, Vulcan for mechanics, the Mercury and Minerva for mmerce and manufactures; the Isis, a smaller medal, the same objects. The Society also awarded medallions of silver and gold, combined for architecture. The awards for arts were in the form of gold, silver, and bronze palettes. At present the Society awards the following medals:—The Albert medal, founded in memory of the Prince Consort, for distinguished merit in promoting Arts, Manufactures, and Commerce; and the Society's medals of gold and silver, for original communications on subjects connected with the Society's work, papers read at the meetings, and generally for promoting Arts, Manufactures, and Commerce in any way.

Geological Society of London.—The Wollaston medal of this Society was founded by William Hyde Wollaston, M.D., F.R.S., F. G.S., &c., for researches concerning the mineral structure of the earth. Since its establishment, in 1840, about 40 medals have been granted, of which 12 have gone to foreign members.

Royal Institution of Great Britain for the Promotion, Diffusion, and Extension of Science and Useful Knowledge.—In the last 20 years about a dozen members, British or foreign, have been rewarded with Mr. Fuller's gold medal for chemical discoveries.

At the Royal School of Mines, Jermyn-street, London, there are nine Royal Exhibitions of the value of £50 per annum, held for three years. H.R.H. the Prince of Wales, as Duke of Cornwall, grants two scholarships of £30 each, held for two years; one becomes vacant every year. Two scholarships of £15 and one of £25 are available to those who have gained the highest number of marks in the past two years' examinations. The medals granted are of bronze, and are given with prizes of books. They are the Edward Forbes' medal for Natural History, the De la Beche medal for Mining, and the Murchison medal for Geology.

The Royal Geographical Society of London, besides its Royal or patron's medal, gives silver and bronze medals yearly for proficiency in various branches of political and physical geography.

The Zoological Society of London awards occasional silver and bronze medals.

The Royal Society of Edinburgh.—The late Dr. Patrick Neill, of Canonmills, the eminent botanist, placed in the hands of this Society a sum to be awarded for a gold medal and prize for distinction in Natural History. The medal bears on one side the profile of its founder. This society also awards a MacDougal-Brisbane medal and prize.

The Statistical Society of London has recently instituted a "Howard medal" in bronze, to be given in every year to the author of the best essay on some subject in Social Statistics, a preference being given to those topics which Howard himself investigated and illustrated by his labours and writings.

The Royal Cornwall Polytechnic Society for the Encouragement of Science and the Fine and Industrial Arts, instituted in 1833, is under the patronage of her Majesty the Queen and the Prince of Wales. It awards two classes of silver medals and two of bronze. During the forty-two years which the society has been established, it has granted more than 1,000 silver and bronze medals, with money to the amount of £4,000 as prizes. Several who won them are now artists of eminence, or are prominent in their several walks of life, and having received some light from the Society, now reflect lustre on it.

The Royal Artillery Institution, Woolwich, and the Royal United Service Institution, Woolwich, award gold medals for the best essays on professional subjects.

The Institute of Civil Engineers grants two descriptions of bronze medals, a Watt medal, and a Telford medal yearly for the best papers.

The Iron and Steel Institute awards their Bessemer gold medal annually.

The Coachmakers' Company of London distributes annually silver and bronze medals and prizes for excellence in drawings, and other works in connection with the trade of coachmaking.

The Painters' Company of London grants silver and bronze medals, accompanied with the freedom of the Company.

The Turners' Company of London also offers silver medals and the freedom of the Company for the best workmanship in various materials.

The Cotton Supply Association of Manchester has since its establishment distributed about 20 gold medals, 50 silver, and 60 bronze, to various firms and individuals, home and foreign, including the Sultan of Turkey.

The Corporation of London has had struck from time to time several handsome medals for special occasions. In 1871 all the members of the corporation received a gold medal from the City of Paris.

ART.

In the department of art, the Royal Academy offers several gold and silver medals annually for competition among art students, which are distributed in December, among others, the Turner gold medal. A scholarship of £25, tenable for one or two years, is offered in addition to the gold medal (worth £20) in historical painting, sculpture, and architecture, and a travelling studentship for one year, with an allowance of £100 if the compositions are of sufficient merit. The silver medal has the bust of the Queen.

The Royal Irish Academy offers the Cunningham gold medal, and the Royal Hibernian Academy of Art bronze medals.

The Royal Dublin Society grants gold, silver, and bronze medals. Medals have been granted for fine art competitions since 1741, also annually from a very early date for improvement in agriculture and planting, reclamation of waste land, &c., and for manufactured articles since the year 1835.

The Royal Institute of British Architects, London, grants the following medals. The Royal medal in gold is conferred on such distinguished architect or man of science of any country, as may have designed or executed any building of high merit or produced work tending to promote or facilitate the knowledge of Architecture or the various branches of science connected therewith. The Soane medallion is for drawing, the silver medal of the Institute for drawings or essays, and a medal of Merit is also granted for essays.

The Royal Scottish Society of Arts, Edinburgh, has at its disposal for award the special Keith gold medal, value £130, the Hepburn medal of the value of £7, the MacDougal-Brisbane medal, other silver medals and plates, and an honorary silver medal.

The Society for the Encouragement of the Fine Arts, London, offers silver medals for open competition to schools and schools of art. Three are to be awarded this year, one to King's College, one to the City of London School, and one to India for the most original work of art. The works that compete for the medals are to be sent to the society for inspection.

In the national competitions of schools of art, various gold medals are offered annually by the Department of Science and Art.

The Crystal Palace directors offer annually to artists for the best pictures and drawings, several large gold medals of the value of 25 guineas, many large silver medals, value six guineas, and bronze value three guineas each.

The Photographic Society of London formerly granted silver medals, but has not done so for many years now.

It was well observed by the *Art Journal* in March, 1872, "Although honours are very rarely conferred upon artists and men of letters in England, they do occasionally come to them from foreign potentates."

MEDICINE AND PHARMACY.

Firstly, we have in the two professions medals awarded. For the Royal Navy the Blane medal. The adjudication of this gold medal is made biennially by the President of the Royal College of Physicians, the President of the Royal College of Surgeons, and the Director-General of the Medical Department of the Navy (in accordance with the bequest of the founder, the late Sir Gilbert Blane, Bart., formerly physician to the Fleet), to naval medical officers who have shown the most distinguished proof of zeal and ability in the official returns rendered annually to the Medical Department of the Navy.

In the Army Medical Department, out of the Alexander Memorial Fund, a gold medal, value £[illegible], and a prize of £50, are given annually to executive medical officers of the army on full pay for the best essay on a prescribed subject.

The British Medical Association, 13, Newhall-street, Birmingham, offers annually the Hastings gold medal for the best essays sent in in competition, but it frequently happens that none are considered important enough to merit the reward.

The Medical Society of London, 32, George-street, Hanover-square, instituted in 1773, awards annually, for the promotion of medical science, the Fothergill gold medal and two silver medals.

The Grosvenor-place School of Medicine gives gold and bronze medals.

The Royal Veterinary College, London, offers medals for the Coleman prize.

At University College, in most of the classes, gold and silver medals are given for excellence in the examination at the close of the courses. The Liston gold medal for clinical surgery, and Dr. Fellowes' medals for clinical medicine—two gold and two silver.

At King's College Hospital the following medals are awarded:—The Todd medical clinical prize, a bronze medal and four guineas in books, annually to the most deserving of the third and fourth year students; the Warneford prize, a silver medal, value £10.

At St. Bartholomew's Hospital and College, the Kirke's gold medal is awarded annually for proficiency in clinical medicine.

At the London Hospital gold and silver medals.

At Guy's Hospital two gold medals annually by the Treasurer, one for proficiency in medicine, and one in surgery.

At St. Thomas's Hospital Medical School Mr. George Vaughan Chesleden's medal and the Treasurer's gold medal are given.

At Charing-cross Hospital silver and bronze medals are granted for practical chemistry, pathology, &c.

The Pharmaceutical Society of Great Britain awards silver and bronze medals annually for botanical prizes. Also at their sessional examinations a silver and a gold medal; also the Pereira prize medal, founded in 18[illegible] in memory of Jonathan Pereira, M.D., F.R.S., F.L.S., born 1804, died 1852. The Council medal of the society has the two figure supporters, with the motto, "Habenda ratio valetudinis." On the obverse, "Pharmaceutical Society of Great Britain, incorporated A.D. 1843, charter confirmed 15 and 16 Vic., cap. 56, 1852."

The South London School of Pharmacy grants silver and bronze medals to those who obtain honours in the pass examinations.

The Society of Apothecaries has since the year 18[illegible] annually offered two prizes for proficiency in the knowledge of the Materia Medica and of pharmaceutical chemistry, to be competed for by students who are attending the third winter season of their medical studies. The prizes consist of a gold medal awarded to the candidate who distinguishes himself the most in the examinations; and of a silver medal, and a book, or books, to the candidate who does so in the next degree.

The University of Durham College of Medicine grants silver medals for botany, surgery, &c.

The Queen's College, Birmingham, and the Liverpool Royal Infirmary School of Medicine, and the Royal Schools of Medicine of Manchester and Bristol give gold

…LPHABETICAL LIST OF SPECIAL MEDALS, AND BY WHAT SOCIETIES OR INSTITUTIONS, &c., GRANTED.

NAME.	CHARACTER OF MEDAL.	BY WHOM GRANTED.
…laide Hospital, Dublin	Silver	
…rt medal	Gold and bronze	Board of Trade.
"	Gold	Society of Arts.
…ion medallion (obsolete)	Gold	Society of Arts.
…othecaries' Company	Silver and bronze	The Apothecaries' Company.
…ott medal	Bronze	University of London.
…ronomical Society		
…ander medal...	Gold and £50	Army Medical Department.
…y medal	Gold	Royal College of Physicians.
…sian medal	Silver	Royal Horticultural Society of London.
…h and West of England Society	Silver	
…by medal		City of London School.
…rkley medal	Gold	Trinity College, Dublin.
…emer medal	Gold	Iron and Steel Institute.
…e medal	Gold	Medical Department, Admiralty.
…d Medical School	Gold	
…ish Medical Association	Gold	
…wne, Sir William, medals (3)	Gold	Cambridge University.
…ell medal		City of London School.
…olic University, Dublin	Gold	
…ring-cross Hospital...	Silver and bronze	
…tia Medical School, Dublin	Gold	
…stal Palace	Gold, silver, and bronze	
…s medal (obsolete)	Gold	Society of Arts.
…eden medal	Gold	St. Thomas's Hospital.
…man medal		Royal Veterinary College of London.
…makers' Company	Silver and bronze	The Coachmakers' Company.
…quest medal	Gold	City of London School.
…y medal	Gold	Royal Society of London.
…'s Hospital...	Gold and silver	
…ingham medal	Gold	Royal Irish Academy.
…la Beche medal	Bronze	Royal School of Mines.
…lison medal	Silver	London University College.
…lin Pathological Society	Gold	
…lin School of Medicine	Gold	
…burgh University	Gold	
…day medal		Chemical Society of London.
…owes medal	Gold and silver	University College Hospital.
…es medal	Bronze	Royal School of Mines.
…h Humane Society	Silver	
…ergill medal	Gold	Medical Society of London.
…ler medal	Gold	Royal Institution of Great Britain.
…ogical Society	Gold	See Wollaston Medal.
…gow University	Gold	
…venor-place School of Medicine	Gold and bronze	
…y's Hospital medal (2 Treasurers')	Gold	
…' medals (2)		City of London School.
…ings medal	Gold	British Medical Association.
…burn medal	Gold	Royal Scottish Society of Arts.
…hland and Agricultural Society	Gold and silver	
…ard medal	Bronze	Statistical Society of London.
…itute of British Architects	Silver	See Soane and Merit.
…itute of Civil Engineers		See Telford and Watt.
…and Steel Institute		See Bessemer.
…medal (obsolete)	Gold and silver	Society of Arts.
…medal...	Bronze	King's College.
…h medal	Gold	Royal Scottish Society of Arts.
…t medal	Gold	St. Bartholomew's Hospital.
…'s College	Bronze	
…ian medal...	Silver	Royal Horticultural Society.
…' medal		King's College
…pool Shipwreck and Humane Society	Gold and silver	
…y medal		
…n medal	Gold	
…n Hospital...	Gold and silver	
…n Medical Society	Silver	
…on University	Gold and silver	University College.
…ig School of Medicine, Dublin...	Silver	
…ester School of Medicine	Gold	
…ll medal		Royal Institute of British Architects.
…Dougal-Brisbane medal	Gold	Royal Scottish Society of Arts.
…er's medal	Silver	Christ's Hospital, London.
…al Society	Gold and silver	See Fothergill medal.
…fiore medal	Silver	Merchant Taylors' School.
…hison medal	Bronze	Royal School of Mines.
…onal Lifeboat Institution	Gold and silver	
…ll medal	Gold	Royal Society of Edinburgh.
…ers' Company	Silver and bronze	
…'s medal	Gold	Royal Geographical Society of London.
…a medal	Bronze	Pharmaceutical Society of London.
…-street Medical School, Dublin...	Gold	
…ceutical Society		
…k medal		Royal College, Addiscombe.
…'s College, Birmingham...		
…'s medals	Gold, silver, and bronze	Science and Art Department.
…'s medals	Gold	Royal Geographical Society.
…'s University, Dublin	Gold	

SPECIAL MEDALS.—*Continued.*

Name.	Character of Medal.	By whom Granted.
Richards medal	Gold	Christ's Hospital.
Royal Academy	Gold and silver	Royal Academy of London. See Turner.
Royal medal	Gold	Royal Society of London.
Royal medal	Gold	Royal Institute of British Architects.
Royal or Patron's medal	Gold	Royal Geographical Society
Royal Academy of Music	Silver and bronze	
Royal Agricultural Society, 10 medals	Silver	
Royal Artillery Institution	Gold	
Royal Botanic	...	
Royal College of Surgeons, Edinburgh	Gold	
Royal Cornwall Polytechnic Society	Silver and bronze	
Royal Dublin Society	Gold, silver, and bronze	
Royal Geographical	Gold and bronze	
Royal Infirmary School of Medicine, Liverpool	Silver	
Royal United Service Institution	Gold	
Royal Veterinary College	...	See Coleman medal
Royal Horticultural Society	Gold, silver, and bronze	
Royal Hibernian Academy, Dublin	Bronze	
Royal Humane Society	Gold, silver, and bronze	See Stanhope.
Royal Institution of Great Britain	...	See Fuller.
Royal Irish Academy	...	
Royal National Life-boat Institute	Gold and silver	
Royal School of Medicine, Manchester	Silver	
Royal School of Mines	Bronze	See De la Beche, Forbes, and Murchison.
Royal Scottish Society of Arts	Gold and silver	See Keith, Hepburn, and Mac Dougal-Brisbane.
Royal Society for the Protection of Life from Fire	Silver	
Royal Society of Edinburgh	Gold	See Neill medal.
Royal Society of London	Gold and silver	See Copley, Rumford, &c.
Royal Society of Victoria	Gold	
Rumford Medal	Gold	Royal Society, London.
School of Art, South Kensington	Gold, silver, and bronze	
Scottish Arboricultural Society	Gold, silver, and bronze	
Shaw's medal	...	City of London School.
Smithfield Club Cattle Show	Silver	
Shipwrecked Fishermen and Mariners' Society	Gold and silver	
Soane medallion	Silver	Royal Institute of British Architects.
Society for the Encouragement of the Fine Arts	Silver	
Society of Arts	Gold and silver	
Simpson medal	Gold	University of Edinburgh.
Stanhope medal	Gold	Royal Humane Society.
Statistical Society	Bronze	
South London School of Pharmacy	Silver and bronze	
St. Thomas's Hospital	Gold	See Chesleden.
South Kensington School of Art	Gold, silver, and bronze	
St. Bartholomew Hospital (Kirk's)	Gold	
Telford medal	Bronze	Institute of Civil Engineers.
Thompson medal	Gold	Christ's Hospital.
Todd medal	Bronze	King's College Hospital.
Treasurer's medal	Gold	Guy's Hospital.
" "	Gold	St. Thomas's Hospital.
Turner medal	Gold	Royal Academy.
Turners' Company	Silver	
University College	Gold and Silver	
University of Durham	...	
University of London	Gold, silver, and bronze	
Victoria Cross	Iron	Her Majesty.
Victoria medal	Gold	Royal Geographical Society, London.
Warneford medal	Gold	King's College.
Watt medal	...	Institute of Civil Engineers.
Wollaston medal	Gold	Geological Society of London.
Zoological Society	Silver and bronze	

medals, silver medals for surgery, &c. The Bristol and Manchester Schools of Medicine, gold medals. The Royal College of Surgeons, Edinburgh, awards gold medals. In Ireland, the Dublin School of Medicine, the Pathological Society, the Catholic and Queen's Universities, the Adelaide Hospital, the Cecilia Medical School, the Ludwig School of Medicine, the Peter-street School, and others, grant silver and gold medals for surgery, anatomy, and practice of medicine.

Agriculture, Horticulture, and Forestry.

The Highland and Agricultural Society of Scotland distributes at its annual meetings a good many silver medals of three grades, major, minor, and medium.

The Royal Agricultural Society of England places at the disposal of its judges annually ten silver medals to be distributed at the country show.

The Bath and West of England Society, and a number of other provincial societies, the Smithfield Club, the Islington Agricultural Hall, and others, also award medals. Besides these, we have the Royal Horticultural and Royal Botanic Societies, which distribute a good many silver and bronze medals at their shows.

The Scottish Arboricultural Society, instituted [illegible] February, 1854, gives gold, silver, and bronze medals annually for the best reports on certain announced subjects.

Deeds of Valour and Bravery, and Saving of Life.

Besides the two official honours granted, the Victoria Cross and the Albert Medal, several societies award medals for valour and bravery.

The Victoria Cross decoration was instituted by her Majesty in 1856; this, in the words of the warrant, her Majesty desired "should be highly prized, and eagerly sought after, by the officers and men of our naval and military services." It consists of a Maltese cross of bronze, with the Royal arms in the centre, and underneath, in a scroll, "For Valour." The cross is suspended from the right breast by a blue riband for the Navy, and by a red riband for the Army.

The following is the official army regulation issued

respecting medals granted for acts of bravery in saving life:—"The Field-Marshal Commanding-in-Chief having sanctioned medals granted for acts of bravery in saving life, being worn in uniform, whenever a Society may consider any officer, non-commissioned officer, or soldier entitled to receive a medal, the decoration, together with a statement of the act of bravery performed, should be sent to the Adjutant-General to the Forces, in order that the recipient's name may be registered and the necessary authority issued for the distinction to be worn. These medals will be worn on the right breast."

In the Royal Navy, any British subject is at liberty to accept and wear a Foreign medal (not being the decoration of a foreign order) bestowed by competent authority for acts of bravery in saving human life. An officer, soldier, marine, or sailor must, however, first obtain permission from the Commander-in-Chief or the Lords of the Admiralty, as the case may be. No permission is necessary for accepting a foreign medal if such medal is not to be worn.

The Royal National Life-boat Institution awards gold and silver medals for aid rendered in the preservation of life from shipwreck. The obverse of the medal is a bust of her Majesty, the patroness, in high relief, by J. C. Wyon. The reverse, three sailors in a life-boat, one of whom (a portrait of the artist, the late Mr. Wyon, R.A., of the Mint), is in the act of rescuing an exhausted mariner from the waves on a fragment of the wreck. Inscription "Let not the deep swallow me up." Since the formation of the society in 1824, it has voted 90 gold and 814 silver medals for saving life, given pecuniary rewards to the amount of £32,300, and expended on life-boat establishments and other means of saving life from shipwreck £240,000.

The Liverpool Shipwreck and Humane Society was instituted in 1839, after the disastrous hurricane which occurred in January of that year. The objects of the society are to save human life, particularly in cases of shipwreck in the neighbourhood of Liverpool. To reward persons instrumental in rescuing human life from danger, and to relieve the widows and families of those who may perish in the attempt to save others. The providing relief for the immediate necessities of the unfortunate sufferers wrecked on the shores contiguous to the port of Liverpool. It has granted about 20 gold and 300 silver medals, and other honourable marks of distinction, besides pecuniary rewards to those who have distinguished themselves in saving life.

The Shipwrecked Fishermen and Mariners' Royal Benevolent Society, London, grants gold and silver medals for deeds of bravery, and has awarded since 1851, 35 gold and 250 silver medals, for assisting at the saving of 5,889 persons.

The Royal Humane Society awards annually a Stanhope gold medal in honour of the late Captain Stanhope, R.N., and many silver and bronze medals.

The Forth Humane Society, Edinburgh, also grants silver medals, and the Royal Society for the Protection of Life from Fire awards silver medallions.

M. Lostal, railway contractor, of Ferminy, has communicated to the Society of Mineral Industry, at St. Etienne, France, the results of his observations on the effect of lime in preserving wood, and his method of applying it. He piles the planks in a tank, and puts over all a layer of quicklime which is gradually slaked with water. The wood is said to acquire remarkable consistence and hardness, and to be quite safe from decay. Wood has been prepared in this manner for several mines.

The necessity of utilising the large rivers for maritime navigation, says *Nature*, is becoming one of the questions of the day in France. The Municipal Councils of Lyons and Marseilles are considering the means of connecting Marseilles with the Rhone by a canal practicable for shipping, while the Municipal Council of Paris have appointed a Commission to devise means to render the Seine navigable from Rouen to Paris.

THE PATENT LAWS.

A meeting of the Institution of Mechanical Engineers was held on Monday, the 28th ult. (Mr. F. J. BRAMWELL, F.R.S., in the chair), to discuss the Patent Bill now before the House of Commons. The following resolutions were proposed and carried:—

1. "That this meeting is decidedly of opinion that the Patents for Inventions Bill, 1875, proposed by the Lord Chancellor, would be much worse in its operation than the Act of 1852, for the following reasons amongst others:—It would give unlimited power to the Lord Chancellor to stop all patents, as well as control the length of patents, and the terms on which they should be used, to a large extent. It would not appoint paid Commissioners to manage the office; it would abolish the provisional specification; and it would appoint irresponsible examiners, who would have the power of reporting against the applications for patents on grounds of which they frequently could not possibly judge."

2. "That any preliminary examination of applications for letters patent that may be hereafter instituted should not extend beyond the question whether the specifications are clear, and whether the invention is open to objection on the ground of want of novelty, regard being had to prior publications in the Patent-office. That an adverse report should not disentitle an applicant to a patent. That in lieu of the proposed publication of reports (which would in many instances operate unjustly), the applicant should merely be required to insert in his specification an acknowledgment of the existence of the prior matter found and pointed out by the Patent-office officials, with a clear statement of what he claims notwithstanding."

3. "That inasmuch as the changes in the law proposed by the Bill now before Parliament differ materially from the recommendations of the Royal Commission, 1865, and of the Select Committee of 1872, it is expedient that no legislation on the basis of the Bill now before Parliament should now take place without special reference to a Select Committee."

4. "That a petition be presented to Parliament against the Bill, embodying the views of the meeting, and that the president be authorised to sign the petition on behalf of the Institution of Mechanical Engineers."

REGISTRATION OF TRADE MARKS.

The Trade Marks Registration Bill, which was introduced into the House of Lords by the Lord Chancellor on the 22nd ult., and read a second time on Monday, the 5th inst., consists of eleven clauses only. It provides for the establishment of a register of trade marks under the superintendence of the Commissioners of Patents. A "trade mark" is defined as meaning "some mark, sign, or device, either with or without the addition, as part of such trade mark, of letters, words, or combination of letters and words." The Act will come into operation on the 1st of January, 1877, after which date no person will be able to commence legal proceedings in respect of infringement of any trade mark, unless it be registered. A mark must belong to particular goods, or classes of goods, and can only be assigned or transmitted in connexion with the goodwill of the business, and it is determinable with such goodwill. The registration of a trade mark shall be *primâ facie* evidence of proprietorship, and after the lapse of five years such registration shall be conclusive evidence of the exclusive right of the person registering to the sole use of the mark. In case of the subsequent registration of the same mark by another person, his title shall be subject to the adverse claims of any person claiming under or through the first proprietor. In case of any registration of a trade mark by any person who is not entitled to the use thereof, or in case of the refusal of the registrar to receive any mark for registration, or if a mark which is

not a "trade mark" within the meaning of the Act, be registered, "any person aggrieved" may apply to the superior courts to have the register rectified. When several different persons claim to be registered as proprietors of the same trade mark, the registrar is empowered to refuse to make any entry until the rival claims have been settled by the superior courts. The court has power to direct an issue to be tried for the decision of any question of fact which may require to be decided for the purpose of the appeal. Except with the special leave of the court, the registrar shall not "register in respect of the same goods, or classes of goods, a trade mark identical with one which is already registered with respect to such goods, or classes of goods, or so nearly resembling the same as to be calculated to deceive." It shall not be lawful to register as part of, or in combination with a trade mark, any words which, by reason of their being calculated to deceive or otherwise, would not be entitled to protection in a court of equity. No "scandalous designs" will be received, and the registrar is empowered to refuse at his own discretion any trade-marks which may in his judgment be armorial bearings. The Lord Chancellor, with the consent of the Treasury, is empowered to appoint officers and to make general rules as to the fees to be paid, the classification of goods, the removal from the register of any trade mark for which an annual fee, if required, is not paid, the mode of proceeding under the Act, and as to the persons entitled to inspect the register. Any rules so made are to be submitted to Parliament as soon as practicable, and are to have the same force as if they formed a portion of the Act.

TOUGHENED GLASS.

Mr. H. Pocklington writes as follows to *Nature* on this subject:—

Perhaps the following short and preliminary account of some observations on the optical and mechanical properties of De la Bastie's toughened, or, as I think more correctly, hardened glass, may interest your correspondent Mr. James H. Logan (vol xii. p. 87).

Immediately after the publication of M. De la Bastie's specification I prepared specimens of the glass. I submitted them to careful optical examination by polarised light. Perhaps the best experiments are those made by means of short cylinders and small cubes and parallelopipeds carefully "hardened." A small cube with half-inch sides thus prepared has its sides ground plane and polished. The operation of polishing may be dispensed with if a small microscopical thin cover be cemented on the ground surface with Canada balsam. The cube is then mounted between strips of blackened cork, and examined in the usual way by means of Nicol's prisms, glass plates or other appropriate polariscope. The beautiful chromatic phenomena thus brought out at once indicate that amongst the causes which operate to produce the hardness of the glass, powerful compression of the interior by the contracting exterior must be one. The phenomena are, in fact, essentially those of compressed glass, and the curves of colour, or black and yellow, seen when the glass is examined by white or monochromatic light, indicate successive curves of tension and balance or no-tension. In a carefully-prepared glass rod of half-inch length these curves are rings traversed by a well-marked black cross. In an oval the rings assume the character of those seen in biaxial crystals. When plates are examined, the light being transmitted from back to front, they appear to act essentially as bi-refracting plates, but with the crosses and bands somewhat irregularly distributed, and capable of being referred to the angles of the plates or to centres of unequal heating.

My experiments on the mechanical properties of the glass have chiefly been confined to testing its hardness and the possibility of grinding it. So far as I have gone at present, I make it to be nearly twice as hard as ordinary glass, which it scratches with ease. It can be cut with a good file well moistened with turpentine, and can be ground on a stone with sand, without fracturing, if great care be taken and the glass be well prepared. One piece, which manifested when under the polariscope evidences of ill-balanced tension, the neutral line lying near one surface, submitted to transverse grooving, but disintegrated on being ground on one surface as soon as the outer surface had been ground away to near the neutral line. There appears to be an easily reached limit beyond which the surfaces must not be unequally removed, but as my friend Mr. Thomas Fairley, F.R.S.E., has been good enough to show me, there is practically no limit beyond which both surfaces may not be simultaneously removed. This result, foretold by me from polariscopical analysis, Mr. Fairley has kindly shown by dissolving the opposing surfaces away by hydrofluoric acid. The least hard portions dissolved much more readily than the thoroughly hardened, and the etched surfaces show wavy lines closely following the tension lines shown by the polariscope. There is further this remarkable feature, that the inner portion of the glass proves to be essentially common glass, which fractures in the ordinary way. Further experiments are necessary for the complete elucidation of the subject, and are in progress, but the preceding may be useful to fellow-workers on the subject.

INTERNATIONAL EXHIBITION 1876—PHILADELPHIA.

According to the accounts given by Mr. Cunliffe Owen, C.B., and Colonel Sandford, the executive officers of the British Commission, the exhibition is likely to be a brilliant success. The buildings are six months in advance as compared with those of previous exhibitions. Every block of marble and granite for the Picture Gallery, which will be permanent, is on the ground, and it is rising as rapidly as the temporary structures.

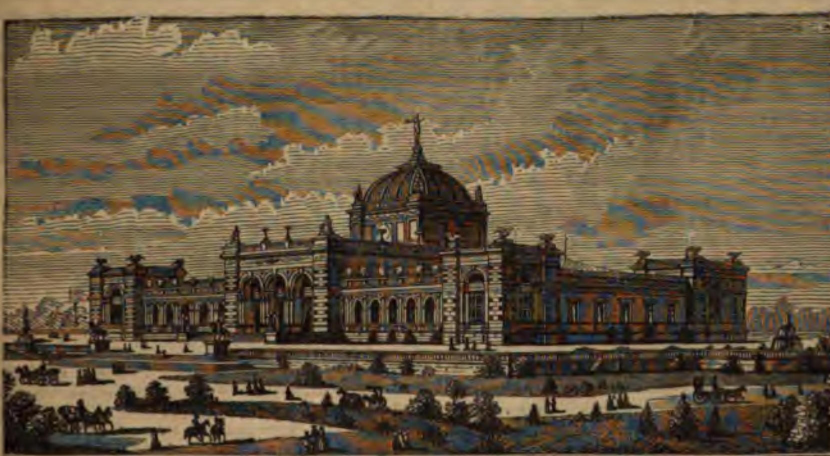
The American demands for space are enormous, but the Executive, in recognition of the friendly co-operation of the Government of this country, and to meet the large demands which have been made by British exhibitors, have re-arranged the space in the Industrial Hall, so as to give to England a commanding central position corresponding to their own.

MAIN EXHIBITION BUILDING.

HORTICULTURAL BUILDING.

forethought displayed in every particular, how- minute, has excited the admiration of the expe- d officers who represent this country. They state that the arrangements are most sensible, and that there will be no petty charges to the exhibitors.

Exhibitors will be allowed to attach to their goods the



MEMORIAL HALL.

at which they can be produced in England, and as l provision is being made to enable visitors from rts of America and England to reach Philadelphia at reduced rates, a vast number of Americans will be enabled to realise the effect which their tariff has in enhancing the price of European products.

MACHINERY HALL.

The following from an American paper gives a sketch of the present condition of the exhibition buildings, views of which are given herewith*:—

The United States Centennial Commission, the organisation which Congress has created for the management of the Philadelphia International Exhibition, having held its annual session has adjourned, to re-assemble about the time of the opening of the exhibition next year. Its chief business was the reception of reports on the finances and progress of the work, which detailed the information about the buildings, stock, subscriptions and donations, and the business prospects of the enterprise. The Commission made no decisions upon any question of detail in reference to the exhibition, everything being referred to this committee. They had a debate in reference to the price of admission, and the feeling appeared to be in favour of a fee of 50c. (2s.) for each single admission, there being no season tickets, and this will probably be adopted. After the close of the session the executive committee organised, and has begun earnest work. The progress of the buildings at Fairmount-park is very rapid, the fine weather greatly aiding the mechanics. There are five exhibition buildings—the "Memorial," "Machinery," "Agricultural," "Horticultural," and "Main Exhibition" halls. The machinery hall is so far advanced that the roof is nearly finished and the sashes are being glazed. The various offices adjoining it—ticket-office, post-office, and custom-house—are now plastered. Upon the memorial hall, which is to be a permanent building, the chief labour is being expended, and it will be finished next autumn, in advance of the time expected. The interior walls are all up, and the roof is being constructed. The fronts are of granite, and they are in some portions almost completed. The massive framework of the surmounting towers can be seen for miles around. This building occupies a commanding position on the Schuylkill, and from the tower there is a fine view up and down the valley of that river, Philadelphia being spread out in the foreground across and down the stream. South and west of the hall are the exhibition grounds, mapped out before the observer, with the thousands of labourers at work. The interior finish and decoration of this hall are about beginning. The main exhibition building is also progressing with rapidity. Several sections are up, and the foundations of a large portion are ready for the superstructure. A statue of "America," 22 feet high, which is to surmount the tower of the memorial hall, is ready to be placed in position. The other two buildings are not in a very forward state as yet, but the foundations are being prepared, and a large quantity of the materials is on the ground. Railway lines are laid in all directions, connecting with the Pennsylvania Railway, and they bring the materials just where they are wanted. The interest in the Centennial throughout the country is constantly growing, and the contributions are quite liberal. The Finance Board do not now seem to have any doubt of their ability to raise all the money required.

The sugar season in Austria, in 1874-5, has been one of the worst known. From the month of August, 1874, to the end of February, 1875, only 928,458 tons of beet-root were cultivated; while in 1872-3 the quantity was 1,668,000 tons. The reason of this great difference is that the cultivation of the beet-root had extended during the last year or two so as to be very favourable to the farmers, but very unfavourable to sugar manufacturers.

The jury of the Exhibition of the French Central Society of Horticulture has awarded a large gold medal to M. De la Bastie for his discovery of hardened glass, on account of the services it is likely to render to horticulture.

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* A view of the "Art Gallery," or "Memorial Hall," appeared in the *Journal* for Nov. 27, 1874, but it has seemed better to repeat it here, for the sake of completeness. The "Agricultural Hall" it is hoped to illustrate at an early date, as soon as a woodcut is received from Philadelphia.

CONCENTRATED BEER.

Concentrated or condensed milk has been long known and used to a large extent in this country, and indeed, throughout the world. It is now proposed to apply to beer a similar process to that employed in the condensation of milk. The idea suggested itself more than a year ago to Mr. P. E. Lockwood, who has been connected with both the English and Swiss Condensed Milk Companies, and with the assistance of a leading analytical chemist who has for a long time given attention to the chemistry of brewing, he has perfected the process and protected it by a patent in this and several other countries. The process is comparatively a simple one, though the result is one of considerable interest and likely to effect a great modification of the export beer trade. Beer or stout is taken at any stage of fermentation, though the process is better applied when it is fit for drinking, and evaporated in a vacuum pan, until a large part of the water and alcohol is distilled away, and the beer or stout is reduced to a thick viscous fluid of about the consistency of treacle or condensed milk. The alcohol and water of course pass off in vapour, which in its turn is condensed in a receiver attached to the vacuum pan, and the alcohol is obtained by re-distilling the liquid taken from the receiver, or a rectifying still may be attached to the vacuum pan, and the whole process may be performed at one operation. This alcohol may be remixed with the condensed beer either before it is enclosed in tins or other receptacles, or at any time afterwards. By this process of condensation the beer or stout is reduced to one-eighth or one-twelfth of its original bulk, according to its original strength, and as the fermentation is suspended by the heat employed, the condensed mixture may be depended upon to keep good for any length of time in any climate. The process of re-making the beer, *i.e.*, the re-conversion of the mixture into beer, is also a simple one, consisting in merely adding the bulk of water originally abstracted, and setting up fermentation again by the use of a small quantity of yeast or some other ferment. Within about 48 hours the beer may be drawn from the tap for use or bottled in the ordinary way, or without using any ferment the beer may be bottled and charged with carbonic acid gas by means of any aërating machine, as is done with aërated waters. It should here be mentioned that Mr. Lockwood's process is an entirely different one from those employed for making beer from solid wort or condensed wort, and protected by several patents. Wort in any form is merely the extract of malt and hops before they have been converted into beer by fermentation, whereas the condensed beer is the beer itself as produced by fermentation at the brewery. In making beer from solid wort a fermentation has to be engendered, a long period is required in order to obtain the proper flavour and amount of spirit, and in hot climates the whole process is liable to break down and the liquid to turn bad; and even when the process is completed successfully the beer is but a new beer; whereas, in the new process, only 48 hours are required to re-make what is actually old beer, and there is but little danger of any mishap occurring under any climateric influences.

But apart from the interest attaching to this new process in a chemical point of view, and as a novel method of dealing with a valuable article of food, the subject is of considerable importance in reference to the export trade in beer. The annual value of beer exported is about two and a-half millions sterling, and the cost of bottling, casks, and freightage, must be something enormous, the barrel casks alone costing 25s. each, and being almost worthless in India and other countries to to which beer is exported. The condensed beer representing the product of a barrel will be reduced by about nine-tenths of its original bulk, and the tin in which the mixture will be exported will cost at the most eighteenpence, so that at least three-fourths of the freightage will be saved. The expenses of condensation and re-making

ll be a mere trifle compared to the saving in the matters t mentioned, and thus, so far from Mr. Lockwood's cess interfering with the brewing trade, it will bably give a fresh impetus to it. But the chief value he process consists in its adaptation to any kind of r, and consequently a lighter and cheaper beer will capable of exportation in the condensed form to pical and sub-tropical countries and re-making there, quality of the added water making but little difence as long as the beer was orignally brewed with er suitable for that purpose. At present only strong holic, and consequently expensive, beers can bear ortation to hot climates, but a lighter and cheaper r re-made abroad, and sold "on tap," would be a at boon both to our own countrymen and others. In direction there really seems hardly any limit to the ntity which might be exported after being subjected he condensing process. As to re-making and bottling made beer in India, the new process would seem ly to be very extensively adopted, as there are already India enough empty beer bottles to build the pyramids Egypt twice over, and they are even cheaper than bottles in England.—*Standard.*

THE PRODUCTION OF INDIA-RUBBER.

The finest caoutchouc of commerce is not the produce ny species indigenous to India, but is produced by the ea *Braziliensis*. Attempts are being made to procure l introduce this species. The caoutchouc of India is duced from the *Ficus elastica*, which grows naturally North-Eastern Bengal, in Chittagong, and in Cachar, m which district a good deal is said to come. It may seen in parts of Sikkim, where in the moist but rocky valleys of the torrents that feed the Teesta and the hanadi, the huge stems stretch down straight to the und, or twine in fantastic groupings of contorted s. These have originally started from a young plant, g ago produced from seed deposited in the topmost of some tall *terminalia*, or toon-tree, which has in course of years been smothered by the giant growth. nature, the *Ficus elastica* is always found towering ve other trees, from the circumstance of its epiphytic gin. When once it has got its firm hold, it sends wn aërial roots that become stems, and thus a gle tree will form a grove covering half-an-acre extent. The chief habitat for rubber is in moist lower hill forests of Assam, and in the st forests of Burma beyond British territory. It well known that the rainfall of Burma steadily diishes towards the north, till at last it ceases about region of Paghan in the Irrawaddy; but thence in, influenced by the mountain masses to the north, again increases; it is in the moist forest of the thern rainy zone that the *Ficus elastica* occurs. It has ently been reported that a climbing species of *Willbia*, yielding caoutchouc, has been found in British ests in Burma. In Assam, the *Ficus elastica* is found both the forests of the Himalayas and in the low lleys of the Naga Hills.

The Indian caoutchouc has hitherto been collected by sons buying the right not only to collect it, but iming also to monopolise the purchase of that brought m foreign territory, and this has given rise to many systes. The greater number of trees are in the ritory of some independent hill tribes, who bring the dia-rubber in and sell it. At present the collection in itish territory has been stopped, partly owing to mplications arising out of the monopoly, but partly cause of the enormous waste and the injury inflicted over-tapping the trees and working them at the ong season. It is to be hoped that this fine source of venue will not long remain in abeyance, but that the nagement of the whole work may be entrusted to the est department. The yield in Assam amounted in 873 to 11,000 maunds, and in Sikkim to 700 maunds. The trees do not form pure forests, but are scattered one here and one there, the best forests containing hardly twenty trees to a square mile. They are cut all over with knives, both on the stem and on the long running roots; no care is taken to prevent injuring the sapwood. The cuts are elliptical in shape; the milk is received in holes in the ground, or in leaves doubled up to form a funnel. A tree tapped in August will yield 50 ounces of milk, giving 15½ ounces of pure caoutchouc. The milk is scanty during the cool season, October to March. The india-rubber is sometimes prepared by stirring the milk in boiling water, when the caoutchouc coagulates. It is shipped in baskets made of split rattan, weighing about 3 cwt. each. It is as a rule badly prepared, and mixed with sticks and dirt. Mr. Collins, in his report upon this article, gives the import of East Indian caoutchouc into London as 1,347 tons from June 1871 to June 1872. It is obvious that there is vast room for improvement in the collection of the juice, and the treatment of the trees, as well as in the manufacture of the material, and in organising the method of production.

CORRESPONDENCE.

EDUCATIONAL CONFERENCE.

SIR,—The report of the Educational Officer of the Society, Mr. Critchett, and the proceedings of the Educational Conference are of such interest and importance that they are sure to attract attention.

What strikes me is, that the examinations are now producing results strictly in harmony with the objects of the Society for the Encouragement of Arts, Manufactures, and Commerce, and particularly with regard to the commercial and technological departments. We must particularly concur with Mr. Critchett in satisfaction that arithmetic, book-keeping, and French are among the chief subjects. The increase of students in German and Spanish is also matter of great gratification. At the same time, Mr. Critchett's report is just that the *vivâ voce* examinations in modern languages are making no progress. Commercial correspondence, as our German examiner points out, is of particular value, but foreign correspondence is of most value to the commercial clerk at home. What we particularly want is, to train our commercial agents and workmen, so that they may take a more active part in maintaining our trade abroad, and this must be done by conversation.

As to Italian it is useful, but we need not regret its low place so far as our interests are concerned, or the neglect of Russian and the Eastern languages. On all grounds the study of Russian is of value, and I shall be happy if some efforts I am now making may promote the establishment of a professorship of Russian.

Mr. George Potter will render another useful service, if he will call the attention of the working-classes to the study of modern languages. This is a subject quite within their compass. I have found many engineers in the Arsenal at Constantinople speaking Turkish better than our merchants, and many a working man from South America speaking Spanish readily. To my mind Spanish is more useful to a working man than French or German, and its knowledge would be a good resource in a time of slack work. In the same way, Russian, Arabic, and Portuguese, are specially available. The demand for working men in Turkey, is, however, falling off. Many a man has been taken in as a partner or set up in a factory on account of his knowledge of the language of a country. It is a resource which enhances the value of his handicraft and protects him against competition.—I am, &c.,

HYDE CLARKE.

32, St. George's square, S.W., July 3rd, 1875.

Sir,—Will you allow me to correct an error that occurred in last week's impression? On line 2, right-hand column, page 730, for "Der schulmässige Kaufman," read "Die Schule des Kauffmanns," Otto Wigand, Leipsic. The work by Thomas Twining, Esq., also referred to, is "Technical Training," Macmillan and Co. It may be found in the library of the Society of Arts.—I am, &c.,

John Yeats.

7, Beaufort-square, Chepstow,
July 5th, 1875.

THE PATENTS FOR INVENTIONS BILL, 1875.

Sir,—On behalf of the Artizans and Inventors' Patent Bill Amendment Committee, meeting at the under mentioned address, formed for the purpose of securing amendments in the Patents for Inventions Bill, 1875, I beg to send you the substance of the resolution which the committee have adopted, showing the objections they take to the Bill in its present shape.

The committee consists of inventors, and persons professionally and commercially engaged in devising and practically applying new inventions; and, therefore, directly interested in the commercial prosperity of the United Kingdom.

The Bill bears evidence of an attempt to do justice to the interests of the inventor and the public, yet it contains many provisions which, while they must prove highly injurious to artisans and inventors of small pecuniary means, as tending to debar them from obtaining any material benefit from the efforts of their ingenuity, will be most detrimental to the public welfare, as such provisions will in various ways discourage the improvement of our useful arts and manufactures.

The objectionable provisions in the Bill are the following:—

(*a*.) The requirements of the deposit of the full specification as the very first step in obtaining protection for an invention, the effect of which will be, that until an invention is complete in all its details, no protection will be obtainable, nor advice or assistance to be had in regard thereto, without jeopardy; which requirement will also entail on the inventor the payment at the very outset (subject to the chance of loss if the application be rejected) of a considerable sum of money for costs of specification; matters of very great importance not usually effected without the employment of professional assistance, unobtainable except at some considerable expense.

(*b*.) An examination before the grant of letters patent, which will be highly objectionable, inasmuch as it will form the groundwork for rejecting an application for a patent "by reason of the frivolous character of the invention rendering it not worthy of a patent," a matter no man, nor any set of men, can with any certainty be capable of deciding; as what may appear to be frivolous to one person will seem of importance to another; and, moreover, as this proposed examination is to take place before the invention has been practically tested in the workshop, or in actual industrial use, the decision must necessarily be arrived at upon very insufficient data.

It is desirable that there should be an inquiry into novelty previous to the issue of letters patent based upon the examination of prior specifications of patents, public documents, and publications, or upon sufficient evidence offered by legitimate opponents. But the extension as proposed of such inquiry beyond novelty cannot prove otherwise than absolutely mischievous, as discouraging inventors, and therefore injuring the public.

(*c*.) The provisions of the Bill for shortening some patents to seven years' duration; in the vast majority of cases fourteen years being, as experience testifies, not too long. It is, however, submitted that if it be considered desirable, to meet the case of minor inventions (such as some of those now registered under the Utility Designs Act), to allow short patents for seven y[ears] to be taken (with the chance of renewal if the pr[oper] authority allows the same); this might be effected [by] offering the option of sueing out such short patents [at] one-half the stamp duties at each and every st[age], beginning with the application, which would ind[uce] very many inventors to apply for the shorter term patent.

(*d*.) The provisions as to forfeiture of patent for n[on-]working of the invention within two years from its d[ate], and as to compulsory licences, are very mischievous, a[s] no possible excuse exists for such enactments, exc[ept], perhaps, applicable to cases where a patentee is pr[oved] to be abusing and misusing his patent rights [and] privileges, and such cases are so rare that they [are] practically no evil.

Further, the Bill requires amendment in its provis[ions] generally, and especially as regards the power given [to] the Commissioners to make rules "prescribing [and] regulating *(inter alia)* the deposit of models in s[uch] cases as they think fit," as this would enable the Co[m]missioners to call for models whenever they please, [and] thus entail a heavy burden on inventors, accurate m[odels] not unfrequently entailing the cost of £100, or [even] larger sums of money. Therefore the deposit of mo[dels] should not be compulsory in any case.

The committee regret to find the Bill does not pr[ac]tically reduce the Government charge for a patent, wh[ich] is greatly needed by artizans and inventors of s[mall] pecuniary means, who constitute the great majority [of] the inventors of this country, and who have for y[ears] past been complaining of the high scale of stamp d[uties] imposed on patents in the United Kingdom; and if t[he] Bill now before Parliament is not so altered as to al[low] provisional protection on deposit of a provisional spe[cifi]cation for a sum of money not greater than £1, as w[ould] be preferable, the first step to protection of an inv[ention] should at all events be very cheap.

In regard to the Government dues on letters pa[tent], there is no valid reason whatever why the cost of s[ecur]ing the right to obtain remuneration for devising [and] developing an invention should amount to many po[unds], whilst the right to remuneration for literary w[ork] under the Copyright Acts does not amount to ma[ny] shillings. Copyright, moreover, unlike patent-ri[ght], not being limited to fourteen years, but extending [to] forty-two years certain, and even exceeding that t[erm] in case the author lives longer. As artisans and wo[rkers] on behalf of industrial progress, the committee feel t[hat] an injustice is done them by heavily mulcting th[em] because their brain-work relates to our industrial p[ro]gress, which would not be the case if it related to [ar]tistic progress or literary work, and the Bill ought [to] be amended, so that all stamp duties be much smaller [in] amount, especially the stamp duty payable at the f[irst] stage.—Yours, &c.,

Thomas Patterson, *Chairman.*
Graham Carttar, } *Joint Hon.*
Thos. Mottershead, } *Secretaries.*

14, Clement's-inn, Strand, W.C.,
June, 1875.

PRESERVATION OF PLASTER CASTS.

Sir,—The thorough saturation of plaster in m[elted] paraffin will, I have reason to believe, preserve it f[rom] the weather in this country. An example so treated [by] me lay for some years on a marble block in my gar[den] here, in the open air, and remained uninjured. On th[e] occasion, a good many years since, of a fancy fair f[or] the benefit of the Female School of Art, connected w[ith] South Kensington, I contributed several specimens [of] small art works thus treated. This application [of] paraffin to plaster works of art was subsequently to th[is] tried on a larger scale at South Kensington, without however any consultation with me, but from the want of proper treatment it resulted in failure. The example

I have, and am ready to show, are apt to get rather too yellow, like yellow ivory, but my friend Mr. G. F. Wilson, F.R.S., who obtained the paraffin for me in the first instance, tells me he thinks that if it were quite pure it would retain its colour.

The mode of saturation is no secret, as it is similar to that employed in the saturation of plaster casts in stearine.

I am, &c.,

JOHN BELL.

18, Douro-place, Victoria-road, Kensington, W.,
June 12, 1875.

P.S.—The paraffin hardens the plaster so much that the nail will sarcely scratch it. It increases its weight considerably, and gives it an appearance approaching transparency, like ivory, and preserves it in repeated washings.

RUSSIAN TRADE IN CHINA.

SIR,—As a subject which concerns the Society for the Encouragement of Arts, Commerce, &c., I would beg to draw the attention of the Council to a report in the *Moscow Gazette** of a meeting of Russian merchants, held for the purpose of discussing the subject of a memorandum on the Russian trade in China laid before his meeting by Mr. Skatchkof, Russian Consul-General in China.

I have been advised by my friends at St. Petersburg, that Mr. Skatchkof, bearing an introduction to me, is about to visit London, and as he probably intends, while in England, to inquire into the condition of our China trade, it may be as well for our mercantile and manufacturing firms to be made acquainted, through the Society, with the statements which he has made at Moscow, and with the decision arrived at in the matter of the Russian trade in China by the body of Russian merchants and manufacturers.

Mr. Skatchkof pointed out that Russian cloths, peltry, and cotton goods, found a very bad market in China, a circumstance which he attributed to the far too superior quality of the goods and to their high price. He proceeded to explain that civil and foreign wars having impoverished the people, they could not now afford the luxuries of former times, and the costly Russian manufactures were therefore beyond the reach of the bulk of the population.

The other circumstances militating against Russian trade in China are the very limited importations of Russian goods, and the English competition, which not alone studies the tastes and the means of the natives, but which also resorts to a device as injurious to the Russian trade as it is in my mind discreditable, if true, to the fair name and reputation of English commerce.

It has been more than once asserted in print by Russians, and it is repeated by Mr. Skatchkof, that English merchants affix Russian marks to their goods, disposing of them by that means more freely owing to the Chinese predilection for goods (cottons and cloths) of Russian manufacture.

It has, moreover, been stated that under forged Russian marks British merchants palm off upon their Chinese customers British stuffs of such bad texture and with such great (concealed) defects, that the Chinese are becoming aware of the imposture, and regret the scarcity or absence in the market of Russian goods of the same prices, and the absolute necessity which they are under of taking what is forced upon them by the English.

I have seen these statements contradicted, and the tables even reversed against the Russians, but, as an Englishman, I can no longer keep silence on a subject which so frequently comes under my notice, and on a statement so authoritatively made by the Russian Consul-General in China.

In bringing it to the notice of the Society, I would seek for an equally authoritative denial of the allegations.

It has been determined by the Russo-Chinese merchants and manufacturers to try conclusions with British merchants in China, by sending out, as a venture, to Hankow and Tientsin (whether overland *via* Kiakhta, or by sea *via* Suez, I am unable to say), an assortment of cotton goods (printed) to the value of from £2,000 to £3,000, manufactured after certain Chinese patterns, and of an inferior quality to suit Chinese tastes and means, and it is confidently expected that they will meet with a more formidable demand than the productions of English manufactories, while at the same time it is calculated (by the merchant manufacturer, Mr. Morozof, of Moscow) that the Russian manufacturers can earn a profit of 16½ per cent. on such piece goods above that made by English manufacturers.

Furthermore, the Russian merchants believe that they could successfully compete with England by developing direct relations with America in the matter of their cotton supply.

The contents of my letter may interest many of our chambers of commerce, and if ultimately found worthy of any special notice by them, this communication to the chambers, through the Society, will be a matter of great gratification.—I am, &c.,

ROBERT MICHELL, F.S.H., F.R.G.S., F.S.S., and Fellow of the Imperial Russian Geographical Society.

June 18, 1875.

* Vide also "Journal de St. Petersbourg," 1-13th June, No. 144.

INDIAN AGRICULTURE.

SIR,—Most of the statements made in a paper on Indian agriculture, recently read before your Society by a Mr. Elliot, formerly a planter in Mysore, are so incorrect and misleading, that I request the favour of being allowed to prepare a paper on Indian agriculture, to be read before your Society, with the view of affording the English public an opportunity of judging how far Mr. Elliot's opinions can be trusted.

I may mention that I am now at the head of the Agricultural Department of this Presidency, and that I have resided nearly seven years in the plains of Southern India, directing agricultural experiments. I was for some time the editor of the *Agricultural Gazette* of India. I hold the diploma of the Royal Agricultural College, Cirencester, and had a very considerable experience in agriculture before I came to India. At the time I left England I was a member of the Royal Agricultural Society of England, the London Farmers' Club, the Central Chamber of Agriculture, the North-East Agricultural Society of Ireland, the Chemico-Agricultural Society of Ulster, the Newcastle Farmers' Club, &c. I have read papers before the Maidstone Farmers' Club, the Newcastle Farmers' Club, and frequently before the members of the Chemico-Agricultural Society of Ulster. I have also acted as a farm judge for the North-East Agricultural Society of Ireland. For some time I was agent on the Irish estate of the Right Honourable the Earl of Dufferin, and was employed by Lord Dufferin for some time in preparing evidence, gathered on the spot, regarding the state of agriculture in the South-West of Ireland, in view to the preparation of the Irish Tenant-right Act.

I would refer you to the Principal of the Royal Agricultural College, Cirencester, to Professor Wrightson, to Professor of Agriculture at the Royal Agricultural College, to J. Coleman, Esq., late Agricultural Professor at the same college, now agricultural editor of the *Field*, and agent to Lord Wentlock: to Dr. Voelcker, consulting chemist to the Royal Agricultural Society of England; to Alderman Mechi; to J. C. Morton, Esq., editor *Agricultural Gazette*; to Dr. Hodge, Professor of Agriculture, Queen's College, Belfast, and to many others if requisite. In the

meantime I send by book-post a few of my reports, which I beg may receive your earnest attention.

We are certainly not doing anything like what we should do, but this is from the small means at my disposal, only about £3,000 per annum for the whole Presidency, the Government land rent of which is about five and a half million pounds per annum; certainly a wretched return against such a rental. To deal with the agriculture of a country, with a population of about thirty millions, nearly all agricultural, we are allowed three thousand pounds per annum! while in England the Kew-gardens alone get, I believe, a State grant of £20,000 per annum.

What we really want in this country is, systematic instruction in agriculture such as is given in Germany, France, America, and in Ireland. We must begin with the sons of our cultivators; the present race of cultivators are too superstitious and ignorant to follow any example, let it be ever so good.

You will, I think, understand that I have written thus far in my private capacity, and not as a Government official.—I am, &c.,

Will. R. Robertson.

Government Farms' office, Sydapet,
13th May, 1875.

GENERAL NOTES.

Instruction in Music.—On the 29th ult., by permission of the Council, M. Rahn, Professor of Harmony, gave a lesson illustrative of his method of teaching the theory of music, in the Great Room of the Society. M. Rahn's object is to put the elementary facts of harmony in such a form as to render them intelligible to the youngest learners, and thereby facilitate the acquisition of accurate musical knowledge as well as mechanical facility. The success which has attended his endeavours in Paris has induced M. Rahn to visit this country for the purpose of making his method known here, and he proposes to publish a translation of his work, explanatory of the method which he adopts, accompanied with a key for the use of English teachers. M. Rahn commenced by saying that the usual way of teaching music is to guide a pupil in the manipulation of the key-board. This, however, is often dull, uninteresting work, and it is possible to make the acquisition of music much more interesting by an explanation of principles. These principles are really easy to learn, and exercise in them forms quite a game for children. There is a certain mixture of notes which pleases the ear, which we call a consonance or concord, and there is a mixture which we call a dissonance or discord. We perhaps cannot fully explain why this is, but there are the facts; some notes sounded together give pleasure, others give pain. It is very easy to reduce to a system what these mixtures should be to produce pleasure to the ear, and it is a simple matter for a person who has no idea of music in any way to improvise a melody that shall be pleasing by following a system so arranged. Many people find out empirically what sequences of notes and what chords are pleasing. They allow their fingers to wander over the key-board of a piano, and if the memory is good they soon learn what is pleasing. Beginning with such a simple thing as following C, E, G, or D, F, A, all up the key-board, or striking either set together as a chord, it is noticed a pleasant effect is produced. Reference was then made to a diagram, showing the notes in succession marked on the five lines. He showed that in a chord there are some notes which must be counted in thirds, a chord of consonance being obtained from a series of thirds one above another. The notes between the thirds if struck together with any of them formed a dissonance. In constructing a melody four full-time notes should be used, though short-time notes would answer if immediately followed by one of the thirds. M. Rahn illustrated his system by starting a note, and then asking one of the audience to name a third and a note between. By this means a melody was composed entirely by the audience, and the lecturer sat down and played it on the piano. At the conclusion of M. Rahn's address, a vote of thanks was moved in complimentary terms by Dr. Stainer.

Aquarium in London.—The buildings for the new Aquarium in Westminster are rapidly progressing. The dimensions of the Aquarium will be about 600 feet long by 240 feet in depth at the widest part. The building will be in the classical style, constructed of red brick and Portland stone, with an arched roof of glass, it will be two stories in height, and will contain in the basement a central tank of salt and fresh water, holding 600,000 gallons; this will be kept in constant motion and made to pass continually through a series of smaller tanks, by the action of a steam engine destined to work both day and night. It is expected that by the incessant action of machinery, the salt water—which in the first instance will have to be carried to Westminster in small tanks by railway and by barge—will be kept fresh for ten years, even if not renewed by additional supplies from time to time. It is stated as a matter of fact and experience that the salt water in the tanks of the Aquarium at Hamburg is found to be quite pure at the end of 12 or 13 years. On the ground floor at the eastern end will be a large vestibule or ante-chamber, to be called "the front room," leading to the central hall or promenade. It will contain a series of table tanks to hold the smaller fish, the zoophytes, sea-anemones, &c. In the promenade, which will be [illegible] feet long, will be ranged seats for visitors, groups of statuary and two large fountains. On the north side of the hall will be an organ and a large orchestra, 60 feet deep, capable of containing a thousand performers. At the western end will be a smaller concert-hall, suitable for musical entertainments of a more select kind. It may be added that the entire roof will be of glass, arched like that of the Crystal Palace, but constructed on a plan quite different from the "ridge and furrow" system of Sir Joseph Paxton, no putty or other composition being used to cement it. Suggestions have been made that the new "toughened glass" should be applied to this purpose, but there is no possibility of the requisite quantity being made. In connexion with the main building there will be rooms for private concerts and for the delivery of popular lectures on matters relating to science and art, and to other subjects of general interest. The ceremony of laying the first stone is to take place almost immediately, and the building is expected to be finished by the end of the year.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Ure's Dictionary of Arts, Manufactures, and Mines. 3 Vols. By Robert Hunt, F.R.S., assisted by F. W. Rudler, F.G.S. Presented by the Publishers, Messrs. Longmans.

Catalogue of the London Library. By Robert Harrison. Presented by the Library.

Reale Instituto Lombardo di Scienze e Lettere. Rendiconti. Series 2. Vol. 6. Presented by the Institute.

The following have been presented by the Author, A. de la Malarce:—

Moyens d'assurer et de développer les Caisses d'épargne d'après l'expérience de l'Angleterre, de la Belgique, de l' Autriche et de la France.

L' Organisation Administrative des Caisses d'épargne en Angleterre, en Belgique, en Autriche, et en France.

Les Caisses d' épargne en Angleterre et en France après la guerre.

Les Caisses d'épargne scolaires et les Penny-Banks.

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FRIDAY, JULY 16, 1875.

Communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

MUSICAL SCHOLARSHIPS OF THE SOCIETY OF ARTS.

It is proposed to form a fund, to be subscribed among the members of the Society of Arts, for the purpose of establishing scholarships open for competition among qualified persons nominated by the Society for examination in such competition. Members willing to make donations or give subscriptions in aid, are requested to communicate with the secretary.

DEPUTATION TO THE SEYYID OF ZANZIBAR.

It may be observed, that in consequence of the proceedings of Sir Bartle Frere in obtaining the suppression of the slave trade in Zanzibar, it seemed desirable to promote legitimate commerce, in order to supply the void. This was one of the principal circumstances which led to the formation of the African Section of the Society, and Sir Bartle Frere opened the Session, Major E. Smith, now Acting Consul-General in Zanzibar, having undertaken to read the first paper. Although the active proceedings of the Section have as yet been chiefly directed to West Africa and South Africa, the East has never been lost sight of, and the means of developing its commerce have been discussed in the meetings of the Committee. On the arrival of the Seyyid of Zanzibar in this country it appeared to the Committee, and the recommendation was supported by the Council, that an address should be presented to his Highness on the important matter of the commerce of his dominions. In accordance with this resolution, on Tuesday last a deputation from the Society waited on the Seyyid, in order to present him with an address. The deputation consisted of the following gentlemen :—Lord Alfred Churchill (Chairman of the Council of the Society), Mr. Andrew Cassels, Mr. Hyde Clarke, Major-General F. Eardley-Wilmot, R.A., F.R.S., Mr. W. Hawes, F.G.S., Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Mr. Seymour Teulon, Col. A. A. Croll, Mr. P. Graham, Mr. J. Heywood, F.R.S., Mr. E. Lawrence, Lieut.-Col. A. Strange, F.R.S., Mr. E. Brooke, Mr. W. Fitzwilliam, Colonel Harley, C.B., Col. F. Gawler, Mr. T. A. Rochussen, Consul J. Petherick, Mr. F. Hendriks, Gen. C. P. Rigby, Mr. T. Briggs, Mr. T. C. Chown, Mr. W. Maitland, Dr. Mann, Colonel Hardy, Mr. Le Neve Foster, and Mr. H. T. Wood.

LORD ALFRED CHURCHILL read the following address :—

To his Highness the Seyyid Bárghash bin Sa'id, Sultan of Zanzibar.

We, the Society for the Encouragement of Arts, Manufactures, and Commerce, avail ourselves of your Highness's permission to lay before you our cordial congratulations on the auspicious event of your Highness's visit to our shores.

We desire respectfully to draw the attention of your Highness to the fact that this Society is formed of 4,000 members, who are associated together for the purpose of promoting Arts, Manufactures, and Commerce throughout the world, and that there is one branch of the Society which is especially charged with carrying out this object on the Continent of Africa.

It is with deep gratification that this large and ancient Society has seen the enlightened efforts your Highness has made, and is still making, to promote commerce, trade, and civilisation in your Highness's dominions, and it thoroughly appreciates the difficulties which your Highness has had to overcome in this great work; and it earnestly hopes that your Highness's visit to our land, and personally viewing the effects which have been produced in it by the cultivation of intelligence, industry, and trade, may strengthen your Highness in the further pursuit among your own people in Zanzibar of the same elevating and civilising influences.

In the desire that your Highness may be permitted to spend many happy years in the prosecution of this excellent work, and that you may be able to look back through a lengthened space of life with unbounded gratification to your Highness's visit to this land, the Society of Arts now lays before you this address, and hopes that you will accept it as an expression of its respect and esteem for the person of your Highness, and as an assurance of its interest in the advancement and welfare of your Highness's kingdom and people.

Sealed with the Society's seal this Fifth day of July, 1875, in the presence of

ALFRED CHURCHILL, *Chairman of Council.*
P. LE NEVE FOSTER, *Secretary.* (L.S.)

The following translation of the Sultan's reply was then read by DR. BADGER :—

To the Honourable Members of the Society for the Encouragement of Arts, Manufactures, and Commerce.

We thank you heartily for your kind congratulations, and for the honour which you have conferred upon us thereby.

We have been informed of the useful objects of your Society—objects which conduce to the happiness of mankind. You have a wide though still uncultivated field for the exercise of your praiseworthy zeal in the continent of Africa, and we sincerely trust that you will not overlook that part of it comprised within our dominions, and we promise you our cordial co-operation.

We need hardly say that we have seen some of the wonderful triumphs of Arts, Manufactures, and Commerce

in this great country, and we shall do all we can to promote them among our own people.

Your kindly wishes for our prosperity and happiness are extremely gratifying to us, and we heartily reciprocate them, bidding God-speed to all the members of the Society, and to its meritorious efforts to add to the welfare of the world at large.

Written in the protected city of London the 9th of Jamâdu'-l-Akhin A.H. 1292 (13th July, A.D. 1875).

(Signed) BARGHASH-BIN-SAID.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A meeting was held on Friday last, July 9th, at the Mansion-house, under the presidency of the Lord Mayor, for the purpose of establishing free scholarships for the City of London and the Metropolis, in connection with the National Training School for Music. Amongst those present were the Lady Mayoress, Lord Alfred Churchill, Mr. and Mrs. Freake, Mr. Samuel Morley, M.P., Sir John Bennett, Mr. Charles Barry, Mr. Joseph Causton, Master of the Skinners' Company, Sir Thomas Dakin, Sir Henry Cole, K.C.B., Mr. Monkland Barnard, Master of the Mercers' Company, Mr. J. Coysgarne Sim, Master of the Merchant Taylors' Company, Mr. John Howell, Mr. Frank Morrison, Mr. Sheriff Shaw, Mr. Deputy Fry, the Rev. G. C. Bell, Mr. Warren de la Rue, Mr. Le Neve Foster, Mr. L. Benson, Mr. C. Morley, &c.

The Lord Mayor, in commencing the proceedings, alluded to the efforts which had been made for many years by the Society of Arts to establish a training school for music, to the recent meeting at Marlborough-house, under the presidency of his Royal Highness the Prince of Wales, the President of the Society, and to the munificent donation by Mr. Freake of the building, which he had previously offered rent free for five years to the school. About 70 free scholarships had already been promised, and it did not seem very much to ask the City of London and the metropolis to provide 30 or 40 more, the school would then be able to commence operations with a fair probability of success. The committee appointed after the meeting at Marlborough-house had held several meetings, and drawn up a brief report, which he would call upon the honorary secretary to read.

Mr. Lionel Benson then accordingly read the following report:—

"1. A National Training School for Music has been founded in proximity to the Royal Albert Hall. The building, which has been most generously presented by Mr. C. J. Freake, member of the Council of the Society of Arts, is nearly finished. It will accommodate at least 300 students, who will receive free education in music at a cost of £40 a-year for each student. About forty-five free scholarships for five years have been already promised, through the exertions of the Society of Arts.

"2. The school will open when 100 free scholarships have been obtained.

"3. The special object of the meeting at the Mansion-house on Friday, the 9th July, 1875, at two o'clock, is to promote the establishment of free musical scholarships for the City of London and the metropolis, of the value of £40 a-year for each student, and to obtain funds, as a capital for starting the National Training School at as early a period as possible.

"4. Her Majesty the Queen has signified her gracious intention of founding a scholarship; his Royal Highness the Prince of Wales, K.G.; his Royal Highness the Duke of Edinburgh, K.G.; her Royal and Imperial Highness the Duchess of Edinburgh; the Lady Mayoress; Mrs. Freake; the Mercers' Company of London; the Fishmongers' Company of London; Sir Titus Salt, Bart., Mr. C. M. Campbell, M.P., for North Staffordshire; Mr. Frank Morrison, for Inverness; Sir John Hawkshaw, for Sussex; Mr. S. Morley, M.P., for Nottingham and Bristol; Mr. Charles Morley; Mr. Kurtz, Liverpool (two scholarships); Mr. Benson Rathbone, for Liverpool; Mr. James L. Bowes, for Liverpool; Mr. W. J. Beale, for Birmingham; Sir William and Lady Armstrong, for Northumberland; Mr. and Mrs. Andrews, for Northumberland; Major Carpenter, and others, have all signified their intention of founding scholarships. Northumberland, Manchester, Birmingham, Bradford, Leeds, Liverpool, Ashford, Halifax, &c., have appointed local committees, and from these places about thirty scholarships have been already promised. The school fee will be £40 a-year, without maintenance.

"5. It is requisite to form a capital fund for providing furniture and fittings for about thirty rooms in the school, and instruments, for which purpose donations are wanted. It is estimated that about £3,000 will be required.

"6. The Lord Mayor for the time being to be a member of the Committee of Management, and it is suggested that for every ten scholarships subscribed for five years in the City and metropolis a representative should be elected on the Committee of Management by the subscribers.

"7. The scholarships founded by the livery companies may bear the names of the respective companies which found them, be it so desired."

Mr. J. Coysgarne Sim (Master of the Merchant Taylors' Company) moved the first resolution. He said the livery companies and the Corporation of London had shown every disposition to introduce modern subjects in all schools under their charge, in addition to classical and grammatical education, which had always to be provided for, and he did not know of any branch of modern instruction more likely to be useful than music. His own love for music had grown from his earliest days, and though he had for a long time past been obliged to forego the practice of it, he still felt that the intercourse which in former days he had enjoyed with the old masters of the great schools of music, and among them those old English masters who had left valuable works behind them, had been very beneficial to him. The ladies whom he saw present were no doubt familiar with the great works of the German and Italian composers, and he was bound to say that the foreign schools were, educationally considered, far superior to anything in England, but this deficiency was now about to be supplied. He thought music must be looked upon as one of those educational requirements of the present day, when there were so many of the rising generation amongst the educated classes who were seeking an honourable means of livelihood. Considering that this movement had the support of the Royal family, and that the schools of music at present existing for the purpose were quite inadequate to the growing wants of the community, he had no doubt the project would meet with a cordial reception in the City of London, and that they would all recommend it as widely as possible amongst their fellow-citizens. It was proposed that the name of any of the livery companies which established scholarships should be attached to them, but of course there would be no power to interfere with the regulations of the school, or to nominate any candidate who should not be able to satisfy the conductors of his ability to profit by the instruction offered. He begged to move:—"That this meeting cordially supports the resolution moved by his Royal Highness the Duke of Edinburgh, seconded by the Archbishop of Canterbury, and passed unanimously at Marlborough-house, on the 15th of June, to the effect that a general

committee should be formed to establish free musical scholarships in the City of London and the metropolis."

Mr. Samuel Morley, M.P., seconded the resolution. He had no doubt that the arrangements of the school would be such as to facilitate in the greatest possible degree the acquisition by those who showed a taste for music the means of cultivating that taste. He had no belief in any attempt to enforce on people a taste which did not exist, but he had seen something himself in Germany of the real domestic happiness created by the power of part-singing in the cottages of the poor, and he would much rejoice to see an impetus given in that direction in England. There were in London numbers of dancing saloons and other deteriorating influences to which young people of both sexes were attracted largely, and he should be very glad to see something done through the agency of music to provide higher occupation and sources of gratification. He should like to see a piano in every house of business, though perhaps the suggestion might cause a smile. In his own house of business they had a considerable musical class, and he should be glad to see some of its members attracted to the teaching of this school of music, so that they might more largely benefit from that which was already a great source of gratification. He understood that these scholarships were to be founded in the first instance for five years, and that those who subscribed £40 per annum for that period would have the opportunity of sending up an individual, who on giving proof of a sufficient amount of ability to justify his or her being admitted to the class school, might perfect that which was begun, and thus obtain what in some cases would be an honourable means of support, and in all a great source of personal enjoyment. He intended to establish two scholarships, one for Nottingham, and one for Bristol, to be placed in the hands of a committee in each case, who would select the pupils, subject to the approval of the London committee. He earnestly believed that this institution might be made the means of national progress in the highest sense of the term, and he was anxious that music classes should be established in every school, even the lowest. After congratulating his friend Mr. Freake on his generous gift of the school building, he expressed in conclusion his belief that this was an undertaking in which City men and City companies might very properly associate themselves.

Mr. John Howell, as an old citizen, having been in business in the City for fifty years, desired to support the resolution. The happiest hours of his life had been those which he had devoted to the study of music, an art which had been somewhat underrated in this country, and its development was perhaps rather difficult in so large and complicated a social community, but it might be accomplished, if public attention could be properly aroused to its importance. Opportunities for practice were not very great, and it was therefore of great importance that parents should see their children taught music at an earlier age than usual; it was only in early life that the great difficulties of manipulation could be conquered, and he believed it would be much better if, instead of girls being always taught the pianoforte, they were more frequently instructed in the violin, the emotional instrument *par excellence*, and therefore especially suited to women. The pianoforte, on the other hand, was the interpreter of the most abstruse profundity of music. If the public looked at the subject with a larger mind, and promoted the cultivation of music, England might hope to take rank with Germany and Italy, not, perhaps, in musical genius, but in the cultivation and refinement consequent on its development. Having been a lover of music for the last 50 years, he went to it every morning before breakfast, and enjoyed it so much that he was anxious for his fellow-creatures to participate in the same blessings.

Mr. Sheriff Shaw said he believed there was a close connection between music and commerce. It was a well-known fact that nowhere in England was part-singing more largely developed than in Lancashire, and even at the time of the cotton famine, when the people were almost starving, they still continued their practice of singing glees and madrigals, and this no doubt largely tended to mitigate the sufferings they had to undergo. At the present moment there was a large extention of music in the Cleveland iron district, with the very best results; it was found to be a great antidote to intemperance, and a moral and intellectual benefit in every point of view.

The Rev. G. C. Bell (Head Master of Christ's Hospital) said that music, both vocal and instrumental, was cultivated to a considerable extent in that establishment, and their experience was that it had a great effect in refining and civilising the boys, whilst it did not in the least interfere with the other branches of education; on the contrary, some of their scholars who had afterwards taken high honours at the Universities, had been the most valued members of the choir and the band. It was constantly a source of regret to see those who had shown considerable musical aptitude passing off into commercial life, and perhaps hanging up their harps for ever, for want of opportunities of practice; he therefore hailed with great satisfaction the establishment of an institution which should give a general stimulus to the cause of musical education, and also provide a congenial and useful career for a certain number of those to whom God had given especial musical talents. He was glad to say that the governors of Christ's Hospital were proposing to enlarge the scope of their operations by increasing the girls' school, and he hoped hereafter that many of their pupils, both boys and girls, would be able to take advantage of the scholarships about to be founded by the liberality of the citizens and companies of London.

The resolution was then put and unanimously carried.

Mr. Monkland Barnard (Master of the Mercers' Company) said he was glad that his company had agreed to found one scholarship, and he thought very likely, if the application had been made now, instead of two and a half years ago when the matter was scarcely started, they would have been more liberal. At any rate he hoped the other City companies would follow their example or exceed it. It had been said that England was not a musical nation, but hitherto she had hardly had a fair chance. He was glad to see that the Government had decided to encourage the cultivation of music, because it appeared that a small proportion of the Government grant was withheld unless the children could sing a certain number of songs. He begged to move the second resolution as follows:—"That the Right Hon. the Lord Mayor and the Governors of the Bank of England, *ex officio*, be requested to act as treasurers of the City and Metropolitan Fund, as well as for endowing free musical scholarships and placing the National Training School for Music on a satisfactory basis for five years."

Mr. Charles Barry (late Master of the Skinners' Company) seconded the resolution with great pleasure, as it was impossible to desire better treasurers of the fund than the Governors of the Bank of England and the Lord Mayor. The latter part of the resolution referred to placing the National Training School for Music on a satisfactory basis for five years, for those who had taken great interest in this matter, believing in the French proverb, *ce n'est que le premier pas qui coûte*, were of opinion that if a school of this kind could be fairly established it would earn so much popular favour as to be able afterwards to support itself. He ventured to hope, therefore, that so small a boon as was now asked would be at once generously conceded; indeed, seeing that 70 out of the 100 scholarships were already subscribed, he hoped that before long the whole 300, for which the institution was calculated, would be provided for. One gentleman had said that music

had not been properly attended to in England, but he could hardly concur in that view when he remembered that within the memory of the present generation England had been the home for the highest class of music, and that musical professors of the highest standing looked to England almost as the height of their ambition, and coming here they were welcomed in the most appreciative as well as in the most substantial manner. The object of the promoters of this scheme was to make native and indigenous that which was so highly appreciated in the case of foreigners. Mr. Sheriff Shaw had shown from his experience in Lancashire how easy it would be to do this with a little encouragement, and comparing the state of musical establishments and performances now with what they were some 25 years ago, it appeared that nothing more was wanting than the opportunity to take advantage of the refinements of music. Education was without doubt the burning question of the day, but it would be very unfortunate if in attending to the more solid part of education the æsthetic part of its character were left out of consideration and the cultivation of the fine arts neglected. One of these fine arts, and the one most easily applied popularly, was music, and, therefore, he hoped that the lead of the Mercers' Company would be well followed.

The resolution having been carried,

Mr. Joseph Causton (Master of the Skinners' Company) moved the next resolution, viz., "That ladies be invited to join the General Committee appointed at Marlborough-house on the 15th June, 1875." Ladies were known to take great interest in all matters connected with music, and he trusted their aid would prove very useful. He had only to add that he should have much pleasure in bringing the question before the Skinners' Company, and he had no doubt his fellow members would go with him in the matter.

Alderman Sir Thomas Dakin, in seconding the resolution, said he had much pleasure in announcing that the Lady Mayoress had promised to join the committee. He took this as the best security they could have that the invitation now given to ladies to join the committee would be cheerfully responded to.

The resolution was put and carried.

Mr. Thomas Reeve (Master of the Tallow Chandlers' Company) had much pleasure in supporting this movement, being convinced that it would tend to produce an elevating influence. The resolution which he had been asked to move, and which he did with the greatest pleasure, was, "That an Executive Committee be appointed, consisting of the following gentlemen:—The Right Hon. the Lord Mayor, Mr. S. Morley, M.P., Mr. J. C. Sim, Alderman Sir Thomas Dakin, the Rev. G. C. Bell (Head Master of Christ's Hospital), Mr. Deputy Fry, Mr. Alderman Cotton, M.P., Mr. M. Barnard, Mr. Alderman and Sheriff Ellis, Mr. Sheriff Shaw, Mr. John Bath, Mr. Joseph Causton, Alderman Sir F. Truscott, Lord Alfred Churchill, Mr. Charles Barry, Mr. W. R. Knobel, Sir John Bennett, and Mr. John Howell, with power to add to their number."

Mr. Sheriff Shaw seconded the resolution, which was carried unanimously.

At this point of the proceedings it was intimated, amid cheers, that the Lady Mayoress intended to establish a scholarship, following, in that respect, the example of her Royal Highness the Duchess of Edinburgh and Mrs. Freake. It was also announced that the Haberdashers' Company would give two scholarships, that Mr. J. C. Sim, Mr. Charles Morley and Major Carpenter would each give a scholarship, that Mr. Warren De la Rue would give £100 towards the expenses, that Mr. G. N. Hooper offered a subscription of 20 guineas to the capital fund for providing furniture, fittings, &c., and that Mr. J. Howell would subscribe 10 guineas a year for five years.

Lord Alfred Churchill proposed a vote of thanks to the Lord Mayor for calling the present meeting and presiding over it. For ten years past the Society of Arts had given their attention to this subject, but it was not until the last three or four years they had been able to do anything practical in it, when Mr. Freake came forward, and generously offered to construct a building for the purpose, and to give the use of it free for five years, an offer which they all knew he had now nobly supplemented by making a free gift of the building to the nation. There was no doubt that the cultivation of music was one of the most civilising influences possible, especially amongst the lower orders, whom it would tend to make more sober, and less inclined to give themselves to frivolous political excitements, whilst it would occupy their time and keep them from deleterious pursuits.

Sir Henry Cole, in seconding the motion, said that a great deal of the success already attained was due to the Lord Mayor. He could not be termed the pilot who weathered the storm, because there had been no storm to weather, but he had done a good deal towards steering the vessel, and he had no doubt would soon bring it safely into port. The executive committee just named would be aided by the best talent in the country, and would no doubt do credit to themselves by the selection of suitable pupils for the school. Gentlemen representing all shades of opinion on musical matters had agreed to be the examiners advising the committee of management, as, for instance, Sir Michael Costa, Sir Julius Benedict, Sir George Elvey, Professor Ella, Mr. Hallé, who was quite a leader in musical matters in Lancashire, and Mr. Hullah, whose name was so well known in connection with music. He was glad to hear that the Lady Mayoress had promised to found a scholarship, and had no doubt that many other ladies would follow her example.

The motion having been carried unanimously,

The Lord Mayor acknowledged it, and the proceedings terminated.

MISCELLANEOUS.

DRILL IN SCHOOLS.

The following letter, from a competent authority in India, has been forwarded by Mr. E. Chadwick, as exemplifying in a military point of view, the importance of this subject, which the Society has taken up in the interest of the civil population:—

My dear Mr. Chadwick,—I was glad indeed to see in the *Broad Arrow* of the 1st of May, that the question of School Drill had met with so favourable a reception at the hands of H.R.H. the Duke of Cambridge, on the occasion of the deputation of the Society of Arts.

At a time like the present when our countrymen are beginning to awake to the realisation of the utter failure for operations of war on a large scale, of their long cherished system of army organisation, it may perhaps be permitted to a soldier to offer suggestions whereby one great difficulty at least in raising a nation, absorbed as a rule in the pursuit of commercial wealth, to really effective resistance in case of sudden attack, may probably be smoothed away.

It can hardly be denied that history proves that nearly all great struggles for independent national existence have primarily arisen from the desire for extended trade, or from the jealousy which brooks no real rivalry in commerce.

It can hardly be denied that nation after nation has exemplified in the past the rule that simplicity of life and its accompanying endurance, together with the spirit of courageous adventure, spurred here by some chance-sought success, there by some great and generally felt calamity, develop an empire, the duration of which depends not so much on size and efflux of time, as on the wisdom, under Providence, of rulers in checking more or less effectually the tendency to decay of the martial spirit through luxury and its concomitants—effeminacy and enervation.

It can hardly be denied that the ever increasing commercial successes of Great Britain and her numerous offsprings are viewed with anything but pleasant feelings by other nations less favoured in the race for wealth.

It can also hardly be denied that some at least of these jealous beholders of our wealth and increasing prosperity, however peaceful at present either in truth or seeming, possess unmistakeably both the mass of population, as well as the elements of success which have raised nations to Empire over the ruin of others.

Now judging by analogy from the results of true education in boyhood, it would appear that nothing could be more calculated to instil into our youth, and thereby preserve and foster in the nation the martial spirit which won our Empire and through that our wealth, than the addition to the regular course of school and college studies throughout the kingdom, of a progressive but complete system of military drill and exercise.

National physique, health, courageous spirit of enterprise, amenability to discipline, good fellowship and comradeship between classes through mutual contact, and the knowledge of working together in the strongly impressionable season of boyhood, the germ of future manhood, towards a common end, and finally patriotism and morality would all be gainers by such a system once universally established by law. We have swallowed the camel of compulsory education already, why strain at a gnat in the way of an extra subject thereof.

Some may possibly object to the inclusion of morality in the above list of beneficial results to be expected. To these objectors it may be replied that constant bodily cleanliness, training, and exercise, combined with intellectual culture, are well-known to the medical faculty as the cure for moral ill-health, as well as the surest safeguards and conducives to moral cleanliness and health, just as much as luxurious living, sloth, and dirt are the reverse.

To compass these ends then, the following appears to be the course calculated to be most successful as well as satisfactory to the national exchequer. Large numbers of non-commissioned officers and soldiers take their discharge from her Majesty's army, and are at present very generally lost to the nation. Amongst these there can be no doubt there are many who would much prefer to continue to exercise a branch of their profession at home, provided it but paid them, to sinking into bar-keepers in pot-houses, small tobacconists, or perhaps indifferent, because long unaccustomed, workers at other trades.

It has been stated by high authority that good drills amongst non-commissioned officers (as instructors) are difficult to obtain even for the wants of her Majesty's forces. Now, good pay, or good prospects, are well-known in all professions and trades as productive of the qualifications for which they are held out. Increase of pay in the army may perhaps be considered as too good luck for all non-commissioned officers and soldiers; so we must look to enhanced value of prospects as an inducement to men to qualify as instructors in drill.

Experience would go to show that numbers of intelligent men, who would never think of joining the army under the present conditions of pay in the lower grades, would willingly do so if assured of a future remunerative income to be gained thereby at home, to which the sole avenue lay in the army itself. Indeed, the nation would be a gainer in more ways than one, by enhancing considerably the pay of a certain fixed number or per-centage of non-commissioned officers, as well as privates, who should fully qualify as drill instructors, and that with the express view of discharge after a fixed, but comparatively short term (at their own request), in order to fill the posts of drill instructors of districts of schools at home. To men thus discharged it would be money well laid out by Government to pay £25 per annum as a pensionary allowance, subject to regular efficient attendance at their work at the schools of the district to which appointed, and to general drill efficiency, steadiness, sobriety, and good character, certified by duly recognised military officers. This allowance by Government merely to be considered as a retaining fee, giving a lien to Government on their services in cases of great emergency, should be supplemented by monthly payments from all schools and colleges attended. These fees from schools to be paid through Government officers, and not direct. The payments from schools would be fairest if according to a graduated scale, regulated by the fees charged to parents for their children's education, free or endowed schools being charged a per-centage on their grants or incomes.

In order to utilise the services of these drill instructors as much as possible, without unnecessary fatigue, a number of closely adjoining schools might be brought together for instruction.

A distinctive uniform should be worn, both by instructors and instructed; by the former as a check on conduct, and by both as strongly conducive to smartness, martial spirit, and self respect.

Periodical inspection of schools at drill might easily be arranged for by officers commanding military districts and brigade centres, by deputy if not in person.

At most schools monitors in some shape exist; but in all a certain number of the smartest boys might be appointed by the head masters as officers and non-commissioned officers of companies, and instructed in their duties as such by the instructor.

The schools of a district might easily be brought together once or twice a month, at least, for brigade exercise, or might occasionally, where possible, be brigaded with volunteer or regular corps with very great advantage. Boys, from my own experience at school, I am certain would look upon such days very much in the light of a well-spent holiday, and as to the general benefit to them there can be no question. On these occasions, no doubt, it could be easy to obtain officers willing to take command as mounted officers.

A few rifles for target practice where possible, and wooden muskets for purposes of drill, would be all the paraphernalia actually necessary.

With gymnastics, swimming, and thorough instruction in drill, the boys of one generation might well become the soldiers of the next if necessary, falling into their places and duties smartly and efficiently in overwhelming numbers against a possible invader, and thus perhaps avoid the dreaded necessity of universal conscription or compulsory service.

Although, with my personal knowledge as a soldier, I can hardly feel so sanguine as to expect that high degree of discipline so necessary to a powerful army in one got together suddenly, even from a nation thus educated, still there can be no doubt, with our present voluntary army, enhanced in value as it would become by the entry into its ranks of numbers of the intelligent class of youths ready trained, and imbued with military spirit and the germs of true discipline at school, the nation would form an easily organisable reserve of serious import to the disturbers of the peace of the world.

The question being one of training a whole nation to arms in boyhood, it must be well understood that no whims of parents or heads of educational establishments must stand in the way of a great national purpose, the fulfilment of the motto, *Salus Reipublicæ Suprema Lex.*

Junius Indicus.

Baxa Bhutan, 5th June, 1875.

REPORT ON THE COOKERY SCHOOL OF ST. MARY'S, SOHO.

By J. C. Buckmaster.

According to my instructions, I visited the cookery school on Saturday, June 19th. This school is held in St. Mary's Clergy-house, Crown-street, Soho, and originated with the Vicar, the Rev. Robert Gwynne, and Mr. Thomas Blackwell, the churchwarden, and has for its object "the teaching of cookery for the poor and invalids." The school commenced on Saturday, the 23rd of January, 1875, and has continued every succeeding Saturday, working from 10 till 4. On the evening of the day of my visit, prizes, consisting of cookery books and utensils, were given to the successful pupils. The refreshments provided on the occasion consisted of six varieties of cakes, sausage rolls, jellies, blancmanges, and pressed meat, which were made by the girls in the school. The instruction has been given by one of the teachers from the National Training School for Cookery. It begins with marketing; some of the girls, accompanied by the teacher, purchase in Newport Market, or more frequently from the costermongers, what is required for the day's cooking, except such things as must be purchased at shops. There is the usual bargaining and criticism, so important in the choice and purchase of food, and the cost of everything is entered in a book. I regard this as a most valuable part of the school work. The following are copied from the book:—

"Went to market at 30 past 9, February 20th, 1875.—Two lbs. of tripe at 8d., 1s. 4d.; dripping, 4d.; two sheep's hearts, 10d.; giblets for pie, 6d.; onions, 4d.; pork for soup, 3d.; flour, 2d.; currants, 1d.; potatoes, 8d.; carrots, sage, and leeks, 3d.; total cost, 4s. 6d." On this date from these purchases eighteen persons dined.

"Went to market at 45 past 9, Feb. 13th, 1875.—A rabbit, 1s. 6d.; sheep's head, 10d.; sheep's heart, 5d.; liver, 9d.; half a pig's head, 1s.; bacon, 10½d.; odd pieces of meat, 4½d.; vegetables, 8d.; rice, 1½d.; currants, 1½d.; sugar, 3½d.; spice, 0½d.; haricot beans (a quart), 7d.; potatoes, 6d.; bread, 6d.; milk, 2½d.; total cost, 8s. 11½d." On this date twenty persons dined.

"Went to market at 10 o'clock, Saturday, March 27, 1875.—6 lbs. of Australian meat, 3s.; ½ lb. of butter, 8d.; eggs, 1s.; milk, 4d.; potatoes, 6d.; parsley, 1d.; onions, 3d.; sugar, 2d.; currants and spice, 3d.; plums, 2d.; mustard, 0½d.; salt, 2½d.; flour, 2½d.; bread, 2½d.; total cost, 7s. 6d." On this date twenty-one persons dined.

On the return of the girls from marketing, the proposed methods of cooking are briefly explained, and each girl works from a written recipe. The teacher superintends the work, pointing out any defects or errors of manipulation, and speaking when opportunity offers on the importance of forethought, cleanliness, and orderly management.

By one or two o'clock, according to the length of time occupied in cooking, the girls, with their teacher, the visitors, and the vicar and curates, sit down to dinner in the kitchen. On the occasion of my visit the dinner consisted of a soup prepared with potatoes, leeks, sago, milk, and two quarts of water, stuffed mackerel, liver and bacon, Irish stew, macaroni pudding, and gooseberry pudding. In many families one of these dishes would have constituted a meal. After dinner four girls in turn are appointed under the direction of the teacher, or one of the elder girls, to wash up and put everything in its place. In looking over the register of things cooked since the opening of the school, I find among others the following: sheep's head soup, suet dumplings and puddings, vegetable and meat soups, milk soups, stews of small pieces of meat, haricot beans, lentils, macaroni, rice, bullock's head, bullock's heart, bullock's kidney, giblet pie, cow-heel, dripping puddings, making bread, and five methods for cooking tripe. The sick or invalid cookery included the preparation of arrowroot, tapioca, mutton broth, beef tea, rice water, apple water, blancmanges, and jellies.

The school consists on an average of fifteen girls, which is rather more than can be conveniently accommodated in two kitchens having a total area of only 365 square feet, and not specially adapted for the purpose. The girls must belong either to St. Mary's or St. Ann's Schools, Soho; some of them are pupil-teachers, but the majority are elder girls of the two elementary schools. The average age is twelve years and eight months, and they pay 3d. per lesson, which includes their dinner. This payment, which only amounts to 3s. 2d. weekly, is obviously insufficient for the maintenance of such a school, and yet it was found that a higher payment at the beginning would have been exclusive. The average weekly cost of the school is 19s. 6d., leaving 16s. to be provided from other sources in one of the poorest neighbourhoods of London. A diary is kept in which the daily work of each girl is entered, as will be seen from the following extracts:—

Saturday, February 29th.

Sheep's head	E. Skeen, St. A.
"	— Norman, St. M.
Sea-pie	Edith Kemp, St. A.
"	Emily Lamborn, St. A.
Sea-pie crust	Fanny Pulsford, St. A.
"	Kate Frew, St. A.
A melt	Sarah Hoffmeister, St. A.
"	Eliza Brown, St. A.
Roast pork	Lizzie Birkett, St. M.
"	Fanny Woodall, St. A.
Harricot beans	Eliza Somerwell, St. M.
Potatoes	Miss Richards, St. M
Sage and onion sauce ..	Lizzie Wilson, St. M.
Currant dumplings	Kate Frew, St. A.
"	F. Pulsford, St. A.

Saturday, June 12th.

Pot-au-feu	Harriet Eastmead.
Bullock's heart	Mary Bower.
Rhubarb pudding	Lizzie Wilson.
Blancmange	Edith Kemp.
Maizena pudding	Eliza Griffin.
Arrowroot	Kate Frew.
Arrowroot pudding	Lucy Griffin.
Barley water	Maria Leveston.
Lemonade	Emily Lambourn.
Gruel	Harriet Collins.
Beef-tea (slow)	Louisa Baystone.
" (quick)	Amy Hunt.
" (for typhoid) ..	Alice Jane West.
Mutton broth	Ellen Rouse.
Pot-au-feu bouillon	Ellen Rouse.

Although the girls attending this school are children of the better order of working men, they were unable to do the simplest thing in cookery, nor had they any idea of the cost of various articles of food, or the proper use of common cookery utensils, but as soon as the school opened they readily gave up a greater part of the only holiday they have in the week, and began work cheerfully; they have frequently expressed themselves thankful both to the vicar and the teachers for the opportunity which has been afforded for acquiring a knowledge of simple economical cookery.

I was anxious to learn what effect this teaching had on elementary education. It would be premature to speak with positiveness on this point, but I was struck with the quick intelligent answers of the girls to questions which I proposed during their work. Instruction in the art of cookery is very analogous to a lesson on experimental physics; with what has to be thought about and understood there is always associated something which has to be done, and under an intelligent teacher, the reason of the thing is ever present in the mind of the pupil. Every lesson was followed by a

ritten examination, and the papers were corrected by e teacher and Mr. Rawnsley, of Baliol College, and arks were affixed according to their proficiency to each per. I beg to enclose some of these questions and pers.

It was on the result of these examinations that the izes to which I have referred were given. These aminations, apart from the cooking, were a useful rt of a girl's education in writing, spelling, grammar, d composition.

I am informed that the girls who passed the best amination in cookery, also passed the best examinaon before H.M. Inspector.

Every Saturday, after dinner, Mr. Rawnsley reads out ch recipe for the following week, the girls writing it wn from dictation in a book provided for that purpose. ter the recipe, the price of each article, as nearly as ssible, is given, which is also written down, and the tle addition sums are worked at once. In this way e cooking is made to help as much as possible the ementary education. The books in which these things e written are taken home, and this has greatly inased the interest of the parents in the school.

UBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the month of May and June, 875. When they are counted by sight the words by sight" are used, when by turnstile the word machine":—

	Voted in 1874	Number of Visitors. May 1875.	June 1875.	How counted.
	£			
1. British Museum*	102,442	...	...	...
2. National Gallery†	6,346	97,749	84,837	(by sight).
3. Kew Gardens and Museum	17,862	171,963	80,416	(by sight).
4. South Kensington Museum	38,024	...	66,436	(by machine).
5. Bethnal-green	5,810	...	33,954	(by machine).
6. National Portrait Gallery	1,748	...	...	...
7. Geological Museum, Jermyn-street	8,998	3,335	2,382	(by machine).
8. Patent Office Museum	1,490	21,300	15,923	(by machine).
9. Edinburgh National Gallery	2,100	7,840	10,768	(by machine).
10. Edinburgh Museum of Antiquities	...	7,804	11,404	(by machine).
11. Edinburgh Museum of Science and Art	9,824	27,791	25,186	(by machine).
12. Edinburgh Botanic Gardens	1,750	...	...	...
13. Royal Dublin Society	1,823	...	...	...
14. Dublin Museum of Nat. History	1,672	...	...	...
15. Glasneven Bot. Gardens and Museum	2,148	...	...	...
16. National Gallery of Ireland	2,380	10,146	9,676	...
17. Geological Society, Dublin	500	...	...	...
18. Museum of Royal Irish Academy, Dublin	2,084	...	...	...
19. Zoological Gardens, Dublin	...	13,506	10,588	...
20. Tower of London	2,236	35,910	31,933	(by sight).
21. Royal Naval College, including Greenwich Painted Hall	1,416	39,442	24,953	(by sight).
22. Royal Naval Museum, Greenwich	...	3,738	5,037	(by sight).

* No return. † First six months of year, 465,847.

By the report of the trustees of the Astor Library, New York, recently published, it appears that the original endowment of 400,000 dols. (£80,000), given by the late Mr. John Jacob Astor, has increased during 25 years by additional donations and investment of income to 773,300 dols. (£154,660), and that the number of volumes in the library has increased during the same period from 20,000 to 150,000. The number of readers in 1874 was 0,972, and the number of volumes consulted, 127,579. The annual cost of keeping up the library is about £3,000.

INDIA MUSEUM, SOUTH KENSINGTON.

The following account of the India Museum, especially referring to the botanical and zoological collections, is taken from last week's *Nature*:—

The India Museum, which was opened in South Kensington last month, was founded by the Court of Directors of the Honourable East India Company in 1798. In 1860 it was removed from Leadenhall-street to Fyfe-house, and in 1869 to the India-office. The galleries of the Exhibition building, in which it is now temporarily lodged, have been leased from her Majesty's Commissioners for the Exhibition of 1851 for three years. The lower gallery is devoted to raw products, and the upper gallery to manufactures. The present arrangement of the India Museum collections is to a large extent only temporary, and fulfils mainly the purpose of bringing them into view preparatory to their final classification. The preparation of descriptive catalogues will go hand in hand with the completion of the different groups.

Room No. 1 is devoted to the commercial products of the vegetable kingdom, with the mechanical appliances associated with their cultivation, collection, or preparation, and is under the superintendence of Dr. M. C. Cooke. A complete collection of these products is exhibited in small tin cases with glass fronts, which are arranged in metal frames, and suffice to give a general view of the productions of the country. Supplemental to this the principal trade articles receive special illustration in a more extended manner in central cases. As this is a new feature in the arrangement of this section, it will take some time before it can be fully and properly developed. What has been done with cotton will in part illustrate what is intended with other products. In this instance the cotton is shown from all parts of India, at first in the boll, then in the seed; afterwards cleaned, together with the seed and oil therefrom, with the waste obtained in the processes of cleaning and spinning and its economic applications. The processes of spinning are next illustrated, with the resultant twists and yarns. These are succeeded by grey and bleached cloth, printing blocks, samples of dyed and printed fabrics, and coloured yarns. Underneath these cases are arranged the agricultural implements employed in the cultivation of cotton, churkas and rollers for cleaning it from the seed, models of spinning wheels and other appliances illustrating the manipulation of cotton fibre. Above the cases are displayed drawings of the varieties of cotton plants, and of the natives at work at the different processes through which the cotton passes from the ploughing of the soil to the complete woven fabric. By this mode the whole history of the progress of cotton from first to last is exhibited at one view, or at least as much of it as could be compressed within available space. Hitherto, although agriculture, and especially its food products, has been fully illustrated, forestry has not had by any means the share which its importance demands. It is contemplated therefore to expand this new division considerably by the addition of collections of the timbers of the three presidencies and of native states, each by itself, so as to show the character of the forests in each division, accompanied by maps and drawings or photographs of the trees. The products of the forests, other than timber, will be shown collectively for the whole of India, accompanied by such diagrams, drawings, and statistical tables as may be necessary; and the fungoid pests and enemies of arboriculture will also be illustrated. Already this illustrative mode of exhibition has commenced, but will evidently proceed slowly, as diagrams, drawings, and tables will have to be constructed, and probably some of the illustrations must be obtained direct from India.

It may be remarked that cinchona bark from the Neilgherry plantations, as well as from Kangra, has the

honour of a case to itself, and it is hoped that soon another important drug recently introduced—ipecacuanha—will be represented by samples grown in India. The economic plants introduced into India must necessarily form an important feature in its trade museum. Amongst trees *Eucalypti*, the baobab, cork oak, mahogany, have not as yet produced marketable results; but tea, cinchona, senna, nutmegs, pepper, cinnamon, cloves, barley, tapioca, the Maranta arrowroot, Orleans and Egyptian cotton, with their hybrids, Carolina rice, &c., are a few of the instances in which the successfully introduced plants have added, or promise to add, considerably to the exports of India. In the development of the natural resources of so vast a region undoubtedly much remains to be accomplished. Passing through this room, a great number of such unknown, undeveloped, or unappreciated objects will not fail to impress themselves upon the attentive observer. Surely with such vast forests, and a system of conservation so steadily pursued, more ornamental and furniture woods are destined to be exported than yet find their way to the coast; and there are at least sound timbers little inferior to teak, such as *Hopea odorata* is said to be, which require only to be more widely known to be more generally appreciated. In resinous products the European markets are as yet but little indebted to the forests of India, but the copals here shown from *Hopea odorata* and *Hopea micrantha* give considerable promise. The wood oils produced by several species of *Dipterocarpus*, and the Burmese lacquer derived from *Melanorrhœa usitatissima*, might be obtained in large quantities, and yet hitherto no practical application for them in this country has been discovered. The latter is employed to a very great extent in Burmah for lacquering furniture and small wares, but it is unsuited for the English process.

Amongst the objects in this room of interest to the botanist rather than to the general public may be cited the Tabashir, a siliceous secretion from the joints of the bamboo; the curious horn-shaped galls called Kakrasinghee, produced on a species of *Rhus*; manna obtained from *Tamarix indica* in the North-west Provinces, and a kind of manna named Shirkhist from the Punjâb, attributed to the *Fraxinus floribunda*; the resin somewhat resembling Elemi, derived from *Boswellia Frereana*, which the late Daniel Hanbury considered one of the ancient kinds of Elemi, though this is disputed on good grounds by Dr. Birdwood; narcotic Indian hemp in different forms, including the Churrus or hemp resin, and various confections into which it enters; the clearing nuts which are employed by natives in clearing water, and are the seeds of a species of *Strychnos*. To which may be added the paper-like bark of *Betula bhojpatra*, used in Northern India as a wrapper for cigars; the bark of one of the species of *Daphne*, from which the renowned Nepal paper is made, and the singular natural sacks made of the bark of *Antiaris saccidora*.

The models of native implements associated with the respective "products," drawings and photographs of the mode of using them, the copious illustrations of plants from whence useful substances are derived, and especially the series of photographs of forest trees, are calculated to increase the public interest in this collection, and add to its usefulness, although these features are not yet developed to the extent or in the systematic manner which they are intended to assume.

Rooms Nos. 4 and 5 contain the zoological collections, under the superintendence of the assistant curator, Mr. F. Moore. In it are comprised the various collections of mammals, birds, insects, &c., contributed by officers of the old East India Company, whose names have been distinguished by their labours in this branch of natural history, of whom may be mentioned Buchanan, Cautley, Finlayson, Hodgson, Horsfield, M'Clelland, Raffles, Roxburgh, Russell, Wallich, &c.

Commencing with the mammals in Room No. 5, the various tribes have been so arranged in the several cases that the visitor at a glance may see the principal species in each group. From want of space, however, many of the larger species are at present precluded from being exhibited, and it is proposed to substitute photographs and other illustrations of them.

Following in order come the birds, which have also been arranged in a similar manner, each group or tribe being represented by prominent and characteristic species.

In this room are also deposited the cabinets of insects, several groups of which are provisionally exhibited in the window recesses, as well as an unique collection of Indian forest insect pests.

The tribes of reptiles and fish are shown in Room No. 4, and, though at present but few species are represented, this section will shortly be enriched by the extensive and valuable collections formed by the Inspector-General of Indian Fisheries.

Supplemental to these groups, which are arranged as a scientific series, these rooms contain an important collection of economic animal products, including an unique series of the silk-producing insects, lac, honey-yielding and gall-making insects of India, and their several valuable products, as well as groups of pearl-oysters, chanks, wools, plumes, horns, ivory, &c.

For a series of fossil and plaster casts from the Cautley and Falconer collections, as well as the collections of shells and crustacea, no cases have as yet been erected.

WATCH-MAKING BY MACHINERY.

One of the most recent improvements in the manufacture of watches consists in the application thereto of machinery, for though attempts have long been made to economise hand labour in this direction, by substituting for it mechanical power, it is only within the last few years that any success has been attained. It is clear that, as far as mechanical accuracy is concerned, the different parts of any machine can be made more true, and where many repetitions of a single part are required, more exactly identical, by machinery than by hand; but the extreme minuteness of the different component parts of a watch prevents this general fact being made applicable to this particular species of manufacture. With regard to clocks, this is, of course, not the case. As far back as 1839, as appears from a report made by M. Francœur to a committee of the French Société d'Encouragement on the "Mechanic Arts," there was at Moret, in the Jura, a manufactory of clocks, in which all the different parts were made in large numbers at once by the help of machinery, so that each clock was an exact *replica* of every other of the same class. American clocks, too, have long been made in a similar way. Nothing, however, of the same sort was for long done for the watch-making trade. Both in England and on the Continent all the separate parts of each watch are hand-made. In England, Clerkenwell and Lancashire are the head-quarters of the trade, the greater part of the wheel work being made in the latter place, while the fitting together is done in London, where also a large proportion of the other small fittings of the watch is made. That any other system of watch-making was impossible has always been the belief of the English trade; and this, no doubt, is true for the very highest branches of the art. It is only where the demand for a certain class of article is large, and where the repetition in large quantities of the same piece is possible, that machinery is available. For the best and most costly description of watches no such demand can possibly arise; nor, indeed, can it be conceived that any machinery, however skilfully devised, could meet it if it did arise. In no case can the rapid, unintelligent work of a machine compete with the best skilled human labour. This is obvious in all trades; but, on the other hand, how much better is the result of machine work than of any handicraft below the best. The machine is never careless, never slovenly, and

gh its work is never—can never be—the best pos-, it is always sure to be up to one uniform standard ellence. By the careful use of gauges, and by ally testing all the separate portions of the watch re they are put together, this standard can be raised n extremely high point, and once this is attained, uld be tolerably certain that every article produced be quite up to it.

nse it seems probable that machinery will one day py as important a place in the manufacture of hes as it does in most manufactures, and, therefore, ef account of the stage it has already arrived at may ot without interest.

has been the case with so many recent anical improvements, it is from America that development of an old trade has come. The ity and cost of labour has had precisely the influence on this as on other manufactures, and has inventors to apply their brains to the utmost to mise this, the most expensive item in the cost of ction. With what actual result as regards excel- of manufacture this has been done, only the test perience can show, and no opinion need be expressed on the merit of the wares produced. This is a question of trade which will very soon settle itself, the machine-made article can compete in the open et with the product of handicraft, there can be little t that it is better at the price. This much only be said, that there are in America several factories hich watches are manufactured on the large scale, separate piece being made by the thousand, and the plete watch fitted together all under one roof. king on such a scale as this, steam-driven machinery n absolute necessity, and this has been developed iently to enable the whole watch, or at least nearly y part of it, to be made entirely by automatic hines. The principle of thus making each part numerous duplicates, so that every piece will fit y watch of the same pattern, is the same as that oyed in Hobbs' locks.

attempt to describe in detail the numerous machines ired for the complicate and intricate operations of h-making, would of course be impossible in reason- limits. A brief sketch of one or two of those used large manufactory at Waltham, in New England, ted by the "American Watch Company," may serve ow the amount of ingenuity expended on them. For ance, the following is the method by which the brass els are made:—First they are stamped in outline from ribbons of metal. A number of the discs thus formed threaded on a fine rod and clamped together. The thus formed is placed in the tooth-cutting machine, re a reciprocating knife cuts a groove in it; the bar rned automatically a sixtieth or other portion of a , according to the number of teeth, and a second ove is cut; the process is then repeated till the re- red number of teeth is formed. For cutting the pement wheel, with its curiously formed teeth, a elaborate apparatus is required. Each tooth re- res six cuts to finish it. For this purpose the little of steel discs is fixed diametrically across a circular e, round the edge of which are six knives, each nted so as to be capable of traversing across the plate. rod is acted upon successively by these knives, ing turned radially so as to come opposite each in . When all six have operated, a single tooth is pleted, and the rod is turned on its axis to ent a fresh surface to the knives. This is con- ed till all the teeth are finished, when the apparatus utomatically thrown out of gear. The jewels are by saws of iron faced with diamond dust, into per shapes, and drilled by a wire hair covered with mond dust, all by machines. Even the screws, of ch 230 are made from a 13-inch length of steel wire waste being more than the amount actually worked , are formed by a machine which makes the thread s off the screw, makes the slot in the head, and de- livers the screw complete. About 150,000 of these screws go to the lb. troy, so that the minuteness of the mechanism may be imagined. All the rest of the watch, except only the dial, is constructed by machines of equal delicacy. The dial has to be painted by hand, though it would seem as if so simple a printing operation ought to done readily enough by mechanism.

ART OF ENGRAVING IN PARMA.

Consul Colnaghi, in his report upon the principal features of interest that present themselves for notice in the province of Parma, mentions the existence of the art of engraving which has been cultivated almost from its origin in the city of Parma. Whether the discovery of etching be due to Parmegiano, Francesco Mazzola, or to Albert Durer, it is not disputed that the former first practised the method in Italy. Mazzola was accustomed to use two copper plates, with the first printing a half tint, leaving the lights in white, and with the second applying vigorous shadows on the previous half tint. While Parmegiano became more celebrated as a painter than an engraver, the year 1523, when he left Parma for Rome, witnessed the birth of another artist, Enea Vico, whose merits induced Pietro Aretino, though not without exaggeration, to prefer him to Marc Antonio. Vico was succeeded, towards the close of the century, by Sisto Badalocchio, who, with the assistance of Giovanni Lanfranco, engraved the Loggio of the Vatican, and without help, part of Correggio's great cupola. Giulio Bonisoni and his pupil Giacomo Foga- ruoli, both of Borgo San Donnino; Giacomo da Parma, who may perhaps be recognised in Jacopo Bertoia, a distinguished follower of Mazzolo; Oliviero Gatti, of Piacenza, who was a pupil of Agostino Caracci, another great painter and engraver combined; and finally, Battista Pensier, or Panzera, a caligraphist and book- seller, whom Dolce styles an excellent worker, com- pletes the list of the principal engravers of Parma, who flourished in the sixteenth century. Smeraldo Smeraldi, the illustrious engineer, who is known to have used the burin, forms a con- necting link between the foregoing and the seven- teenth century, in which the engravers are greater in number, if not in merit, than their predecessors. The most remarkable among the twenty-five of whom there are records were:—Domenico Maria Fontana and his daughter Veronica, Angelo Falco, Mauro Oddi, Guglielmo Leoni, Don Filippo Mara, and Ugolino da Parma; to whom may be added Girolamo Imperiali, a Genoese nobleman, who studied at Parma, and became a pro- ficient in painting and engraving.

In the nineteenth century the number of engravers increased to thirty-nine, among whom were Giorgio Giacomboni, who was also a landscape and miniature painter; Giuseppe Patrini; and last, but not least, Pietro Martini. The indefatigable Prevenet, and the versatile Brisciania worked on into the nineteenth century, in the second decade of which Parma was to be no longer the home of isolated engravers, but the centre of a homo- geneous school of art. Paolo Toschi, of Parma, returned to his country about 1819, after a long residence in Paris, where Berire had taught him engraving and Oortman etching. Although yet of extreme youth, Toschi was already well known in his profession, and soon undertook or received commissions to en- grave classical works which required not only the help of his friend and colleague Antonio Isac, who died young, but the assistance of pupils who soon crowded his studio during the whole period of his teaching, to the number of sixty-five. In a few years, surrounded by talented scholars, the master was able not only to con- ceive the idea, but to commence the execution of his greatest work, the engraving of Correggio's frescoes, before time and neglect should have completely destroyed them.

The difficulties to be encountered in this enterprise, owing to the vastness of the compositions, the curved surface on which, for the most part, the frescoes were painted, the want of light, the foreshortening, the characteristic style of the painter, some of whose greatest beauties and most masterly effects are produced by means of the boldest and seemingly irregular touches, would have sufficed to check the ardour of less persevering artists than Toschi and his associates, who from long study had thoroughly imbued themselves with the spirit of the master's work. The means, however, to carry out the project were wanting. State assistance was needed, and Toschi, Director of the Academy of Fine Arts, was commissioned by the Government of Maria Louisa to copy the frescoes in water colours. He commenced the work with Professor Callegari, Raimondi, and others, and for several years the artists patiently ascended the lofty scaffoldings placed under the cupolas of the Duomo and the Church of St. Giovanni until the drawings were completed. In 1844, the circular announcing the intended engraving of the celebrated frescoes was issued. For ten years Toschi and his assistants, at one time eighteen in number, worked indefatigably, until, in 1854, when twenty-three plates were finished and twenty-two published, the master died almost suddenly. All doubt as to the continuation of the series was, however, set at rest by the disinterested acceptance, by Professor Raimondi, of the propositions of the Government of Parma, but the work languished, having the assistance of only five engravers, until, by a decree of 1860, C. Farini, Governor of Emilia, established a superior school of engraving at Parma, under Raimondi, who at the same time, for the completion of the great work, was given an increased number of salaried assistants, among whom were the Cavaliere Bigola, now professor of engraving at the Academia Albertina of Turin, and Professor Dalco.

THE COMMERCE OF TREBIZOND.

By its geographical position Trebizond is the natural emporium of all the country to the south-east of the Black Sea, and has been since the remotest times the principal route to and from Persia. Its commercial importance has increased or decreased alternately in consequence of political events, until it was entirely lost on the exclusion of all foreign vessels from the Black Sea. The revival of its importance in modern times dates from about 1830, and it has steadily increased since. There are, according to Vice-Consul Biliotti, two distinct branches of trade flowing through this town, the Anatolian and the Persian; whilst in the absence of sufficient data to form an accurate conclusion, the fact is admitted that the former has declined and the latter has increased. The opening in 1870 of the Poti-Tiflis Railway, and the construction about the same time of the Erzeroom road, have, upon a comparison of the last five years, occasioned an increase of £172,680 in favour of the year 1873. It must not, however, be inferred that the country is in a flourishing condition, which arises from the imports being always in excess of the exports, and there is no doubt that a similar state of things, by draining, little by little, as it does now, the resources of the Anatolian provinces, will lead to their complete exhaustion. In the year 1873 the value of the imports were £659,000, whilst those of the exports amounted only to £338,500, or scarcely more than half the former. Reckoning that from the transit trade with Persia a profit of £150,000 may accrue to these provinces, there is still the enormous deficit of £370,000 a-year against them upon the balance of trade.

The principal articles of export are grebe feathers, Indian corn, box-wood, nuts, tobacco, wheat. In former years the wheat required for the consumption of the town itself was imported by sea, and mostly from Russia. A few years since, the inland districts contributed their share of the supply of grain, and during the year 187[illegible] the quantities carried from the interior were such, as [illegible] only to be sufficient for the wants of the inhabitants, but also to enable the hitherto unheard of amount [illegible] 400,000 bushels to be exported. Three causes [illegible] assigned for this extraordinary increase; firstly [illegible] principally, the facility of conveyance through [illegible] Erzeroom road, although only available during [illegible] summer months; secondly, the high price fetched [illegible] Europe, and thirdly, the exceptionally available [illegible] of transport, owing to the caravans of the neighbouring province of Samsoon, where the grain crops failed, ha[illegible] come to seek employment in that of Trebizond. [illegible] exports of the Persian transit trade consist of [illegible] wool, hides, dried fruits. There seems not the slightest doubt that the Poti Railway has diverted part [illegible] latter trade, although not to the extent which [illegible] supposed. Valuable goods, silks especially, and [illegible] others, are forwarded through Poti, but the bulk [illegible] merchandise continues to find its way to and [illegible] Persia through the former road. Causes of [illegible] kinds have helped hitherto to keep the balance in [illegible] of Trebizond, but as soon as the present fortunate [illegible] bination of circumstances ceases, it is to be feared [illegible] town will sink, so far as the Persian transit trade [illegible] cerned, to quite a secondary rank.

The largest proportion of the imports consists [illegible] manufactures, which are far ahead of all other [illegible] and with the exception of about ten per cent., the[illegible] British. These ten per cent. consist of [illegible] special prints, &c., which are manufactured [illegible] prices in Switzerland, while this country cannot [illegible] with Great Britain on the other articles, such [illegible] goods, madapolams, &c. The proportion of [illegible] per cent. in which each of the two before-m[illegible] countries furnishes its contingent, has existed on th[illegible] footing with insignificant fluctuations for many [illegible] past, and in consequence of the motive adduced, [illegible] to continue to be always the same. The trade [illegible] manufactures to Persia seems to have been [illegible] during the year 1873. The inhabitants of the [illegible] itself having naturally made more progress in the [illegible] European articles in general, the proportion of [illegible] consumed per head stands higher than at the [illegible] districts. Furthermore, there are items, such as [illegible] and other beverages, Paris articles, jewellery, &c., [illegible] are almost unknown to the inhabitants of those [illegible] places. It may be reckoned that the domestic [illegible] amounts to £40,000 a year of European articles [illegible] about an additional half of that sum of the pr[illegible] from other parts of the Ottoman Empire, [illegible] cluding those conveyed from the interior of A[illegible] tolia. Among the latter there are about [illegible] bushels of wheat, representing alone £50,000. [illegible] prices of provisions, the produce of the country, [illegible] towards the end of the year, undergone an increase [illegible] almost all cases of 30 and in some of 100 per cent. [illegible] cause to be assigned is the exportation on a large [illegible] to Contstantinople. The imposition of a government [illegible] on forests, and the scarcity of wood in the vicinity of [illegible] town, have also doubled the price of fuel. A kind of [illegible] anchovy, called *hamsi*, which is caught during [illegible] winter months, is, owing to its cheapness, 3d. a cwt., [illegible] principal food of the natives at Trebizond and [illegible] surrounding villages. Besides the large quantities [illegible] fresh, each family pickles a provision sufficient for [illegible] year. It is reckoned that the annual fishery, wh[illegible] however, in 1873 was not so abundant as usual, [illegible] to nearly 10,000 cwt.

The principal, or rather the only occupation of [illegible] populations of the inland districts is agriculture, but [illegible] earnings they derive are hardly sufficient to enable [illegible] to defray their expenses and to pay their taxes to [illegible] Government. The fine forests which are found in [illegible] province are not a source of general revenue to the [illegible] habitants, as they must limit themselves to cutting timber only in spots where practicable paths or [illegible]

water may enable them to convey it to the shore. There are also extensive groves of box-wood, which, for the same reason, are not felled to their full extent. The mineral resources are immense, but they are turned to no, or very little, account. The Mussulman population living on the coasts of the Black Sea is mostly given to maritime pursuits, and furnishes the most important contingent of the Imperial Ottoman navy. Armenians are sometimes boatmen in harbours, but Greeks never embrace a sea-faring life. There are no large factories in the province, and the small industrial establishments—such as tanneries, dyeries, printing of European muslin, &c., with patterns adapted to the locality—are limited to the wants of the country. The only article of manufacture exported, and worth mentioning, is the ketenbezi, or linen stuff, for which Rizeh enjoys a high reputation; it furnishes the turbans worn by the Sheh-ul-Islam, and the most costly yashmaks (veils) used by the richest ladies in Turkey. The ketenbezi is hand-made, and unites strength to a truly wonderful fineness and lightness of tissue. The linen stuff manufactured in the rest of the province are much valued, but they are far from attaining the perfection of those of Rizeh.

The loss consequent on the deviation of the Persian transit trade from its present course will, in the opinion of Vice-Consul Biliotti, be likely to prove a fatal blow to the inhabitants of this province, unless the existing resources are awakened from their slumbering condition. These resources, which ought to be encouraged and promoted by all practical means and facilities, are the development of agriculture, the felling of forests, and especially the working of mines. If these different branches are brought to act properly, the results will not only compensate for the foreseen loss, but will moreover ameliorate the general condition of the inhabitants of this part of Anatolia to an extent which it would be difficult to attain in other countries.

SWISS PARQUETERIE.

The parquet manufacture which has been recently introduced into Switzerland surpasses in pecuniary results the other wood-carving industries of the country. The favourite woods employed are walnut, pear, plum, cherry, maple, lime, and fir, and fine foreign woods are gradually being used for the same purpose. The largest factory is at Interlacken, which was founded in 1851, and has employed upwards of 100 workmen for the last seven years. It is fitted up with every kind of machinery, and is capable of turning out about 15,000 square feet of parquets per diem, or between 5,000,000 and 6,000,000 of square feet per annum. The variety in the patterns is something astonishing, when the low rates obtaining are taken into consideration. Every species of mathematical figure is made use of, together with designs in various colours, the white, yellow, brown, and black lines are combined in every possible manner, forming lozenges, squares, rectangles, triangles, &c. The veneered floors, though necessarily the most elegant, are not in such general demand as the massive parquets, varying from one inch to one and a-half inch in thickness. So far, Mr. Jenner states, but little use has been made of curved lines in adding to the beauty of the patterns, which is to be attributed to the higher prices which the greatly enhanced difficulties of execution would render necessary.

The trade is carried on in eighteen out of the twenty-two cantons, and is now in the most flourishing condition. As nearly as can be ascertained, the annual production of the twenty odd establishments reaches the value of 8,000,000 francs (£320,000). The prices throughout the country are nearly the same; they vary from 50 centimes (a little less than 5d.) per square foot for the cheapest description of parquet, to several francs, according to the richness of the designs and the fineness of the wood. The usual price of the kinds most in demand is, at present, from one to two francs per square foot. The ordinary parquet is made of deal, but the oaken floorings are most prized for their solidity. There are varieties of the former, however, made of the wood of fir trees grown in the Alps, at a certain elevation, in which the snowy whiteness and the fineness of the grain is such as to render them suitable for the most elegant apartments. It may fairly be said that hardly a Swiss house with any pretence to comfort is now built without a parquet in at least one of its rooms. In respect to neatness, solidity, durability, elegance, and cheapness, the use of machinery has certainly enabled the maker to achieve wonders. The home demand has been so far proportionately greater than that for any other country. The facility of procuring materials on the spot, the abundance of water power, and the great increase of new buildings for the well-to-do classes, furnish a ready explanation of this fact. Hitherto, the exportation, owing chiefly to the heavy expense for carriage, has not been very large; it attains perhaps about 20 per cent. of the amount manufactured.

CORRESPONDENCE.

INDIAN AGRICULTURE.

SIR,—I am sorry to observe by Mr. Robertson's letter, published in your last issue, that the Government of Madras has wasted in agricultural experiments about twice the amount I thought they had, or, in other words, about £30,000. I use the word waste advisedly, and shall continue to use it with reference to that expenditure until I can lay my hands on some tangible and practical return for the outlay that has been incurred. Hitherto, as stated by me in my lecture of April 2nd, I have only been able to discover that Mr. Robertson has progressed so far as to have established the fact that green crops for fodder can be grown in the hot weather, and that it pays better to steep rather than to boil horse-grain (*Dolchos uniflorus*).

As regards other signs of progress I can discover none except of a negative kind; for instance, Mr. Robertson seems to have discovered that where labour is very cheap labour-saving machines do not pay, and in one of his annual reports he very sensibly says, "We greatly undervalue native implements and tools. Take, for example, the picottah (native water-raising apparatus), mamotie (large hoe), plough, and drill, they are frequently made of very inferior materials, and are carelessly put together, still taking into consideration their small cost, and their suitability to the present circumstances of the ryot, I feel sure we have nothing that will successfully compete with them." As to thrashing machines, he says that "We have as yet no thrashing machines that will effectually thrash all kinds of Indian crops, and even if these difficulties were overcome it is very doubtful whether the labourers using well-constructed flails would not more cheaply and effectively thrash out the grain."

Then as regards seeds, Mr. Robertson is of opinion that it will not pay to attempt to introduce English forage and root crops. More good he thinks might be done by importing indigenous varieties, and in this very obvious conclusion I need hardly say I entirely concur.

As to improved methods of cultivation which are suitable to the means, the size of holdings, and the social condition and circumstances of the people, I can find none that are even suggested by Mr. Robertson. And I am inclined to think that he is utterly unable to find any, and for this simple reason, that he states in his letter under consideration, that "the present race of

cultivators are too superstitious and ignorant to follow any example, let it be ever so good." That remark alone is quite sufficient to shew that Mr. Robertson has either nothing practical to teach, or is so ignorant of the language and the people as to be unable to teach them. For, I have invariably found, that the more a man knows of the native farmer and his circumstances, the more convinced will he be that, so far from being stupid, he is a very shrewd-headed individual, who is perfectly ready to adopt anything that he can clearly see will pay, and that is suitable to the means he has at his disposal. Sir Bartle Frere, for instance, has borne ample testimony to the shrewdness of the native farmer. And, just to give you one instance to the point, I may mention that Captain W. C. MacDougall (in charge Stud Depôt, Buxar, and writing in 1864), after observing that he had had ten years' experience of Indian farming on a large scale, says:—"I considered the native farmer to be as good a cultivator as will be found in any country; poverty prevents his taking advantage of superior means." And I may remind you that I quoted in my paper the evidence of an unusually intelligent Scotch border farmer whom I employed as manager of my estates in India, and that he said simply:—"When I came here first I thought I could improve the agriculture of the native, but I now find that I can suggest no practicable (by that he meant, of course, suitable to the means, size of holdings, &c., for anyone could suggest improvements if he could alter the circumstances to suit them) improvement at all, except a slight improvement in their plough."

From what I have said, it may naturally be inferred that I think it a mere waste of money to employ a person in Mr. Robertson's situation; and if that gentleman is to continue rooting about with some 20 agricultural students at his heels near Madras, I certainly do think that the State could very well dispense with his services. But if Mr. Robertson were employed under a proper system, there is not only need for him, but for several more like him. For, as I pointed out in my paper, I am of opinion that a miniature farm should be attached to every school in the country, and be worked by the boys, with the view of improving indigenous plants and seeds, and introducing new and improved varieties of vegetables, and medicinal and other useful plants, and in especial improved breeds of sheep and cattle. As to large central farms, a few of which might be started in each presidency, gentlemen in Mr. Robertson's situation might be employed on them, not in teaching agriculture to native students, but in growing improved varieties of seeds for distribution to the minor farms, and in breeding improved kinds of stock with the same object. And the head of this central farm should spend the greater part of his time, not on the farm itself, but in visiting the minor farms, and studying the peculiarities and requirements of each individual district.

Permit me in conclusion to observe, that if instead of devoting thirty-five lines to an enumeration of the papers he has read, and the situations he has filled, Mr. Robertson had given you the points as to where he considers I am in error, it would have been much more satisfactory. If Mr. Robertson will be good enough to send you a letter for publication I shall be most happy to reply to it, and have not the smallest doubt but what I shall be able to show that the statements I had the honour to make before your Society were neither misleading nor incorrect, as he vaguely asserts them to be.—I am, &c., ROBERT H. ELLIOT.

38, Park-lane, W., July 12th, 1875.

THE MANUFACTURE OF IRON.

SIR,—In November, 1873, the Society of Arts did me the honour to receive with patient indulgence and favour, my memoir on a new method of refining cast iron, and converting it into either iron or steel. The essential principle of this process was the separation of the heating operation from the chemical reactions. Premising that the success of the reagents so employed has been fully proved by practical trials in the puddling furnace on the scale of manufacture, the only untried part of the process was the heating of the metal bath by means of a mixture of carbonic oxide gas and nitrogen in the proportion of 3 to 1, combined with heated air just sufficient for complete combustion, the gaseous compound being urged by a blast engine upwards through the body of the metal, the whole bath being both so agitated and mixed by the ascending products of combustion, carbonic acid gas, and nitrogen, as to do, in effect mechanically, the work of the puddler. For the details I must refer to the memoir itself in your *Journal*. Since the paper was read to the Society I have occupied myself in collecting opinions from competent persons in various quarters, favourable or otherwise, as the case might be, and it may be interesting, as it is certainly due to the Society and to your readers, to learn the nature of the objections made to the economy of the heating process, its chemical success being established.

The carbonic oxide gas is to be derived from two sources—1. The calcination of limestone or chalk, and the conversion of the carbonic acid gas by carbon into carbonic oxide. 2. The calcining of carbonaceous matters with the peroxide of manganese, the latter derived, preferentially as cheapest, from ores consisting of peroxide of manganese combined with notable amounts of peroxide of iron. No objection has been made to the latter mode of producing the gas. To the former it has been objected—Firstly, that "as two volumes of carbonic oxide result from one volume of carbonic acid united with a second atom of carbon, heat must be absorbed and lost by this change of volume." Secondly, "That a great expenditure of fuel will be required to raise the converting carbon to the point proper for the chemical change" I will deal first with the second objection, although, as I have never yet been favoured with even an approximate estimate of the stated great amount of fuel, it would be quite fair in me to treat it as a loose conjecture. The gas evolved from calcined limestone or chalk is already at a full red heat, so that the raw carbon is the only element to be heated. Let us assume that the required degree of heat is 1,000° F., a liberal allowance, and that the carbon is at 32° F., though in fact at 80°. Let the weight of the carbonic acid be 22 lbs.; this will require 6 lbs. of carbon (in the fuel) for its conversion, giving as the result 28 lbs. of carbonic oxide. The specific heat of coke is nearly ·202, therefore the heat units required to raise 6 lbs. of carbon to 1000° will be $6 \times 1000 \times \cdot202$, or 1212 units. 1 lb. of rich coke will give out by its combustion about 12,000 heat units; if, therefore, we divide 1212 by 12,000, we have ·1 lb. as the fuel required for the operation, that is $\frac{1}{10}$ lb. for 6 lbs., or 1 in 60, which is 1·66 per cent., say, to allow for ashes, 2 per cent. This is quite insignificant, and it will be enough in confirmation to remind your readers that they have often seen, in your own and in other lecture-rooms, carbonic acid gas at the ordinary temperature converted into carbonic oxide, simply by passing it over charcoal in a gun-barrel at a good red heat.

I come now to the second objection. The proposed conversion is represented by the formula $CO_2 + C = 2\,CO$. Now, in the molecular-volume theory and notation this gives us first, 1 molecule CO_2 + $\frac{1}{2}$ molecule C = 2 molecules CO. The ratio of the volumes before and after the chemical union will therefore be 2 vols. CO_2 + 1 vol. C : 4 vols. CO, or 3 vols. : 4 vols. = 3 : 4. This is an expansion of one-third only, for the objection did not include and take account of, as I do, the volume of the carbon vapour.

We have now our 28 lbs. of carbonic oxide, which we are to burn with 16 lbs. of oxygen into 44 lbs. of carbonic acid gas. Using again the molecular-volume notation, as $2\,CO + 2\,O = 2\,CO_2$, we have 2 molecules CO + 1 molecule O = 2 molecules CO_2. The volume ratio will therefore be 4 vols. CO + 2 vols. O : 4 vols. CO_2, or

ls. CO + 1 vol. O : 2 vols. CO_2; that is, 3 vols. : 2 or 3 : 2, being a contraction of one-third in the me after combustion as compared with that before

e shall see that the above data give a complete comtion between the heat units lost and those gained e expansion and in the contraction respectively. To ite fair, I shall take, as the least favourable to mythe greatest specific heat, that of the carbonic oxide, e there is expansion of volume or heat lost, and the specific heat, that of carbonic acid gas, where there ntraction or heat gained. There was, we have seen, xpansion of one-third in volume. Now, a gas exs by about $\frac{1}{500}$th part of its volume for each degree hrenheit.

have therefore the proportion $\frac{1}{500} : \frac{1}{3} :: 1° :$

ber of degrees due to $\frac{1}{3} = \frac{500}{3} \times 1° = 166{\cdot}66°$.

weight of gas, 2 CO is 28lbs., its specific heat is the heat units absorbed are therefore × 166·66° × ·248 = 1157.

t us now consider the contraction of $\frac{1}{3}$ after comon of the 28lbs. of carbonic oxide with 16 lbs. of en, yielding 44lbs. of carbonic acid. It is obvious as much heat must be given out in the contraction e volume of a gas from 3 to 2, as would be required pand it from 2 to 3, that is by half of its volume.

have, therefore, as before $\frac{1}{500} : \frac{1}{2} :: 1° :$

ber of degrees due to expansion of $\frac{1}{2}$ (or contraction $\frac{1}{3}$) $= \frac{500}{2} \times 1° = 250°$. The heat units for

s. of carbonic acid with its specific heat of ·216 will fore be 44 × 250° × by ·216 = 1276. We can strike the balance of heat lost or expended and heat d or recovered, as follows :—

Dr.	Units.
onverting fuel	1212
eat absorbed in expansion	1157
	2369
To balance	7
	2376
Cr.	Units.
eat gained in contraction of volume	2376

he excess therefore is only 7 on 2,369, or ·0025 of whole, representing ·0058 of 1 lb. of coal.

hat, then, it will be asked, is the advantage to be ed by this method? Why not apply your 6lbs. of on directly, burning it at once into carbonic acid by which it yields the greatest number of heat s? I will endeavour to give a conclusive answer to e questions. First, if you could so burn the carbon obtain all its heat (which you cannot do) you could apply that heat to the special object in hand. If burn six parts of carbon with air, so as to obtain onic acid gas, the temperature of combustion would (French measures)—

$$\frac{6 \times 8000}{\underbrace{22}_{CO_2} \times {\cdot}216 + \underbrace{16 \times \frac{77}{23}}_{N} \times {\cdot}244} = 2693° \text{ C.}$$

* These results may all be obtained from the relations between specific gravities and the weights of the several elements as mined by experiment.

But if you burn 28 parts of carbonic oxide with 16 parts of oxygen, or, which is the same thing, 14 parts of carbonic oxide (derived from 6 of carbon) with 8 parts of oxygen, you have a temperature—

$$\frac{14 \times 2500}{\underbrace{22}_{CO_2} \times {\cdot}216 + \underbrace{8 \times \frac{77}{23}}_{N} \times {\cdot}244} = 3145° \text{ C.}$$

The difference is no less than 452° C., or 846° F.

Now, if you look into the denominators of these fractions, which contain the products of combustion, carbonic acid and nitrogen multiplied by their respective specific heats, you will see that in the direct combustion you have 16 of nitrogen where you have only 8 in the indirect method, a difference of one-half; in fact, 52 lbs. instead of 26 only.

Therefore, the method is only an artifice for the purpose of obtaining a higher temperature, all the heat evolved being at the same time applicable at the very points where the work is to be done. High temperature is only concentrated heat. You may have a greater quantity of heat in a cistern of tepid water than you have in a teakettle (just as you have 48,000 heat units in the direct combustion, where you have only 35,000 units in the indirect), but can you make a cup of tea with it? Your 48,000 units are diffused in a larger mass of matter than your 35,000 units, and this makes the whole difference in the temperature, as in the efficiency of the furnace. Let us see what this efficiency amounts to.

Mr. Prideaux some years ago pointed out that it was only one-half of the excess of the temperature of the furnace above the welding point of iron that was efficient in the operation, and that an addition of only one-eighth to this excess increased the efficiency fourfold. Upon the same scale it would be found that the temperature of combustion of "Pyrogen" gas (the gas proposed), 2705°C., or 4,900 F., would increase the efficiency of the furnace sixteen-fold.

Then what is the price to be paid for this great advantage (not to speak of the absence of all the ordinary waste of heat and fuel)? We have 2 per cent. to expend in heating the converting carbon or fuel, that is all. The heat absorbed in the expansion is given up again in the subsequent contraction. The temperature to which one-half of the carbonic oxide has to be raised remains to be utilised after its combustion in common with that of the other half due to the 6lbs. of carbon, and can be readily utilised, even in the way of "regeneration," if need be.

The importance of this method is not limited to metallurgical operations. The gas, which I have named "Pyrogen," is applicable to general heating purposes just as ordinary gas is to lighting, and by the same means of distribution, though at one-tenth of the cost. This I have pointed out in a pamphlet presented to our Council, and with an amount of saving in cost, comfort, convenience, and health, which can scarcely be exaggerated. I may now add that by slaking the quick lime with "exhaust" steam, a vast body of water may be raised to the boiling point, and conveyed to every house in a town as the means of warming all its living apartments, leaving the gas to be applied only to cooking purposes, at the same time facilitating effective ventilation, and greatly diminishing the risk of accidental fires. No doubt we shall be told that the omnipresent and impressible "Englishman" likes to "see" his fire. But the first thing which the shivering "English" millions like is to be well warmed, not to see a struggling spark in a half-empty grate of dull, red cinders. There is another thing which our typical Englishman likes to see, and that is his money, of which, at the probable price of fuel, he is likely to see much less than he did when fuel was at half its present price.

I fear I have trespassed too far on your space, but I trust the importance of the subject may excuse me.—I am, &c., F. C. Knowles.

Mayfield, Ryde, 12th July, 1875.

P.S.—There is every reason to believe that the combustion of "Pyrogen" gas will render the "lime light" a practical reality.

NOTES ON BOOKS.

Ure's Dictionary of Arts, Manufactures, and Mines. By Robert Hunt, F.R.S., Keeper of Mining Records, &c., assisted by F. W. Rudler, F.G.S., and by numerous contributors eminent in science and familiar with manufactures. Seventh edition, in three volumes. (London: *Longmans*, 1875).—It appears from the preface that during the lifetime of Dr. Ure his well-known dictionary passed through four editions, and since 1858, when Mr. Hunt undertook the editorship, three more have appeared. The present edition shows a very considerable advance, as regards the amount of material comprised, on those preceding it. The fifth edition of 1863 contained in the three volumes 2,726 pages. In the present the total number amounts to 3,255. Such an addition of over 500 pages, or a sixth of the whole book in the space of twelve years, must be allowed to be more than is required by the advance in science and manufactures made during that period, and it may therefore be fairly concluded that the dictionary has not merely been kept up to date, but has been made more complete than before.

How great the difficulties are which beset the editor of such a book as this, can only be understood by those who have experience in work of the same sort. Dealing as it does not with pure science, but with the applications of science to commercial purposes, it has to rely for information principally on those whose real or fancied interests it is to keep such information to themselves. The object of the manufacturer is naturally to extend his own business by accumulating and keeping hidden the secret of his trade, not to assist rivals by making known the results of his own researches. This reason alone is sufficient to prevent any dictionary of the arts from being brought absolutely up to date, as the possessors of new discoveries and new methods of manufacture are anxious to turn them to practical account for their own benefit, not to publish them for the good of their neighbours. This excuse might well be pleaded for any shortcomings in the work, and it would be strange indeed if in an undertaking of such magnitude specialists were not able to discover some flaws. There is, however, no need, even if it were the province of this *Journal*, to discuss the merits or demerits of so well-known a book. It is sufficient to mention that a new edition has been published, with considerable additions and revisions. Much obsolete matter has been omitted, and replaced by new information. The more important articles have been for the most part re-written, and many new articles have been added. The type of the whole has been reset, and some slight alterations have been made in its character, in order to assist the eye. About two hundred of the woodcuts are new. It has been considered advisable to retain the old chemical notation, on the ground, it appears, the formulæ now generally adopted by chemists are not yet sufficiently settled or free from chances of further alteration, to render it advisable to use them in a work intended for general reference. A long list of contributors is given, and it comprises very many names well known in science, and in what may be perhaps called "scientific commerce," but though due acknowledgment is made to all who have assisted, it may be taken for granted that the chief credit of the work is due to the two editors whose names appear in the title-page, Mr. Hunt and Mr. Rudler.

GENERAL NOTES.

Saving Life at Sea.—A dress, somewhat on the principle of Captain Boyton's, has lately been invented by Mr. C. M. Lloyd. It is intended to be used in cases where, from expense or other causes, the more elaborate costume of Captain Boyton is not available. It consists of an ordinary coat fitted with receptacles, which can be readily inflated with air, but when empty presents no apparent difference from any other coat. This may be worn by itself as a preservative in case of accident, or, if put on with a pair of waterproof overalls, it serves as a Boyton dress. A somewhat more complicated apparatus is formed like the bow and stern of a canoe, so that the wearer is practically supplied with a small canoe, which he can propel and direct with a paddle in the ordinary manner. An emigrant's bed is formed on a somewhat similar principle. The inventor has lately made some practical trials of his various appliances in the Thames, by going from Waterloo to Lambeth on them, and he states that he has spent as many as seven hours in the water thus dressed without suffering any inconvenience.

Brussels International Exhibition, 1876.—As already announced, an International Exhibition will be held next year in Brussels under the patronage of his Majesty the King of the Belgians and the presidency of H.R.H. the Comte de Flandre. The exhibition, the initiative in which has been taken by the Belgian Société Royale de Sauveteurs, will include all matters relating to the saving of life and the lessening of suffering under every circumstance, whether arising from war, fire, or shipwreck, accidents by machinery, railway, locomotion generally, or in mining operations. In addition to the above, the programme comprises all matters relating to the preservation of health, including the proper construction of public buildings, factories, &c., and the improvement of the dwellings of the working classes generally. A Congress will be held in connection with the exhibition for the discussion, by representatives of all nations, of the subjects coming under each section of the programme. This Congress is to be permanently organised, holding its meetings triennially in the various European capitals. The Crown Prince of Prussia has accepted the honorary presidency of the German Committee. The Archdukes Charles Louis and Joseph are honorary presidents of the General Committee for Austria and Hungary respectively. In France a committee is being formed. Intending exhibitors and others interested in the exhibition may communicate with Mr. E. Johnson, 3, Castle-street, Holborn. The Lord Mayor presided at a meeting held lately at the Mansion House for the organisation of a General London Committee, subdivided into sections, especially identified with the subjects contained in the various divisions of the official programme. Noblemen and gentlemen desirous of joining the committee may address Major Burgess, the honorary secretary, at the Mansion House.

Paper Material.—A good deal of interest has been excited by the recent reports on the paper-making grass of Algeria, the so-called *alfa* or *Stipa tenacissima*, which covers hundreds of thousands of acres in that country. But the *Agricultural Gazette* of India states that another plant is to be introduced into Algeria of still greater commercial value. This is the *Hibiscus esculentus*, the use of which as a fibrous plant has long been recognised. The plant, though indigenous to the West Indies, has long been naturalised in India. Its pods produce the common vegetable known as ochro by the English, gomto by the French, chimtomto by the Spanish, and benditeai in India, where it is so much esteemed for its mucilaginous thickening for soups. The pods are gathered green and pickled like capers. The seeds may be boiled like barley, and the mucilaginous matter they contain is both demulcent and emollient. They have also been recommended when roasted as a substitute for coffee. A patent has now been taken out in France for making paper from the fibre, and for this purpose is to be introduced into Algeria. The fibre is prepared solely by mechanical means in a current of water, without any bleaching agent, and the pulp washed and bleached is reported to make a strong, handsome paper equalling that from pure rags. It is called banda paper.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,183. Vol. XXIII.

FRIDAY, JULY 23, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

By command of H.R.H. the Prince of Wales, President of the Society, M. Michel Chevalier attended at Marlborough House on Wednesday last, when his Royal Highness presented to M. Chevalier the Albert Medal, awarded to him by the Society, for "distinguished merit in promoting Arts Manufactures, and Commerce." The members of the Council present were Lord Alfred Churchill (Chairman), Mr. F. A. Abel, F.R.S., Mr. G. C. T. Bartley, Mr. Andrew Cassels, Mr. Hyde Clarke, Sir Henry Cole, K.C.B., Col. A. A. Croll, Major Donnelly, R.E., Major-General F. Eardley-Wilmot, R.A., F.R.S., Mr. C. J. Freake, Mr. Peter Graham, Lord Hampton, Mr. Wm. Hawes, F.G.S., Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. Robert Rawlinson, C.B., Rev. W. Rogers, Lieut.-Colonel A. Strange, F.R.S., Mr. Seymour Teulon, Mr. E. Carleton Tufnell, and Mr. T. R. Tufnell.

His Royal Highness (in presenting the medal), speaking in his own name and in that of the Society, alluded in complimentary terms to the efforts made by M. Chevalier on behalf of Commerce and Free Trade.

M. Chevalier briefly acknowledged the compliment, and expressed his obligations, both to his Royal Highness and to the Society, for the honour which had been conferred upon him.

EXAMINATIONS, 1876.

The Council have decided that the Society's scheme of Examinations shall be thoroughly revised, and have appointed a Committee for that purpose. The Programme for 1876 will be issued as soon as the details have been settled by the Committee.

NATIONAL TRAINING SCHOOL FOR COOKERY.

The Education Department, the Female Training Colleges, and School Boards in the metropolis and country are all at work to connect instruction in cookery for female students with National Education. The great want for a long time will be properly trained teachers. The National Training School for Cookery has several students in training, and seeks for more. With the view of assisting this important movement and spreading the knowledge of it especially among Institutions in Union with the Society, the Council, on the 19th July, passed the following resolution:—

"That a notice be published that the Council are prepared to establish five scholarships of the value of £10 10s., giving free instruction to female teachers of cookery to be trained at the National Training School for Cookery; such scholarships to be awarded by competition; the members of the Society of Arts and of Institutions in Union with the Society to have the privilege of naming candidates for competition."

It is expected that any well-educated lady who becomes a certificated teacher of cookery (not a domestic cook) may look forward to obtaining an income of £100 a-year, by conducting a local school where adults of all classes, and the students of public schools, may attend to receive instruction and to practise. The competition will, in the first instance, take place in London, in the month of October next. Full information can be obtained of the Secretary of the National Training School for Cookery, Exhibition-road.

MUSICAL SCHOLARSHIPS OF THE SOCIETY OF ARTS.

It is proposed to form a fund, to be subscribed among the members of the Society of Arts, for the purpose of establishing scholarships open for competition among qualified persons nominated by the Society for examination in such competition. Members willing to make donations or give subscriptions in aid, are requested to communicate with the Secretary.

NATIONAL TRAINING SCHOOL FOR MUSIC.

Kensington-gore, London, S.W.

For the history and progress of this School, originated by the Society of Arts, London, see the annual reports of the Council since 1866.

1. To establish this School permanently and effectively, it is necessary to obtain at least 300 free scholarships for male or female students.

2. In respect of these free scholarships, a payment of £40 a year for each student is requisite, to cover the expense of musical instruction of the highest character; also instruction in languages, declamation, and deportment; management, rent, and household expenses, and preliminary expenses in obtaining scholarships and in establishing the school.

3. The appointments to these free scholarships will be made by public competition in districts of the United Kingdom or competitions in schools, &c. It is hoped that every district and all public schools will be sufficiently interested in the culture of persons gifted with musical abilities to come forward and secure to their district the advantages of one or more of such free scholarships.

4. The sum of £40 a year may be obtained by permanent endowments, made by public spirited individuals, who may thus enrol their names as national benefactors for all time; by endowments as memorials of great musicians; by endowments for only five years; or by sufficient annual sums to make up £40 a year.

5. It is desirable that a local committee to obtain the scholarships should be formed in every county, city, and town in the country. The City of London and metropolis meeting at the Mansion-house, the Society of Arts, London, Manchester, Birmingham, Leeds, Bradford, and Liverpool have appointed local committees. Halifax and Nottingham have also engaged to form committees and endow scholarships. Mr. C. J. Freake has caused a suitable building to be erected at his own cost, and munificently presented it to the country.

6. Mr. Lionel Benson has been appointed by the Society of Arts to visit localities and to assist in forming local committees.

7. Individuals willing to endow scholarships at once, or to guarantee that a given city, town, or district, shall have one or more free scholarships open for competition, are requested to send their names and addresses in the following form:—

Name.	Address.	Amount of endowment, donation, or annual subscription.

I am willing to endow a free scholarship, or guarantee the endowment of a free scholarship, or contribute the sum named above as a donation towards a scholarship fund.

Signature

To P. Le Neve Foster, Esq., M.A.,
Secretary, Society of Arts, Adelphi, London, W.C.

Names of Subscribers for Scholarships open for Competition, also of Donors to the General Fund. Corrected up to 10*th July*, 1875.

(*a*) Annual. (*d*) Donation.

	£	s.
(*a*) Her Majesty the Queen	50	0
(*a*) H.R.H. The Prince of Wales, K.G... ..		
(*a*) H.R.H. The Duke of Edinburgh, K.G. ..	50	0
(*a*) H.R.H. The Duchess of Edinburgh.. ..	50	0

For Scholarships open for Competition in the following places.

The City of London and Metropolis.

(*a*) The Merchant Taylors' Company of London, five scholarships five years, yearly ..	200	0
(*a*) The Mercers' Company of London.. ..	50	0
(*a*) The Fishmongers' Company of London, two Scholarships	50	0
(*d*) Mr. Henry Arthur Hunt, C.B., towards a Girls' Scholarship	100	0
S. Morley, Esq., M.P., for five years, yearly	80	0
(*a*) C. Morley, Esq., for five years, yearly	40	0
(*d*) Warren de la Rue, Esq., F.R.S. (to the general fund)	100	0
(*a*) Major Carpenter, for five years, yearly ..	40	0
(*a*) J. Coysgarne Sim, Esq., for five years, yearly	40	0
(*d*) Mrs. Freake, for a perpetual Scholarship ..	1000	0
(*a*) The Lady Mayoress, for five years, yearly..	40	0
(*d*) John Howell, Esq. (to general fund), yearly	10	10
(*d*) G. N. Hooper, Master of the Coachmakers' Company (to general fund)	21	0

Ashford (Kent).

Has agreed to establish one Scholarship of £40 annual, and subscribed £54 10s. for the first year.

Bedford.

Sir John Harington, Bart., and Lady Harington

Berks.

Sir Charles Russell, Bart.
Mr. and Mrs. Higford Burr
Sir John Shaw Lefevre, K.C.B.

Birmingham.

	Annual. £	s.		Total. £	s.
Beale, W. T. for five years, yearly	50	0	..	250	0
Elkington and Co...	20	0	..	100	0
Chance, R. L.	20	0	..	100	0
Ryland, Miss	20	0	..	100	0
Ratcliff, Colonel	10	10	..	52	10
Peyton, R.	5	5	..	26	5
Peyton, A.	5	5	..	26	5
Harding, W. S.	5	5	..	26	5
Sharp, W.	5	5	..	26	5
Milward, R. H.	5	5	..	26	5
Gillott, J.	5	5	..	26	5
Marigold, J.	5	5	..	26	5
Dixon, G., M.P.	5	0	..	25	0
Harrold, Mrs.	5	0	..	25	0
Jaffray, J.	5	0	..	25	0
Adams and Beresford	3	3	..	15	15
Harrison and Co.	3	3	..	15	15
Harding, C...	2	2	..	10	10
Beale, C. G.	2	2	..	10	10
Beattie, J.	2	2	..	10	10
Heap, Dr.	2	2	..	10	10
Harding, S.	2	2	..	10	10
Coachman, R. E.	1	1	..	5	5
Harding, Miss	1	1	..	5	5
Spencer, T.	1	1	..	5	5
Mitchell, F...	1	1	..	5	5
Lord, J. C.	1	1	..	5	5
Fletcher, H. H.	1	1	..	5	5
	£195	7		£976	15

Bradford.

(*A public meeting will shortly be held here.*)

The following subscriptions have already been promised:—

	Annual. £	s.		Total. £	s.
Sir Titus Salt			..	1,000	0
H. W. Ripley, M.P., for 5 years, yearly	10	0	..	50	0
H. Averdieck, Esq.	10	0	..	50	0
Emil Goldschmidt, Esq.	10	0	..	50	0
Henry Mason, Esq..	10	0	..	50	0
	£40	0		£1,200	0

Bristol.

(*a*) S. Morley, Esq., M.P., one Scholarship for five years, yearly..	40	0		200	0

Cambridge.

Miss Thackeray (for girls)

The Diocese of Canterbury.

The Archbishop of Canterbury

The County of Cheshire.

	Annual. £	s.		Total. £	s.
(*a*) The Duke of Westminster, K.G.	15	0	..	15	0

Derby.

The Countess of Chesterfield
Sir Joseph Whitworth, Bart., and Lady Whitworth
Mr. M. T. Bass, M.P.

Devon.

The Duke of Somerset, K.G., Lord Lieutenant
Sir Thomas Dyke Acland, Bart, M.P.
Mrs. A. D. Coleridge

Dorset.

Hon. Mrs. Seymour Dawson Damer
Captain Dawson Damer, M.P.
Mr. and Mrs. Clay Ker Seymer
Lady Augusta Sturt
Mr. Gerard Sturt, M.P.
Miss Grace Sturt

Gloucester.

Mr. and Mrs. Gambier Parry

Halifax.

Committee—Messrs. T. Shaw, J. Hutchinson, C. Edwards, Archdeacon Musgrove, J. Lister (Hon. Sec.)

Subscriptions Announced.

	Annual. £	s.	Total. £	s.
F. C. McCrea, for 5 years, yearly	10	0	50	0
J. Lister	10	0	50	0
L. J. Crossley	10	0	50	0
T. Shaw	10	0	50	0
Archdeacon Musgrove	10	0	50	0
Wm. Foster	5	0	25	0
	£55	0	£275	0

Hants.

The Earl of Carnarvon
The Lord Northbrook
The Right Hon. W. Cowper Temple and Mrs. Cowper Temple
Mr. and Mrs. Wyndham Portal
Sir Thomas and Lady Fairbairn

Hereford.

The Earl and Countess Somers
Mr. C. Wren Hoskyns
Mr. George Moffatt
Mr. John Arkwright.

Herts.

The Earl and Countess of Essex
Miss Alderson
The Lady Margaret E. Cecil
Lord Arthur Cecil
Lord Lionel Cecil

Huntingdon.

Mr. W. Wells, M.P.

Kent.

The Earl Sydney, G.C.B., and Countess Sydney
The Bishop of Dover
The Lord de l'Isle and Dudley
Mr. H. A. Brassey, M.P.
Mr. and Mrs. John Webb
Mr. James Nasmyth
Mrs. Day

Lancashire.

The Countess of Derby
Lady Margaret E. Cecil
Mr. Thomas Ashton
Sir Thomas Bazley, Bart., M.P., and Lady Bazley
Mr. James Hertz
Mr. William Rathbone, M.P.
Miss Gerard
Viscount Cardwell and Viscountess Cardwell
Mr. Sam Mendel
Sir Joseph Whitworth, Bart., and Lady Whitworth

Leeds.

Organising a Committee.

Leicester.

Mr. Albert Pell, M.P.
Lord and Lady John Manners

Lincoln.

The Duke of St. Albans

The Town of Liverpool.

	Annual. £	s.	Total. £	s.
*Kurtz, A. G. for 5 years, yearly	80	0	400	0
Rathbone, Benson	40	0	200	0
Bowes, James L.	40	0	200	0
Gladstone, Robertson	20	0	100	0
Rathbone, Philip	20	0	100	0
Rensburg, H. E.	5	0	25	0
Samuelson, Edward	5	0	25	0
Hornby, H. F.	5	0	25	0
Baring, Thomas	5	0	25	0
Massey, Frederick	5	0	25	0
Smith, Charles W.	5	0	25	0
Raffles, W. Winter	5	0	25	0
	£235	0	£1,175	0

* One Scholarship each for a boy and a girl.

The City of Manchester.

A Committee has been formed, consisting of the following, &c.

Sir Joseph Whitworth, Bart; Messrs. T. Ashton, F. Bridge, H. Cheetham, Principal Greenwood, E. S. Heywood, Houldsworth, C. Sever, and Clementi Smith, with Mr. Duffield as Hon. Sec.

Middlesex.

The Lord Hatherley
Mr. John Holms, M.P.
The Campden Trustees will use apprentice funds for Scholarships in Kensington Parish
Mr. and Mrs. J. R. Holland
Miss Thackeray. (For Girls)
Mr. F. Clay
Mr. George Plucknett
Mrs. Cohen and Miss Lucy Cohen. (For Girls' Scholarship)

Norfolk.

Mr. Tyssen Amhurst

Northampton.

The Earl and Countess Spencer

The County of Northumberland.

	Annual. £	s.	Total. £	s.
(a) Sir William and Lady Armstrong, for five years, yearly	40	0	200	0
(d) Bishop of Durham	25	0		
(a) Louisa, Marchioness of Waterford	5	0		
(a) Countess Grey	10	0		
(d) The Earl Tankerville	5	0		
(d) Earl Durham	10	0		
(d) Earl Percy, M.P., if £980 are raised	20	0		
(a) Mr. and Mrs. Andrews, for five years, yearly	40	0	200	0
(d) Albert Grey	5	0		
(d) Right Hon. Sir George Grey, Bart., G.C.B.	2	0		
	£162	0	£400	0

Nottingham.

The Duke of St. Albans
Mr. W. G. Ward
Mr. Th. R. Starey (guarantees that the Town of Nottingham will send a scholar)
(a) S. Morley, Esq., M.P., one scholarship for five years, yearly £40 0 .. £200 0

Oxford.

The Duchess of Marlborough

Shropshire.

Lord and Lady Acton.

The County of Stafford.

	Annual. £	s.	Total. £	s.
(a) Mr. and Mrs. Colin Campbell for five years, yearly	50	0	250	0

THE STAFFORDSHIRE POTTERIES.

Godfrey Wedgwood, Esq.

STAFFORD.

Right Hon. Sir C. B. Adderley, Bart., K.C.M.G., M.P., and the Hon. Lady Adderley

SURREY.

Viscount Cardwell, M.P., and Viscountess Cardwell
Mr. Reginald Bray and Mrs. Bray
Mr. Henry Bessemer

THE COUNTY OF SUSSEX.

Mr. and Lady Dorothy Nevill
Mr. Dyer Edwardes
Mr. and Mrs. T. Field Gibson

	Annual. £ s.		Total. £ s.
(a) Sir John Hawkshaw, F.R.S., for five years, yearly	25 0	..	125 0

WARWICK.

The Earl and Countess of Warwick

WILTS.

The Marquis and Marchioness of Lansdowne
Mrs. Alfred Morrison
Mr. G. Goldney, M.P.

WORCESTER.

Lord Lyttelton and Lady Lyttelton
Lord and Lady Hampton

THE COUNTY OF YORKSHIRE.

The Lord and Lady Wharncliffe
Mr. Christopher Sykes, M.P.
The Right Hon. W. E. Forster and Mrs. Forster
The Marquis and Marchioness of Ripon
Mr. F. A. Milbank, M.P.

THE DIOCESE OF YORK.

The Archbishop of York

THE CINQUE PORTS.

The Earl and Countess Granville

KILDARE.

The Lord Gerald Fitzgerald

MONAGHAN.

Mr. John Leslie, M.P.

TIPPERARY.

The Viscount Hawarden and the Hon. Misses Maude

ARGYLE.

Mrs. Pender

AYR.

Sir Peter Coates

FIFE.

Sir Coutts Lindsay, Bart., and Lady Lindsay

HADDINGTON.

Lord Elcho, M.P., and Lady Elcho.

INVERNESS.

(a) Mr. and Mrs. Frank Morrison for five years, paid in full £250 0
MacLeod of MacLeod
Mr. J. C. MacDonald

PERTH.

The Hon. A. G. Kinnard, M.P.

RENFREW.

Sir Peter Coates

ROSS.

Mr. and Mrs. John Fowler

SUTHERLAND.

The Lord Ronald Gower, M.P.

ANGLESEA.

The Lord Clarence Paget and Lady Clarence Paget

CARNARVON.

The Lord Penrhyn

DENBIGH.

Sir Watkin Williams Wynn, Bart, M.P.

GLAMORGAN.

The Right Hon. Lord Aberdare

NEW SOUTH WALES.

Sir Daniel Cooper, Bart.

AUSTRALIA.

Sir G. Verdon, K.C.M.G., C.B.

MISCELLANEOUS.

WEATHER CHARTS IN NEWSPAPERS.

By R. H. Scott, F.R.S.,

(Director of the Meteorological Office).

The recent appearance of weather charts in some of the daily papers has attracted the attention of many to whom such charts are new, and who, though they may have realised the fact that the weather all over the British Isles on the same day is not the same, do not see how the conditions prevailing in one district influence those in another, or how, by a comparison, *e.g.* of the weather in Ireland and Scotland, with that in England on any day, we can form some idea of the changes which will probably have taken place by next morning.

The honour of having been the first to render possible the discovery of such relations as those just indicated, by the publication of daily charts, is due to Le Verrier, who, in 1858, brought out his *Bulletin International*, containing a lithographic weather chart for Europe, and the example set by him has been followed by this country, whose Daily Weather Charts date from March 11, 1872, and are now distributed at the rate of about 500 copies a-day to subscribers, and for exhibition at various public offices, seaports, and fishing stations. It is hardly necessary here to allude to the charts issued by the Signal-office, Washington, of which three appear for every day, or to Captain Hoffmeyer's charts for the whole of Europe, which, however, appear some months after date, and are only useful for the detailed scientific study of weather.

The advantage presented by such a graphic account of the weather, as compared with a mere tabular record of observations, need hardly be mentioned; it is almost like the difference between a picture and a description. But I may here explain that the charts which accompany our own Daily Weather Reports are four in number, and give a representation of—(1.) The barometrical pressure. (2.) The temperature. (3.) The wind and sea disturbance; and (4.) The weather and state of the sky over the United Kingdom, and some of the adjacent parts of the Continent, for 8 a.m. every morning.

It is not, however, with the daily weather charts that I have to deal at present, but with the charts which have appeared since April 1 in the *Times*, and of late in the *Hour* also, in which it is endeavoured to show the leading features of the four charts just mentioned combined in one chart, and so I must confine my remarks to the amount of information which these convey.

t is obvious that a circulation of 500 copies daily is olutely nothing as compared with the number of ders of any of our leading papers, and so for a long e the attention of the Meteorological-office has been ected to the undoubted desirability, and the question- possibility, of providing in a short space of time a rt suitable for the columns of a newspaper. The dit of having persistently urged the matter till it met final success is due to Mr. Francis Galton, F.R.S., le the practical details of the process have been de- d and perfected by Messrs. Shanks and Johnson, of Patent Type Founding Company.

may be of interest to see how such a chart is pro- d, what it shows us about the weather of the day for h it is drawn, and finally what is its use as to form- judgment of the weather probable for the next day, ough this last cannot be given within the limits of rticle such as the present, even were our knowledge ciently codified into regular laws and rules.

he production of the chart is a pretty simple matter. observations at about 50 stations in these islands and he Continent are taken at about 8 a.m., and tele- hed in cypher to London, where they arrive, when oes well, before 10 o'clock. As fast as they come in figures are put down in their proper places on a large t, and as soon as this chart is finished, so as to afford sonably complete view of the general state of affairs orological for the day, the chart for the newspapers is menced. The space which can be allotted to the chart e columns of the *Times* is but small, and so it is neces- to condense into it as much information as possible out sacrificing clearness. What this information is hall explain later on. Once the chart is drawn, it t to the Patent Type Founding Company's works d Lion-square, and there copied mechanically, at a ed scale, on a slab of a special composition, which been formed in a mould bearing in bold relief the ne of the land on the map. This outline, of course, s out in the impression as a deep groove. The en- ing is done by a drill, the depth of the cut being ated by the workman. The only speciality about part of the process is that the composition cuts quite without risk of chipping. The curves are copied t from the chart, while the words and letters are put y means of templates, so as to ensure uniformity in type.

e instant the engraving is completed the slab is y to furnish a cast, which is, in the first instance, n in rather fusible metal to save time in cooling. first block being obtained, the ordinary process of g an impression from it in paper ensues, and this effected, it is a simple matter to produce from this ssion any number of stereotype blocks type high, are then sent to the newspaper office, set up with pe, and worked off in the usual way, just like a graph of letterpress.

e next point then is what this chart shows us. In first instance we see the dotted lines; these are are called "isobars," from two Greek words mean- "equal pressure." These lines are obtained by ing lines on the chart to join together the places the barometrical readings are the same, and, as all see presently, they are the most important lines an give on a weather chart, to show us, when their ations are read aright, what the winds and weather ikely to be. The other entries on the chart are the erature at certain prominent stations; the state of eather and the sea disturbance, which are given in s, the latter being always in capital letters; and h last not least, the wind, which is shown by s flying *with it*, not *against it*, like the vane of a eathercock. The force of the wind is shown by five s, which are as follows:—O calm, ⟶ light, ⟶ to strong, ⋙⟶ a gale, ⋙⟶ a violent gale. The result is a chart like those given below, and it can ed in about an hour after the completion of the al chart in the office.

With regard to the actual interpretation of the chart, I must pre-suppose in my readers some knowledge of the elements of meteorology, else it would be hopeless, within the limits at my disposal, to render what I have to say intelligible. The most important principle, of which sight must never be lost, is that of the relation of the wind, both in direction and force, to the distribution of barometrical pressure. Wind is produced by differences of pressure, for the air naturally flows from a place where pressure is in excess, to one where it is in defect, and this motion of the air is wind. The wind moves not in straight lines, but in great curves or sweeps, and its motion is ruled by the distribution of pressure, as we shall soon see. A glance at almost any of these charts will show that, even on the calmest day, there are appreciable differences between the barometrical readings taken at the same time over the United Kingdom. Meteorology is not at present able to explain what the causes of such differences of pressure are—if it were we should have made many steps towards the accurate prediction of weather—and we must for the present take these areas of high and low pressure respectively as existing, but we may assert that on the mutual action of these areas on each other all our weather, with its manifold and perplexing changes, depends. The areas are called cyclonic and anticyclonic, from the Greek word κύκλος, a circle; Piddington, the author of the "Seaman's Handbook of the Law of Storms," having been the first to propose the generic name of "cyclones" for the typhoons of the Eastern Seas and the hurricanes of the Atlantic, which are each connected with an area of very low pressure (*i.e.*, an area where the barometer has fallen very rapidly), round which the wind sweeps with terrific velocity. Practically, at present, any region of relatively low pressure is called cyclonic, and any region of relatively high pressure, anticyclonic. If at any place, or over any district, the barometrical reading is lower than at the places all round it, that place or district is the centre of a cyclonic area; if, on the contrary, the reading at the place or district is higher than at places all round it, that place or district is the centre of an anticyclonic area.

A chart like those now under consideration is rarely sufficient to show the full extent of an area of either class, but we can gather from the general course of the isobars, and the directions of the several winds which are shown on it, where the respective areas lie. These areas or regions, as they are also called, are shown on a chart by the course of the isobars which enclose them. On such a chart there are several isobars corresponding to the various gradations of barometrical pressure. Take the chart for April 29, given below (p. 779). The isobar of the lowest readings is that of 29·9 ins., it is therefore the nearest to the centre of the cyclonic area, and accordingly it is taken as a sign of the existence of such an area to the northward of the North Sea, and that this is a correct supposition is proved by the direction of the winds in Norway, as will shortly be pointed out, and as is seen from the explanatory remarks on that chart. The isobar of 30·2 ins. is the highest on the chart, it is nearly closed, and is more or less surrounded by the isobar for 30·1 ins. These isobars show us that an anticyclonic area is lying over the entrance of the English Channel, and this statement is confirmed by the sweep of the winds at Scilly, Paris, and Biarritz, as will be at once explained. On this chart the isobar of 30 ins. marks, so to speak, the neutral area, but cyclones and anticyclones *are relative terms*. The reading may be above 30 ins. at the centre of a cyclonic area, or below 29·5 ins. at the centre of an anticyclonic area. The greatest care must be taken not to identify the isobars with the areas of atmospherical pressure which they mark out. The isobars are not cyclonic or anticyclonic, though the winds may be said to have a cyclonic or anticyclonic sweep. That the definition given above of a cyclonic area is fully borne out by the chart

in question we may show by the fact that the lowest reading reported that morning was 29·8 at Skudesnaes, and *all round it*, as far as reports go, we had higher readings. Wick, 29·85; Aberdeen, 29·89; Cuxhaven, 30·07; the Scaw, 29·93; Stockholm, 29·89; Christiansund, 29·87. The report from the Shetlands had not arrived when the chart was drawn. While speaking of the extent of the areas, we may say that while, as a general rule, the cyclonic areas are far more limited in superficial extent than the anticyclones, the former sometimes attain prodigious dimensions, one on the 19th of January, 1873, having covered the space from the Bay of Biscay to Iceland.

It may now be asked, how does the direction of the wind enable us to judge of the distribution of pressure? This is the great discovery of recent times in weather knowledge. The air either flows out of an anticyclonic or into a cyclonic area, but it moves in a curved course sweeping round the centre, where there is a calm in both cases. The direction of this motion in the northern hemisphere is *with* watch hands in the former, and *against* watch hands in the latter case; in other words, if we started from the south point of any area and drifted before the wind which was blowing there, we should in the former case move as an East wind, and afterwards change through S.E. and S. to S.W. and so on; in the latter case, we should begin to move as a West wind, and afterwards change through S.W. and S. to S.E., &c. If we consider either of these instances carefully, we shall see that when we are drifting with our back to the wind we have always a higher barometrical reading on the right hand than on our left; this is, in other words, that the direction of the wind is nearly parallel to the isobars. This is all stated very concisely by what is known as Buys Ballot's Law, which is as follows:—"Stand your back to the wind and the barometer will be lower on your left hand than on your right."

Hence we see that from the direction of the wind we can draw positive conclusions as to the distribution of pressure. If we have a south wind in the west of Ireland, we know that there must be an area of low pressure over the Atlantic outside our coasts to produce it. In the same way, westerly winds in Caithness and Shetland show positively that the barometer over the Faroes, and probably over Iceland too, is lower than it is with us.

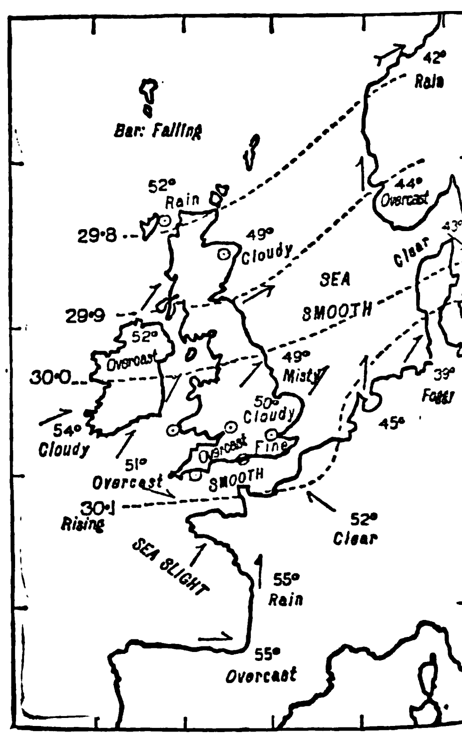
It is needless to multiply examples like the above, and I must say something about the means which we possess of judging of the wind force from barometrical readings. The force, moreover, depends on the difference of pressure over a definite distance. If the barometer in London is an inch higher than it is say in Edinburgh, there will be a strong wind from the westward over the north of England—in fact, a storm, while if the difference in readings between the same places is only a tenth of an inch there will be hardly any wind at all.*

This is all simply expressed by the idea of a "gradient," as a means of gauging these differences. The barometrical gradients cited in the remarks on the daily charts are in hundredths of an inch of mercury, and the definite distance is 50 geographical miles, and it is found that the wind will not reach such a force as to be too strong for yachts and small craft unless the gradient is at least six hundredths of an inch. The direction of the wind will always be nearly at right angles to the line along which the gradient is cited. These principles form the very foundation of our knowledge of weather, and they are nothing but a development of Buys Ballot's Law.

It need hardly be pointed out how the principles which have just been mentioned deal a death-blow at the old rules for weather which are expressed in the words still to be seen on barometer scales, "fair," "change," "rain," "stormy," &c., which are little less than utter nonsense. It is undeniable that there is more chance of strong wind when the barometer is low than when it is high, but this arises from the circumstance already mentioned, that cyclonic areas are usually much smaller than anticyclonic, so that when the barometer is low there is probability of a steep gradient, from adjacent higher readings, existing, than when the readings are high; although it sometimes happens that the barometer in these islands will remain for a day or two below 29 inches, *i.e.*, below "stormy," without much wind, as the gradients are slight.

I shall now proceed to give practical instances of the use of these charts, but in doing so I, as before stipulated, must give my readers credit for an acquaintance with a portion of the A B C of practical meteorology, the fact of the difference between the two great currents of air, the equatorial (S. and S.W.) winds which are warm and moist, and the Polar (N. and N.E.) winds which are cold and dry. I must also premise that it is not possible to find in summer such telling examples of the various types of weather as are met with almost daily in winter, so that we must only do the best we can with such charts as have already appeared in the *Times*.

I shall take instances of the two classes of areas with their concomitant weathers, and strive to show something of what may be learnt from them. The period which I shall first describe is that from April 27-30, which was cyclonic, although not very markedly so; *i.e.*, there was a general deficiency of barometrical pressure near the United Kingdom, as is shown by the passage of several cyclonic areas over these islands; and see what it teaches us not only about cyclones or areas of barometrical depression, but about the laws of their motion.

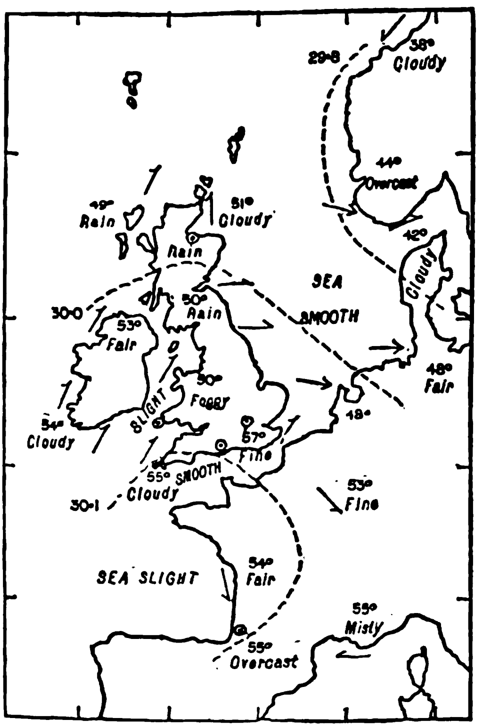


April 27, 8 a.m.

In the first instance we have four isobars shown, indicating that pressure is least off our northern coasts,

* This very statement, almost *totidem verbis*, occurs in Webster's "Recurring Monthly Periods of Atmospheric Action," London, 1857, p. 201, but it unfortunately attracted no attention when first published.

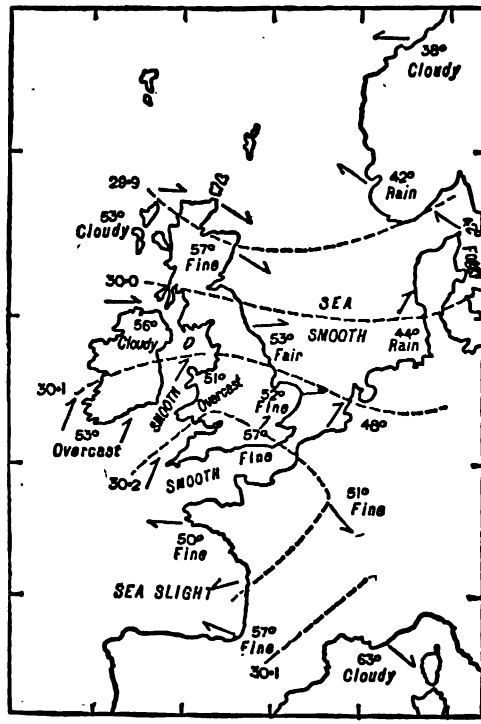
and highest in the south. The winds are generally nearly parallel to the isobars, with a tendency of influx of air towards the region of least pressure, but to this there are are some exceptions. The south wind at Skudesnaes is affected by the coast line of Norway; the fresh north-west winds in Denmark belong to a system of depression which has just passed over that country, and the winds in France are irregular, being merely light local airs. The general wind is from W. to S.W., but while in the south of England, near the region of high pressure, the weather is warm and fine, though cloudy, mist is reported from Scarborough, and in the north of Ireland and Scotland the weather is showery, even with thunder storms (a frequent accompaniment of advancing depressions) on the eastern shores of the latter country, while rain is falling in Caithness and at Christiansund in Norway also, with a south-west gale. The probability from these conditions is that, by next morning, the area of low pressure will have advanced to the eastward, and that the winds in Scotland will have veered to west or north-west.



April 28, 8 a.m.

The chart for next morning shows us that the cyclonic area existing over the sea on the previous day has advanced over Norway, and the winds shown on the coast of that country belong to its rear, being N.N.E. to N.N.W., confirming the statement just made as to the position of the centre. The isobar of 29·8 ins., which on the 27th passed from the island of Harris to near Trondjem in Norway, now sweeps from just outside the Norwegian coast and across Denmark to near Copenhagen. The reduction of pressure over Germany had caused the area of high pressure to become contracted, so that the winds in France take an anticyclonic sweep round it, and the weather in the south of England remains fine. In the North, however, we have some signs of approaching disturbance in the shape of the advance of another cyclonic area with its system of winds. The barometer had risen briskly since the previous day, and is now, at 8 a.m., giving way again in the Hebrides, while cloud and rain have become more general in the north.

We see by the chart for next morning that the new depression is following the track of its predecessor pretty closely, but its centre is situated near the Shetlands,



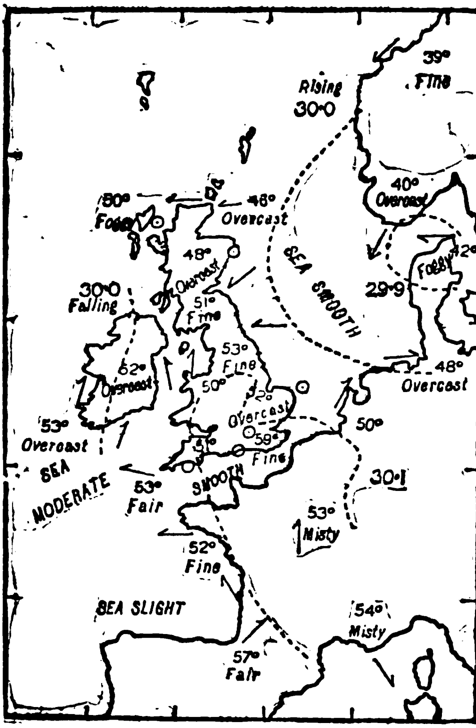
April 29, 8 a.m.

for the easterly winds in Norway *must* be on the northern side of the centre in accordance with Buys Ballot's Law. although from the absence of information we cannot draw the closed isobars which would mark it out more definitely. However, the direction of the winds in Norway from the eastward, shows us that the area is not a large one, and that it will probably cross the North Sea. The fog and mist have reached the eastern shores of that Sea, while in these islands the sky has cleared, and the anticyclonic system of the previous day in the south-west has not changed its appearance materially.

The next chart, for April 30, exhibits a very interesting state of affairs. The small depression, whose course we have traced, lay over Jutland and the Skager Rack, and could we see Sweden on the chart, we should find the cyclonic circulation round it complete, while the easterly winds in its rear have extended to Scotland. The area of high pressure has moved eastwards, and its outline has assumed a most irregular shape; but our weather, in England, remained almost unchanged. In Ireland, however, the wind has backed to south, at all stations, with a rough sea and cloudy sky, and of course, according to the principles so often quoted, the isobars run north and south, pointing to a low pressure over the Atlantic, the normal conditions accompanying our south-west wind at any time of year.

The sea which came in was not caused by the force of the wind on our own coasts, but by gales outside; in fact these gales grew to such violence on the 3rd of May, as to force the *Faraday* to buoy the telegraph cable she was laying on the banks of Newfoundland, and they sent to our coasts, two days later, the sea which broke up the ill-fated *Schiller* in a few short hours, though hardly a breath of wind was stirring to lift the fog which hid the deadly rocks of Scilly from the captain's view.

These disturbances which I have traced were the

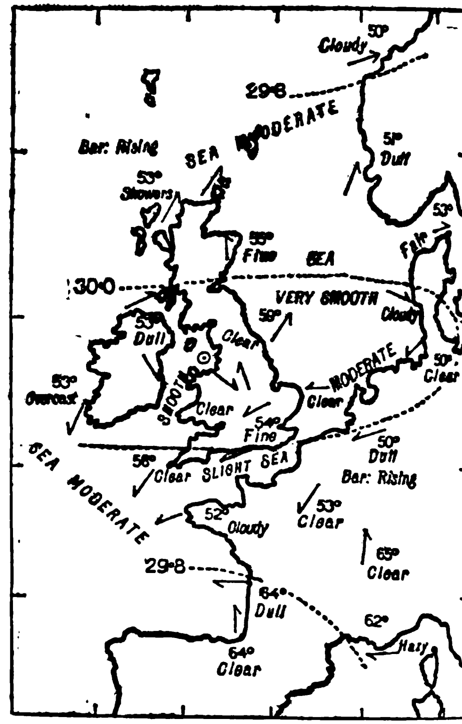


April 30, 3 a.m.

final break-up of our protracted winter, and the whole series of charts show that when we have westerly winds and fine weather, we may expect that to the northward of these islands the wind will be less steady, and will have a tendency to veer and back between S. and N.W., while the successive depressions pass by, or over, us to the eastward.

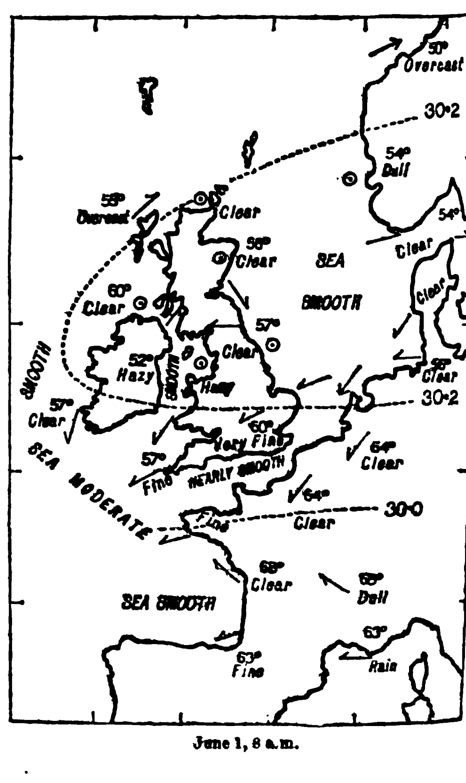
Such a direction of motion as this is general whenever the area of high pressure lies over France. The cyclones follow the main course of the stream of air, and as that is westerly on the northern side of the anticyclonic area, the cyclones move from W. to E., as was the case on the 27th. When the district of high readings lies more in the south-west, the systems of depression take a more south-easterly course, as we see from the instance of the 29th.

As an example of an anticyclonic period, and the changes which it brings with it, I shall take May 31st and the two following days. On the first of these days a belt of high pressure stretches from Holstein across England and Ireland, enclosed by the isobar of 30 inches. To the northward and southward of this the isobar of 29·8 inches appears, indicating the position of two areas of comparatively low pressure on each side of the central belt. The wind is not so strictly anticyclonic as might be expected, but still it draws from S.W. in the North of Scotland, through W. in Denmark, to N.E. at Cuxhaven, and E. in the Channel. The sharp change of direction of the wind round the pointed end of the region of high pressure is very striking, and it will be noticed that the general motion of the wind is *with* watch hands, or directly opposite to what it was in the instances previously treated. Within the central area the breezes are light and variable, but over the rest of the chart we see the two great currents represented—the equatorial, with its S.W. winds, blowing over Scotland and the West of Norway, and bringing with it a warm temperature, loudy skies, and showery weather; while to the south-



May 31, 8 a.m.

ward the true polar current appears, as a cold, dry, east wind, with a clear sky. Experience teaches us that with such conditions we need not expect any very sudden change of weather.



June 1, 8 a.m.

y next morning we find that the barometer has risen than 0·2 in. over Scotland and the North Sea, and e anticyclonic system has to some extent changed its and appearance, having opened out on its eastern closed in on its western sides, for from the fact of readings at Stornoway and Valencia being both w 30·2 ins., we may venture to draw the isobar over the n our western coasts between those stations. The t on the wind has been to displace the equatorial nt, which now only shows at Stornoway and tiansund, with its cloudy skies, while the easterly s have gradually extended northwards over land, and the clear weather is reported even up to hness, with this remarkable peculiarity, that, as we aling with the conditions of summer, we find the th of the east wind increasing, inasmuch as the erature of the north of Europe is much higher at season than at the period of our usual east winds. to the southward, in Provence, we see dull weather rain, where the atmosphere is no longer under the yclonic influence.

June 2, 8 a.m.

n the chart for the next day we see that the whole yclonic system of air circulation has moved away to north-eastward, and the central area of high pressure over Norway. The easterly winds have become eral over the United Kingdom, and the fine weather came with them, but the air is foggy at several ions. Over the Bay of Biscay we see the cyclonic n of the wind, with rain setting in—the unfailing ication of the approach of an area of depression. This r system appeared over France on the morning of 3rd, and entirely obliterated the anticyclonic actions ch we have just been tracing.

Here, then, we have an area of high pressure moving y slowly to the north-eastward, and drawing up after the belt of easterly winds. The area is more extensive n that of the cyclonic systems formerly noticed; its tion is more sluggish, and the atmospheric circulation determines is less rapid.

The moral we may therefore draw from this latter series of charts is, that whenever we see an anticyclonic system developed on the chart we may calculate on its persistency for some days, and we need not, in general, expect high winds.

Space would not permit me, even if there were the charts to produce, to show what our chances of weather would have been if the anticyclone had lain over Ireland, when a succession of cyclonic disturbances might have been expected to take a southerly course over the North Sea, causing the northerly winds on the eastern edge of the anticyclone, *i.e.*, over Great Britain, to freshen, perhaps to the force of a gale, as each individual system passed us by.

Such are the principles we have to guide us in judging of weather and in issuing warnings of storms. In winter if the characteristics of the different winds are more decided, the motion of the disturbances is often more rapid, and the whole condition of affairs is far more serious. Accordingly it must be confessed that our warnings are not unfrequently too late to be of much service to our exposed western coasts. One great reason for this is insufficiency of information. It is simply impossible that reports taken once a day can give an account of all the changes which supervene during the twenty-four hours. It is equally clear that to see at breakfast time a chart for the preceding morning is far less useful to us than a chart for the previous evening, not to say, even for midnight, would be. The attainment of improved rapidity of publication is merely a matter of £. s. d. Given unlimited money and the thing can be done.

A stereotyped chart can be delivered to a London newspaper within about four or five hours after the observations have been taken all round our coast, but the mere cost of telegraphy for a single set of say 25 reports is £1 5s. a-day, or about £400 a-year (including Sundays), and the expense of a night service of reports from such stations as are open at a late hour, with the extra attendance at the London office entailed thereby, could not be less than £1,000 a-year. Had the Meteorological Office that sum at its disposal for the purpose, the work could be done, but it is hardly reasonable to ask the Government to pay such an amount for the ostensible purpose of furnishing recent weather information for the public press.

It is a very favourite matter with critics of European meteorological work to contrast the weather charts, published thrice a-day at Washington, with those which are issued only once a-day here. In such strictures the circumstance is always ignored that the cost of weather telegraphy in the United States is £50,000 a-year, exclusive of all salaries, while our own Meteorological Office can only devote to the same object an annual sum of less than £3,000.

In conclusion, I may make a short digression with reference to the principles on which storm warnings are issued.

As soon as the telegraphic reports indicate that a disturbance of the atmosphere, probably accompanied by a gale, has either reached us or is near our shores, warning telegrams are issued to such parts of our coasts as are apparently threatened. The principles which we have to guide us in forming a judgment on these points cannot be stated in a paper like the present, but they are, in very general terms, as follows:—

The approach of a cyclonic disturbance is shown by the fall of the barometer and the changes of the winds at the different stations, in accordance with Buys Ballot's Law. Corroborative evidence is afforded by the variations of temperature and of weather, by the roughness of the sea, by the appearance of haloes, auroras, &c. The coasts threatened in the first instance are usually those where these symptoms first appear. The probable subsequent path of the storm, if storm there be, is shown by the general distribution of barometrical pressure, as already explained, and by the behaviour of the barometers at our different stations as the time wears on.

The degree of success which has attended our warnings in these islands, on the average of the last two years, has been that over 45 per cent. have been followed by severe gales, and over 33 per cent. in addition have been followed by winds too strong for fishing boats or yachts, though in themselves not severe gales; this gives a total percentage of success of nearly 80.

It cannot, however, be too emphatically stated that the meteorologists who have had most experience in dealing with meteorological telegraphy in Western Europe are most decided in their opposition to any idea of their being able to foretell weather with certainty in the present condition of our knowledge.

COPYRIGHT OF DESIGNS BILL.

The objects of this Bill, which has been introduced into the House of Lords by the Lord Chancellor, and was read a second time on Tuesday last, are to enable the Commissioners of Patents to exercise all the functions and powers formerly vested in the Board of Trade. It will come into operation on the 1st of January next, and may be cited as "The Copyright of Designs Act, 1875." The Commissioners of Patents are empowered to make, and when made to revoke and alter general rules for regulating registration under the various Designs Acts. The discretion or power vested in the registrar under the said Acts shall be subject to the control of the Commissioners of Patents, and shall be exercised by him in such manner and with such limitations and restrictions as may be prescribed by the said general rules. Rules made under this section are to be laid before Parliament. The office of registrar under the former Acts to be abolished, but the Commissioners of Patents are to make suitable arrangements for the proper performance of the duties of the registrar and for the other duties directed to be done under the former Acts of Parliament. Any delegation of duties to the clerk of the Commissioners of Patents made by the Board of Trade shall be as valid as if it had been done under the powers of the Act now before Parliament. The Acts referred to in the schedule are 5 and 6 Vict., cap. 100; 6 and 7 Vict., cap. 65; 13 and 14 Vict., cap. 104; 21 and 22 Vict., cap. 70; and 24 and 25 Vict., cap. 73.

CORRESPONDENCE.

AN ART CURIOSITY.

SIR,—A painting belonging to myself is now on view at the Leeds Exhibition (No. 782a). It represents a party of Indians gold-washing in a pool. An engraving of it, by Theodore de Bruy, is in the *Historia Americæ*, an old Latin book, published in Frankfort in 1560. The picture is believed to be the original work from which the engraver produced the illustration, but who painted it is not known.

The painting is cleverly finished in bas-relief, in a manner totally different from that of any known master. Size, 50 in. by 40 in., on canvass. Some of your readers, learned in art, may know something of its origin.—I am, &c., GEORGE ELLIS.

10, Bolton-road, St. John's-wood,
July 21st, 1875.

The members of the Royal Commission on Scientific Instruction and the Advancement of Science have now held their final sitting, and appended their signatures to the following reports:—The sixth report, on Science-teaching in Public and Endowed Schools; the seventh report, on the University of London, the Universities of Scotland, the University of Dublin and Trinity College, and the Queen's University in Ireland; and the eighth and final report, on the Advancement of Science and the Relations of Government to Science.

GENERAL NOTES.

The Patent Bill.—Since the last note on this subject petitions against the Bill have been presented to the House of Commons from the Bradford Chamber of Commerce (June 24), Bradford and District Trades' Council (June 2…), members of the Southampton Trades' Council (June 2…), and from Frederick Joseph Bramwell, President of the Institution of Mechanical Engineers (July 6). Petitions for alterations have been presented from the inhabitants of Liverpool (June 23). Inhabitants of Bedford (June 2…), Members of the Patent Law Committee (June 24), and from the working men of Rochdale (June 24). Mr. C. … Parker Rhodes (June 29) prays for Royal Commission to consider some proposals which he makes with a view to the reform of the Patent-laws. Up to the 6th instant … petitions, with 246 signatures, have been presented against the Bill; 24 petitions with 905 signatures pray for alterations; one petition with one signature asks for a Royal Commission, and one petition with 179 signatures prays for a Select Committee. There is not a single petition in favour of the Bill. It is understood that the Bill will not be proceeded with this session.

Exhibition of Scientific Apparatus.—This Exhibition at South Kensington will open on the 1st of April, 18… and remain open until the end of September, after which time the objects will be returned to the owners. It will, as has been already intimated, consist of instruments and apparatus employed for research, and other scientific purposes, and for teaching. It will also include apparatus illustrative of the progress of science, and its application to the arts, as well as such as may possess special interest on account of the persons by whom, or the investigations in which, it had been employed. The precise limits are defined under several sections in a syllabus which has been issued for the information of exhibitors. Models, drawings, and photographs will also be admissible where the originals cannot be sent. The apparatus may, in certain cases, be arranged in train as used for typical investigations; and arrangements will be made, as far as it may be found practicable, for systematically explaining and illustrating the use of the apparatus in the various sections. Forms on which to enter descriptions of objects offered for exhibition may be obtained on application to the Director of the South Kensington Museum, London, S.W. These forms should be filled up and returned as soon as possible, so that exhibitors may receive early intimation as to the admissibility of the objects they propose to send. The cost of carriage of objects selected for exhibition will be defrayed by the Science and Art Department. It is hoped that institutions or individuals having instruments of historic interest will be good enough to lend them. The following are the various sections into which the Exhibition will be divided:—Arithmetic, Geometry, Measurement, Kinematics, Statics and Dynamics, Molecular Physics, Sound, Light, Heat, Magnetism, Electricity, Astronomy, Applied Mechanics, Chemistry, Meteorology, Geography, Geology and Mining, Mineralogy, Crystallography, and Biology.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

La Législation de l'Instruction Primaire en France depuis 1789, jusqu'à nos jours, par M. Gréard. (3 vols.) Paris, 1874. Mourgues Frères. Presented by the Rev. James G. C. Fussell.

Keramic Art of Japan. Part I. By G. A. Audsley and J. L. Bowes. London, 1875. Sotheran and Co. Presented by the Authors.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,184. Vol. XXIII.

FRIDAY, JULY 30, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EXAMINATIONS, 1876.

The Council have decided that the Society's scheme of Examinations shall be thoroughly revised, and have appointed a Committee for that purpose. The Programme for 1876 will be issued as soon as the details have been settled by the Committee.

MUSICAL SCHOLARSHIPS OF THE SOCIETY OF ARTS.

It is proposed to form a fund, to be subscribed among the members of the Society of Arts, for the purpose of establishing scholarships open for competition among qualified persons nominated by the Society for examination in such competition. Members willing to make donations or give subscriptions in aid, are requested to communicate with the Secretary.

The following subscriptions have already been promised :—

Lord Alfred Churchill (Chairman of Council), for 5 years, yearly	£5
Sir Henry Cole, K.C.B., for five years, yearly	5
E. C. Tufnell " " "	2
Peter Graham " " "	2
Andrew Cassels " " "	2
E. J. Reed, C.B. " " "	5
R. Rawlinson, C.B. " " "	2
Edwin Lawrence " " "	2
Edward Brooke " " "	5
Hyde Clarke	5
F. A. Abel, F.R.S.	5
Seymour Teulon	5
Major-General F. Eardley-Wilmot, R.A., F.R.S.	5

NATIONAL TRAINING SCHOOL FOR COOKERY.

The Education Department, the Female Training Colleges, and School Boards in the metropolis and country are all at work to connect instruction in cookery for female students with National Education. The great want for a long time will be properly trained teachers. The National Training School for Cookery has several students in training, and seeks for more. With the view of assisting this important movement and spreading the knowledge of it especially among Institutions in Union with the Society, the Council, on the 19th July, passed the following resolution :—

"That a notice be published that the Council are prepared to establish five scholarships of the value of £10 10s., giving free instruction to female teachers of cookery to be trained at the National Training School for Cookery; such scholarships to be awarded by competition; the members of the Society of Arts and of Institutions in Union with the Society to have the privilege of naming candidates for competition."

It is expected that any well-educated lady who becomes a certificated teacher of cookery (not a domestic cook) may look forward to obtaining an income of £100 a-year, by conducting a local school where adults of all classes, and the students of public schools, may attend to receive instruction and to practise. The competition will, in the first instance, take place in London, in the month of October next. Full information can be obtained of the Secretary of the National Training School for Cookery, Exhibition-road.

CANTOR LECTURES.

The first lecture of the course of Cantor Lectures on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft," by the Rev. Arthur Rigg, M.A., was delivered on February 8th, 1875, as follows :—

Lecture I.

On Tools used in very early times as evidenced in Pre-historic Implements and Drawings of Ancient Date, also on Tools used in recent times amongst (so called) Savage Races.

In a course of lectures on mechanism delivered in this room during the winter of 1871 and 1872, reference was made to the place man should occupy in a general zoological classification. You were then reminded that to Aristotle, who died 322 B.C., we are indebted for the first attempt at accomplishing such a classification. The distinguishing characteristic of man regarded for this purpose alone was the selection by Aristotle of a feature which is especially appropriate to the present course of lectures. Aristotle called man "a tool-making animal," for he could not find any other group of animals who made special implements and used them as we do tools. So generally is this view of man accepted, that in recent times the inferences from it are wider and more extended than Aristotle could have anticipated. For antiquarians now admit (without controversy) that wherever on or under the surface of the earth "tools" are found, it is clear that there men have once dwelt.

The first traces of tools are said by geologists to be met with in the post-tertiary strata, and accepting the statements of those to whom public opinion assigns a competency to read and interpret the writing which geological pens have inscribed

upon the materials of this earth, the inference from such a fact is that man's existence may be placed so far back that centuries are insignificant periods of time.

Sir Charles Lyell (from such data as are now referred to) speculates that at least two hundred thousand years have passed since implements were formed, evidently to be used by those who lived at that time. The date of these implements is unmistakably clear; they are found in the respective geological strata, not in solitary isolation, but in groups, and under circumstances, and in such various localities, as effectually to dispose of any suggestion of fraud or collusion. These silent evidences of facts are long precedent to all human traditions. History, as history (not the traditionary tales or poetry of even a far-off ancestry), written in a spoken language, and in what may be called intelligible alphabetical characters, and of such a nature as deals with man in his social state, and therefore may be expected incidentally to allude to tools, does not carry us further back than the days when Herodotus (who is called "the father of history") repeated at the Olympic games the history he had written. Writings of a non-historical social character prior to those of Herodotus are far from scarce, but an attempt to write history proper in alphabetical characters had not previously been made.

Although this alphabetical history is so recent, compared with the interval that must have elapsed since some of the tools now in our possession were formed, yet we are not without the means of an assured penetration into many years before alphabetical history commences. There is a precedent pictorial history, rude compared with what we call pictorial, but for our purpose very superior to that conventionalism which too often stamps its defacing hand upon the truthful and graphic simplicity of undisciplined art. This pictorial history has been written on the monuments of Egypt and the walls of Herculaneum and Pompeii, in a form which the enlarged diagrams in the room illustrate. For our wants at present Egypt, Herculaneum, Pompeii, and Rome will supply not only what may be truly called pictorial, in the clear delineation of tools actually in use more than 3,000 years ago, but they add in some cases real history in that they have entombed the very tools themselves.

If we penetrate still further back, then even pictorial history fails us, and the implements alone of these far-off generations offer a silent evidence from which to form a diagnosis of the mechanical operations of the human race.

Although the question of dates may come before us again, it will not be without value if even now a preliminary conception be formed of the times comprehended in what has already been alluded to.

The first written alphabetical history is by Herodotus, and dated at 445 B.C. Assume that he might with confidence avail himself of the traditionary history of three preceding centuries. Then alphabetical history carries us back for (1875 + 445 + 300) 2,620 years from this time. Pictorial history carries us back for (1875 + 1740 + 300) 3,915 years from this time. Now, records (taking the marginal dates in the English Bible as our guide) fix the Deluge at 2,348 years B.C., *i.e.*, the Deluge took place (2348 + 1875) 4,223 years from this time. Our pictorial history then carries us back to within (4223—3915) 308 years of the Deluge.

Abraham died 1822 B.C., and Joseph was sold into Egypt 1729 B.C., *i.e.*, Abraham died (1875 + 1822) 3,697 years ago. Joseph was sold into Egypt (1875 + 1729) 3,604 years ago. Consequently, pictorial history takes us back hopefully to the days of Abraham, even if three precedent centuries be not granted, and certainly to those of Joseph and his brethren. Job is supposed to have lived (1875 + 1520) 3,395 years ago, *i.e.*, 29 years before the Israelites left Egypt.

Whatever information we consider we possess, prior to the dates now given, may "so far as tools are concerned" be called pre-historic. This word "pre-historic," has, however, a clearly defined meaning with geologists. If one turns to a scheme of geological strata, then those strata found above the tertiary are divided into three classes—the post-glacial, pre-historic, and historic. In the former (post-glacial) there are not any traces of handicraft work. In the second (pre-historic), there are found remains of canoes made of trees, of dwellings erected on piles, implements made of flint and stone, and fragments of charred wood. When speaking of the third or historic period, even then geologists do not refer to such written history as we understand by the word; but to the foregoing implements they add such as are made of metal. (With the flora and fauna of these periods we are not concerned.) Each may for himself decide how many years are comprehended in these three geological periods.

For our purpose these are three "ages:" one in which tools were of stone; and this is again subdivided into two periods, the palæolithic or ancient stone period, when the stone tools were left with rude and rough exteriors; and the neolithic or recent, when there was somewhat of an external finish or polish on the tools. A second age in which tools are found formed of pure copper or bronze, the pure copper tools being so rare that they are comprehended in the term bronze. A third age in which tools are formed of iron; these introduce us to the age in which we live.

It must not, however, be assumed that these ages are markedly distinct. It is more than probable that whilst in one part of the world men were using bronze, in another part they might be using iron. Thus much, however, is certain, that in times to which even geologists might hesitate to apply the term "recent," the smelting of copper and of tin were known, and the combining of these metals to form the hardest bronze made and used at the present time, was also practised. An analysis of these ancient bronze implements shows that the copper is alloyed with from 5 to 10 per cent. of tin*. Metallurgists now report that this combination secures the maximum hardness combined with toughness, and the absence of a crystalline character. If more tin be added, a file will produce a granular rather than a fibrous abrasion. Therefore the men in this geologically pre-historic bronze age were in the alloying of copper as wise as we. Whether they relied upon the proportion of the parts of the alloy, or whether they had

* Analysis of Egyptian bronze implements gives 94·0 copper, 5·9 tin, and 0·1 iron.—"British Museum Guide," p. 39.

means for tempering the tool produced, as we temper steel, is not clearly ascertained.

An examination, in the course of these lectures, of such examples of tools and implements as relate to the first two ages, in a brief and cursory manner, may suffice to put before you the state of man's skill in handicraft before either the pictorial or alphabetical history of the human race commences. Where these latter histories commence our interest increases, because we shall find we have passed from handicraft tools, of whose works we have little or no evidence, unless rude carvings be considered as works, to a class of tools and works produced so like our own, that an inspection of them seems to blot out the time which has elapsed since their formation.

There is, however, another source of information which materially helps us in supplying inferential, if not actual knowledge, with regard to the first formed tools. The traditions of a people as well as the customs and practices of their forefathers are preserved and repeated, generation after generation, by savage and altogether uncivilised and isolated races of men. Hence, amongst savage tribes and roving barbarians may be found at this day tools altogether different in form from those amongst civilised people. Such tools may be, and probably are, derived from ancestors of what we may call geological antiquity.

Now, in the Pacific Islands, in North America, Australia, Africa, and elsewhere, races of men at present exist amongst whom the use of metals is unknown, and whose implements correspond exactly with those found mixed with the fossil remains of extinct animals. Knives of flint are mentioned by Herodotus as used in Egypt in his day for embalming—many such knives are found in the tombs. These knives were employed long after bronze and other metals were general. Such records confirm the suggestion that in looking amongst secluded races we shall find the tools of their ancestors' ancestors. Hence the connection in this lecture of pre-historic times and (so called) savage races. I say *so called*, for let no one despise the handicraft contrivances and skill of the untutored. Those who hold themselves highest are far more indebted than they publicly confess to uneducated men of clear thought, cunning resources, singular ingenuity, and much handicraft skill. It is well known that even in our own times the earliest germs of many most important inventions and discoveries have their origin in the suggestions of hard-working but illiterate artisans.

The searchings for what will be produced in these lectures have left an impression on my mind that in originality, adaptability, variety, skill, applied to what men in those days required, we are certainly not superior to men whom we call savage. Let me anticipate the conclusion, and show you one or two tools which warrant this opinion. There is the model of a scraper, or plane, on the table brought from Icy Cape by Sir Edward Belcher, which, for singular fitness for the purposes to which it may be employed, far exceeds the similar productions of any civilised tool-makers either in England or America.

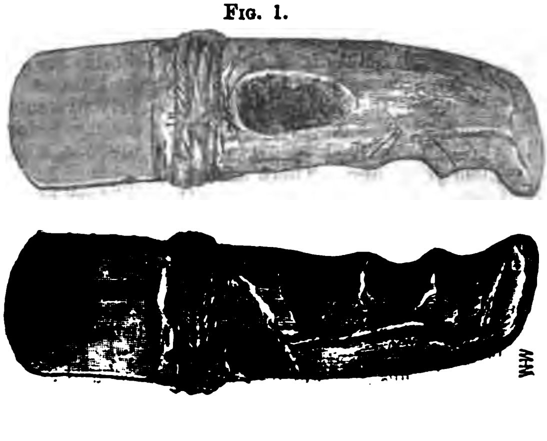
Since there is said to be nothing new under the sun, it may be asked whether this contrivance, which may be thousands of years old, is new enough to be patented. This scraper, or plane, instead of our usual smoothing-plane, would probably find a ready sale; even the form may be suggestive to those who use one-handed planes, and who are willing to accept hints from any quarters, even savage races.

It will be observed that the Esquimaux designer of this plane had carefully considered the external adaptabilities of the right hand, even though he may not have known the internal anatomy. Let us deal with the form as of Exquimaux origin, although before these lectures are closed it will not be difficult to show that the original design is to be found in the days of Joseph, and, perhaps, even in those of Abraham. The plane, or scraper, is essentially a single-handed one; it is, in fact, a very well-contrived smoothing plane in all respects except the mouth.

Now note the peculiarities. The external form has been moulded to fit the palm of the hand, it is as though the hand had been laid in a plastic material on the table, the hand being curved as it usually is in writing with a pen. If now the hand were to grasp this plastic material the two first fingers would impress their form upon the upper surface. The two next fingers would impress themselves into the side, and their pressure being met by an equal pressure from the thumb, the material would be firmly held. Such is the general form given to this scraping tool or plane. Be he Esquimaux or Egyptian by whom the original suggestion of form was given to the instrument, he contrived a protection for the working wrist. (Wilkinson's "Ancient Egypt," vol. iii., p. 140, No. 358.) You may observe that the sole of this shaped block of wood in my hand does not end with the hand. It is prolonged under the wrist, and thus becomes a shoe or sandal, so that the whole of the pressure from the wrist and hand is borne upon this sole. In front of the fingers is the scraper or chisel. You will notice that the tool has no mouth-piece, and in that respect is deficient. In the sole, however, it has the guide principle not only fully recognised, but skilfully incorporated.

The Esquimaux woman's knife now in my hand is equally well-adaped to the purpose for which it is employed. The cutting portion of "jade" is bound to a bone handle by thongs. An observation of the indents in the annexed woodcut will sufficiently explain the construction. The single indent on the one side is for the thumb of the right hand. The indents on the lower woodcut

FIG. 1.



are for the fingers of the same hand. If any one will handle the knife, they will admit there is great firmness of grasp, combined with much freedom and flexibility of motion.

Although the tendencies of men's minds are to the transference of bodily labour to machinery, yet there will ever remain large tracts of land where machine-driven tools cannot be utilised, and where handicraft tools are alone available. Further, it must also be considered that our machine-driven tools are but handicraft ones, formed for handling by a power which has not the varied adaptability of the human fingers, arms, feet, and legs.

To pass from the earliest suggestions of bronze implements to the first really true unquestionable period of metal tools, the forms and modes of using which are so clearly shown pictorially, we are introduced into Egypt.

Strange, indeed, is the retrospect which places us so suddenly upon a people where civilisation and art and science seem to our modern eyes to have sprung Medusa-like from a primeval social chaos. But so it is; when we enter upon Egyptian history, which in its truthful clearness about tools enlightens a gloom as a flash of lightning would do a moonless winter night, we are as much perplexed with the embarrassment of material as we had previously been with the dearth of it.

The paintings and sculptures of Egypt and Herculaneum place very clearly before us the tools in use so far back as pictorial history can carry.

It may with apparent truth be asked why we should inquire into the tools used when works of great magnitude and of such artistic skill are met with in Egypt and in the museums of Europe and Asia. Surely we may accept the use of tools and contrivances without further research. Not so; there are very many useful lessons in these tools—there is much to be learnt from searching into old ways, and many a disappointed inventor might now be in ease and affluence had he patiently studied the works not only of those who immediately preceded him, but even of these far distant Egyptian artisans.

Although prior to the time of which we are speaking tools have been found in the earth, yet no works—unless such implements as arrows, hooks, needles, &c., be regarded as works—done by these stone tools have reached our times. The oldest known combinations of materials constituting what may be called works of men, and existing as such at the present day, are the pyramids of Egypt. The tools and contrivances used in the building of the early pyramids are not known. Those who have investigated the subject place the erection of these early pyramids about 2120 B.C., *i.e.*, about a century before Abraham arrived in Egypt, and (1875 + 2120) 3,995 years ago. There are no hieroglyphics on these, and they do not carry their history as the tombs we are to speak of do.

Reproductions (even to an imitation in the colouring) of drawings and sculptures in ancient Egypt have occupied the attention of artists of great repute in France, Italy, and Prussia. The volumes containing these illustrations are large, the size of the plates being two feet three inches by one foot eight inches, and some-times more. The French reproduction was a result of Napoleon's invasion of Egypt in 1799; it consists of eleven large folio volumes of plates, and entitled *Description de l'Egypte*, 1809-22 (this is in the library of the British Museum); the Italian one is by Rosellini, *Monumenta del Egitto*, 1832-44. The Prussian one is by Lepsius, *Denkmaler aus Ægypten*, 1848-56. These are in the library of the Royal Institution, and to that by Rosellini, the plates in which are coloured as the originals, we are indebted for the diagrams on the walls.

With reference to the fact that there are numbers of wall paintings in this past age representing practical arts, it should be remembered that these arts must have been in high repute, for long after the dates now referred to wise laws were instituted in Greece, by which every one was forbidden to be idle, and each was required to give an account to the magistrate of his application to some pursuit. But a person was not permitted to exercise two arts at the same time, on the ground that he who undertakes many things generally executes every thing badly.

To return. As with ourselves so with the Egyptians. The son generally followed the employment of his father, or some other relative, and the trades, at least many—especially the carpenters—were formed into guilds, or societies, for mutual improvement. Unfortunately for centuries past handicraft has been despised. Not so in early days; not so when the guilds in London held their own. We may be sure that they who by their handicraft could contribute so much to social comfort as cabinetmakers, carpenters, quarrymen, stonemasons, sculptors, shoemakers, potters, dyers, glass-blowers, engravers, weavers, fullers, tanners, founders, smiths, papermakers, were not lightly esteemed. Even in Herculaneum and Pompeii, as well as in Egypt, there are traces of this respect, and the same respect is found at Athens and at Rome.

One or two words upon the representations of these tools at all in sculptures and drawings. The artisans of Egypt, much like the best class of handicraft artisans among ourselves, were attached to their tools. Some may smile, but it is nevertheless true, that a good handicraft workman entertains true and real affection for the implements he daily uses, especially those which are his agents in the production of approved work. This affection perhaps cannot be appreciated where men work among machines and are called "hands," as though heads and hearts were not wanted.

One evidence of this affection may be seen in the dilligence with which a careful and skilled artisan polishes and preserves from dirt and scratches, the tools he most prizes, and by which his best work is done.

Transfer and intensify this affection, and we need not ask how it happens that what were much loved were often drawn. In Egypt the attachment or affection seems to have been so strong, that the workmen called their tools by pet names, as we do children, and even dogs and cats. Not that the names were characteristic—they were simply terms of (may we say) endearment.

In the days of which we speak (and the feeling still prevails in many parts), it was considered a duty to the dead to surround them in the tombs with that which in life they loved. "Sutteeism"

India is the operation of this feeling. ce not rude drawings only, but actual paintings sculpture of tools are found, and in some cases tions from, and even collections of tools. A ection of tools belonging to a cabinetmaker his "bass" or basket, has been found in one he tombs at Thebes. In cases 42 and 43 in the Egyptian room in the British Museum may een the basket and the tools.

brief enumeration of the contents of this bass case may interest some.

ass of palm fibres, neatly plaited with cover.

ell shaped wooden mallets or hammers, such as used by masons at the present day.

ails of bronze.

skin pouch for holding small tools and nails.

horn for oil for sharpening tools, such a horn may be seen at this day in a country wheelght's shop.

rill bow, drill spindle, and drill cap.

hisels.

atchet heads.

dzes, knives, and chisels with wooden handles.

n one bronze hatchet, and one bronze adze, one bronze saw is the name Thothmes III. of Dynasty, 1450 B.C. These therefore were in (1875+1450) 3,325 years ago. And on other les of axes is the name of Ata, an officer, in the of the 6th Dynasty. In addition to these, the ptian cabinetmaker had in his "bass," rasps, a mmet, and a hone. No unsuitable catalogue! would be well, and a great gratification to y a householder, if when a joiner comes to do ll repairs in a house he was as well supplied h requisite tools as these Egyptian workmen re.

here are also baskets made of fibres of the m tree with which labourers removed earth and d; just as labourers do in London at the pret time.

The numerous photographs in this lecture-room of ient tools and implements in the British Museum e been kindly lent by Messrs. Mansell, photophic publishers, of Percy-street.

These illustrations, and the objects for which y are brought before you, will lose much of r true interest and value, if even very briefly a tement be not made of the circumstances under ich the originals were probably executed.

Those who investigate the ancient monuments Egypt (and there are many who can do so, and ak with as much confidence of the meaning of hieroglyphics as one who reads a book a language he thoroughly understands) tell that no very reliable information as to dates ve been found previous to the reign of Osiren (1st) who lived about 1740 B.C. (1875+1740) 15 years ago: he was of the 16th dynasty of Egyptian kings, and reigned as king for fortyee years, and is supposed to be the Pharoah o promoted Joseph.

During his long and prosperous reign he couraged the arts of peace, and employed many rsons in buildings and excavations. At Beniasan on the west bank of the Nile, lat. 28 N., ng. 31 E., he erected grottoes or tombs, from hich many of the diagramatic illustrations are ken. There are thirty grottoes, which seem to ve been the burial places of the principal families the city of Hermopolis, a place on the opposite or east bank of the river. Some of these consist of two or three apartments, the largest being 60 feet × 40 feet. The paintings on the walls chiefly represent scenes of domestic or social life, and so give an insight into the habits and customs of the ancient Egyptians. There are processes in agriculture, in the manufacture of weapons of war, views of boats and of fishing, athletic sports, and the modes of executing various handicrafts.

Now there can be no doubt that the tools and contrivances represented on these tombs must have been in use long prior to the general adoption of them as types for mural painting.

It does not seem unreasonable to ask you to regard the diagrams before you as typical of the tools used in the days of Abraham, and very near the time when our Scripture history begins; for these tombs or grottoes were erected about 600 years after the Deluge.

From the sculptures of Beni-Hassan and on similar tombs at Thebes and elsewhere, we learn that the Egyptians were acquainted with the manufacture of linen, glass, cabinet work, gold ornaments, and numerous objects indicative of art and skill. That they played at draughts and ball as we play is also established by the sculptures here. That they made toys such as fishes, and dolls, and beads, and balls for their children as we do. That their dentists could not only fill decayed teeth with gold as our dentists do, but that they could insert false teeth and secure them to sound ones by means of gold wire, is established by the fact that such have been found where modern work was not likely to have been, even within the mummy cloths. That they could beat gold to a fineness nearly, if not quite equal to that which we have done, has been established by a careful analysis of the gilding found on the mummy cases.

That the diamond was used not unfrequently as we are now beginning to use it may be inferred from a passage in Jeremiah (17 v. 1), "The sin of Judah is written with a pen of iron and the point of a diamond." You also remember that in the book of Job (said by some to be the oldest composition in the world) it is written, "Oh! that my words were graven with an iron pen and lead in the rock for ever" (Job 19, v. 24). It is curious to note in some of the sculptors' shops in London the durability of their monumental inscriptions is secured by the same process, viz., filling up the lettering with lead, and this is sometimes described as "*patent* indelible lettering."

An Egyptian painting in the grottoes of Beni-Hassan represents two glass-blowers at work. (Wilkinson's "Ancient Egyptians," vol. iii., No. 349, p. 89.) They are using long tubes, exactly as our workmen do at the present day, and but that these men are kneeling or sitting on the ground, as Indians generally do, and that the crucible in which the glass is being melted differs from ours, it might be said that the sketch had been made at Newcastle or Warrington. In the drawing in Rosellini's plates even the lump of plastic hot glass as taken out of the crucible is represented and coloured.

Glass beads, coloured in imitation of precious gems, are also found.

That embroidery and needlework of various kinds were executed, shows that needles were well known. Some of their needles are in

the case marked 6496-7 (shelf 3), of the first Egyptian room of the British Museum; they are of bronze, with eyes like ours, and very similar to the bone ones of the geologically pre-historic times. Embroidery seems in all ages to have been a favourite occupation and a valued production. Indeed, it is not an unusual domestic heirloom. If there are any here, possessed of what are called "samplers" worked by some of the generations preceding that of their great grandmothers, they may find, carefully fastened into the sampler, the needle with which the embroidery had been executed. A similar procedure may have been adopted in these earlier Egyptian times, hence the number of bronze needles.

The accounts of the Tabernacle in the Book of Exodus (chap. xxvi. and xxvii.) amply confirm the skill of these people in needlework embroidery. The same account shows that there was a generally diffused knowledge of wire (Exodus xxxix, v. 3.)*

There is reason to conclude that the gold, when cut into strips, was afterwards drawn into round wire. The ark was overlaid with pure gold, and gold could be cast (Exodus xxv., v. 11 and 12). They made fringes (Numbers xv., v. 38), hence they made cords, also ropes of leathern thongs, as represented in sculpture; one drawing of this latter process is very clear. The leathern hides are cut circularly, so as to obtain the greatest length, and a man is represented as sitting on a heap of these arranging them for a fellow-workman, who travels backwards, and twists the thongs by a contrivance which may be verbally described. (Wilkinson's "Ancient Egypt," vol. iii., p. 144, No. 359; Rossellini, Plate lxv., fig. R.)

A cord passes round the body above the hips; this cord seems to be fastened to an eye in a metal tube. Within the tube, somewhat after the manner in which bands of hay are made in rural districts, a piece of wood can rotate. This piece of wood is represented as having a hook at one end, to which is attached the cut leather thong. The man with the band round his waist twists a a combination of these leather thongs, which are fed on by another man who sits upon the floor. What would immediately take the eye of a mechanic is the attachment of a heavy cannon-ball-like weight to an arm, as a similar weight is attached to the arm of the "Samson" by which railway carriages are coupled. In the Egyptian instance this weight seems attached to the hooked rod, and was probably an early attempt to accomplish that for which a fly-wheel is now employed.

That an extensive knowledge of weaving existed the mummy cloths show; but we are not so familiar with netting as done in these early times. Netting-needles, however, are figured, and these are so like those now in use, that had the paintings not been so ancient it might with truth have been thought the originals were sent from England. There are two shapes figured on this diagram, and those who now net can perhaps testify to the handling of some of the descendants of these netting-needles—the family likeness is so preserved. (Wilkinson's "Ancient Egypt," vol. iii., p. 140, No. 358.)

* "And they did beat the gold into thin plates, and cut it into wires to work it into the blue, and into the purple, and into the scarlet, and into the fine linen, with cunning work."

In former days, as now, the process of calendering or ironing woven materials for the purpose of producing a smooth surface, was generally practised. The drawings which these ancient paintings supply of what was probably a smoothing tool, or otherwise a plane for calendering (and from which our laundresses' irons are descended) is of the shape sketched (Wilkinson's "Ancient Egypt," vol. iii., p. 140, No. 358):—

(1) seems to be a projection for the thumb, and on the opposite side there was doubtless another for the fingers.

(2) seems to be a place on which to rest the wrist.

(3) fits into the hollow of the hand.

(4) seems to have been sloped away so that the person calendering or smoothing the cloth, could see the progress of the tool. The instrument was probably made of some of the hard woods.

These ancient Egyptians were well versed in tin as an alloy of copper, indeed the Arabic word at the present day, "kasdeer," and the expression used by Homer when he describes the raised work on shields, as in that of Achilles (Hom. Il. 18, lines 565-574), and other parts of the armour (Book 18, lines 612-474), is the same as that given to these islands by the early Phœnicians "Kassiterides." The Greek word for tin is "kassiteros."

It would be out of place to bring before you many interesting particulars of this character, and thus much has been said of tin, because it is that with which copper is alloyed to form "bronze"—if the alloy is zinc then what is truly called brass is the result. The Egyptians could also "damaskeen," or inlay bronze with gold. The bronze implement seems to have been carved with a sharp tool, and cut square down, so that the narrow lines might be filled with the cut gold strips previously referred to, and although occasionally perhaps soldered in, yet the engraving was either so truly square or even undercut that if beaten in with hammers it was fixed; indeed, some of the hieroglyphics are cut to the depth of two inches, the edges and all the most minute parts of the intaglio presenting marvellous sharpness and accuracy, and this too on a granite stone which can turn the edge of some of our best modern steel tools. They could also solder metals in the reign of Tothmes III., 1490 B.C. The Egyptians used beams and scales like ours, and there was a contrivance which served the purpose of the pointer on our beam, and indicated when there was an equality of weights. (Wilkinson, vol. ii., p. 10, No. 78; Rosellini, Plates 41 and 41.

The island of Naxos, from whence the best emery is brought, was not far from the mouth of the Nile, and we need not doubt that they knew the value of emery as much as we do.

One more tool, and then we must pass on to some of the diagrams on the wall. We are all familiar with the ordinary steel for sharpening knives, which our butchers hang from their girdles, and often use more from habit than necessity. Similar steels may be noticed as hanging from the girdles of the butchers sculptured on the tombs of Thebes. (Wilkinson, vol. ii., p. 375, No. 273.)

In addition to the articles carried by the Egyptian cabinetmakers in their "bass," as enumerated in a previous part of this lecture, there was a "bevil-square." (Wilkinson's "Ancient Egypt," vol. iii., page 174, fig. e, No. 364; and Rosellini, plate xlv., No. 3.)

This "bevil-square" deserves more than a passing notice. In my hand is a bevil-square, kindly lent for these lectures by Messrs. Fenu, tool-makers, Railway-approach, London-bridge. I understand they obtained the original from France 15 years ago. Let any one compare this with the diagram on the wall from Rosellini, and he will satisfy himself of the identity of the two. It is to be regretted that a square, combining so many useful peculiarities, has not (so far as I know) ever been introduced into our English workshops. It is certainly found in a French and Austrian cabinetmaker's collection. Before these lectures close, we shall have on the table one from an Austrian workshop of a very simple construction—indeed, made exactly as this one on the diagram representing an Egyptian veneering, and a "bevil-square" placed against the wall of his workshop.

Perhaps no tool in the Egyptian cabinetmaker's basket will be looked at with more curiosity and respect than his drill apparatus. It is unmistakable and clearly figured on this diagram of a cabinetmaker drilling the framework of a chair for weaving in the seat. In all respects (save one) it is the common bow-drill of the present day. The respect in which it differs is the mode of producing the pressure on the drill spindle. Our Egyptian artisan has his hand on the top of the drill spindle pressing it forward much as we now press forward one of the neat Archimedean drills. The other hand works the bow. Now in the drawing there is sketched a large block on which the hand rests, and in which the drill spindle rotates. This is the palm-nut—it is the fruit of the Heban Palm; which as soon as it ripens becomes exceedingly hard and capable of receiving a very high polish. It was very naturally used, in the early times of which we are speaking, and travellers testify that in the rural districts of Egypt the carpenters even in these days are using the nut for the same purpose. This may be the proper place in which to state that breast plates of bronze, similar to those we use in drilling, have also been found in the tombs of Egypt.

Now that attention is directed to the workman drilling a chair, it cannot be out of our course to ask you to observe how well they must have formed these chairs. There are no cross rails to bind the legs. The whole framework is as dependent upon the joints of the seat as is the case in our very best made chairs. Other drawings (not shown here) leave us in no doubt as to the object of the drilling the seat bars. These seats were formed of ingeniously interlaced work of string, and there are traces of some done very artistically, as we sometimes see in the higher class of chairs with our interlaced cane seats. The photographs on the walls of the rooms are very clear as to both the pattern and manner of interlacing.

These chairmakers in the time of Joseph and the Israelites in Egypt not only constructed well-made lattice-worked seated chairs without leg-bars, but they also made them of elegant forms. Naturally the legs of the chair were formed after those of animals. They did nothing by halves; hence they did not take two legs from the animal and leave two behind, but they put the four animal's legs on the chair, the two hind legs behind, and the two forelegs in front. They also made camp-stools similar to ours, and low chairs with variously fashioned backs. (See in first Egyptian room in British Museum, cases 14-19, also the photographs in this room.)

It can hardly be thought that the skill in designing and constructing not only chairs, but cabinets, tables, and other articles of general household furniture, was not equal to that of designing the best and finest of joints. Such was the case, for dovetailing on which we now rely, and which has at one time or other called forth many contrivances for accomplishing it by machinery, was known and practised by the ancient Egyptians. The keying of stones in masonry in Egypt is frequently with a wooden dovetail key. They also understood our plan of tongueing, in order that two planks might be joined edgwise. In one respect their mode of tongueing was even better than ours. They inserted the tongues as we do, and with glue. Then when the planks were thus united, they seem to have bored pin holes through planks and tongues, and driven into these trenails, as now used in boat building chiefly, although not unused in good cabinet work.

HERCULANEUM.

The history of the foundation and erection of this city is very obscure. It was situated about five miles east from Naples. In the time of Titus, A.D. 79, it was overwhelmed by the eruption of Vesuvius, which destroyed Pompeii; first buried by ashes, and then overflowed by lava. Its place was discovered by the sinking of a well in 1706, when the remains of a theatre were found. Two villages having been built upon the superincumbent lava, it has been very difficult to follow up such investigations as were from time to time contemplated. The obstacles to progress were met as best they might, and the chief results of about fifty years' occasional investigations are deposited in the museum at Naples; there are statues, paintings, and vases, also domestic implements of every use and description. In various forms many of these have been published, some as reproductions in plaster, others as paintings, others as engravings. One of the largest collections of the latter is a volume entitled "L'Antichitan d'Ercolano, Naples, 1757," in ten thick folio volumes, the text being in Italian. Messrs. Martyn and Lettice have translated portions of this work, and from their translation the three diagramatic illustrations on the wall have been copied. The originals have more details than the copies contain, but the latter are sufficiently complete to introduce us to the tools and modes of carrying on certain portions of work done by the makers of wine, by shoemakers, and by carpenters.

An examination, however cursory, will enable any one versed in these crafts at the present day to compare our mode of operating with that adopted two thousand or more years ago, in the south of Italy.

In one diagram there are represented two winged genii, evidently intelligent carpenters; the occupation, and the tools around them may be instructive to us in the nineteenth century. The attitudes of the carpenter genii are what might be assumed at this day by two men who were intending to cut off the corner of a piece of plank. They remind one of the modern pit-saw with one man above and one below.

What next will attract attention is the saw itself. Compare the artistic drawing of this tool with one on the table, and of which the Fig. 2 is

FIG. 2.

a sketch, a construction of framing common at this time. The identity is very striking, and we may almost be disposed to say that with all our improvements and our advances we have not altered this string-stretched frame saw, for it is now as it was more than two thousand years ago.

The artist does not seem to have been a carpenter, for he appears to have made the central lineal bar, whose fixture between the two ends gives the fulcra on which the tension of the upper cord acts in tightening the saw, to take in his drawing the front of the saw. Subject to such corrections as antiquarians skilled in carpentry may suggest, there seems every reason to conclude that the instrument is exactly like our own, and that the lower line is the saw, and the upper one the cord, by the twisting of which the requisite tension is given to the saw. The hands of these carpenter genii are well placed; the lower workman applies one hand to the frame in the line of the stretching bar, and the other hand to the top—thus, so far as he is concerned, leaving the saw-blade quite visible through its entire length, and at the same time steadying it. The upper workman has one hand also on the tension bar, and thus he and his copartner are working in concert—in the same line—no cross-winding of thrusts or pressures. These, too, are the right hands. The left hand of the upper workman is employed in steadying the plank—an attitude and occupation for which the left hand is even now often called into requisition. Thus one workman steadies the saw with his left hand, the other steadies the wood with his left, each using the right hand for the work. The trestles on which the bench rests are the same in construction as trestles at the present day, and it is worth while noticing that the bench top is drawn as made of thicker timber than that the genii are sawing. There are two square holes in the top of the bench. Even if the drawing did not suggest the probable use of these, an ordinary carpenter could do so. We are not, however, left in doubt, for at the end of the bench or the right hand there is a plank prepared for sawing, and it will be noticed that it is held in its place, *i.e.*, held steady by means of a holding down iron of which the one in my hand and others to be found in any carpenter's shop at the present day are exact counterparts. Under the bench is a box, apparently one in which the tools might be kept. In front of this box is what we may call a hammer, the square shape of the handle however may not be thus interpreted, and perhaps it is a square. On a bracket shelf against the wall is a small pot or jar, in which probably oil or grease for the tools may have been kept.

ON THE GRAPE AND OLIVE PRESS.

The press usually described by ancient writers had a screw or weights; such presses seem to have succeeded the one figured. This one is evidently very ancient, and offers to view several things of which little or no mention is made among ancient authors. It consists of two large rough pieces of timber fixed upright into the ground, and fastened together at the top by a cross beam equally large and rude. There are horizontal cross timbers which appear to be planned so as to move or slide in vertical grooves. Between these sliding boards are roughly shaped wooden wedges; indeed, they seem little better than the natural branches or stems of trees inserted one over the other with pressing sliding boards between.

The positions or attitudes of the genii working clearly explain the object of this contrivance, and that which gives it both importance and value as an illustration of a tool used in ancient handicraftism, is the fact that they used hammers with long handles just as smiths do at the present time when welding iron or other work that requires a heavier blow than the ordinary one-handed hammer can give.

Now the really instructive part for us this evening is the placing of these genii on the opposite sides of the press, and so evidently using wedges with the tapers in opposite directions, a plan of wedging up which a skilled artisan would always use in preference to a single wedge if the circumstances of his work permit. Nor is this the only commendable feature in the wedging. The narrow cross boards which can slide in grooves in the uprights are so placed that whilst each has a wedge and its bearing to himself, he can bring his whole force to bear upon this wedge without any fear of disturbing the wedges struck by his friendly opponent. The lower part of the press consists of a flat board, upon which the wedges act, and so cause it to press upon the grapes, and the "must," or juice of the grape flows out at the spout prepared for it.

THE SHOEMAKER'S SHOP.

The two genii are sitting upon stools. The one seems to be stretching with his right hand upon a last the upper leather of a shoe, which he holds tight with his left hand. That which lies on the table is a last very similar to the lasts used at this day. In the closet at the right-hand side are a number of lasts. On the shelf at the back, fixed against the wall, are a number of finished shoes, very similar to our own at the present day, even to being made as "rights" and "lefts"—not sandals such as are usually understood as shoes in use in these very early times. On the lower shelf are two vessels, which were probably used to contain the colouring matter with which shoes were dyed of different colours.

The Attorney-General stated in the House of Commons last week that the Government had determined not to proceed with the Patents for Inventions Bill.

MISCELLANEOUS.

STREET PAVING AND CLEANSING.

e following article, on the recent Report of the y's Committee on this subject, appeared in the of the 23rd inst:—

application of Science and Art to the street g and street cleansing of the metropolis, which the matter of a Report just issued by a Com- of the Society of Arts, is an imposing subject. one in which the public would probably be dis- to display a very lively interest, if they could feel el that any demonstration of interest would ate the attainment of the smallest degree of im- ment. But it is more than thirty years since the ry effects of street paving and street cleansing first made an object of public inquiry in this ry. The condition of our streets, nevertheless, is tter in which thirty years have seen but a very ificant advance. Hygienists have of late been ously at work in examining the relation of the tion of our streets to the state of public health, and sult bids fair to awaken public attention to a fact known and acted upon in some ancient nations at five thousand years ago—that the main cause of e, as well as of physical discomfort, is dirt. The ty of Arts has minutely analysed that misplaced r which in various weathers is called London dust ndon mud, and which, by the extent to which posits itself on the textile fabrics worn and within the limits of the metropolis, is said to the washing bill of London to a matter of five ns sterling per annum. Their conclusion differs way from that at which private analysts have ly arrived. London dirt—that volatile but too ntial matter which pursues us, and all that belongs whithersoever we go—is generated almost exclu- by the traffic of London streets. It seems that in West-end of London it is just as plentiful, just as and just as deleterious in its effect at seasons of year when scarcely any fires are used, and when can, therefore, be but little smoke and soot in the The chief element in the composition of London the horse manure which is daily deposited in the s to the extent of at least a thousand tons, com- in proportion to the traffic, with abraded iron braded granite. Dirt, as we have been long ago is nothing but matter in the wrong place. The theory of matter and force includes all philosophy; the Society of Arts appropriately follows up the ine that dirt is mere waste of matter by assuring us the other chief physical discomforts of life in the opolis are due to a mere waste of force. All loud from vehicular transit, all vibrations of houses and ing of doors and windows, really denote nothing but eedingly bad economy of our store of useful force; this waste is to be placed mainly, if not entirely, score of the low state of science and knowledge on rt of those who are charged with construction and tenance of the public thoroughfares. The public have suspected this before, and their suspicions well be confirmed by the results of experiments by English and French engineers upon public s, as detailed in the document before us. The n of each and all is that the application of a very real scientific engineering to the construction and ning of our streets would result in an immense g of time, labour, expense, and discomfort. The ght on a clean and well-paved road is but one- enth of that upon a piece of muddy Macadam, and a e on a level tramway can draw three and a-half times the weight, at the same speed and with the same expenditure of power, that he can draw on an ordinary road. If we could reduce by only one-half the tractive force required for transit, it is clear that a reduction would be effected of exactly one-half the dirt and dust of the streets. The Report seems to prove that a result which seem so hopelessly Utopian is really by no means impracticable.

It is clear that if smooth tracks could be laid down for the wheels of carriages, distinct from the track which affords a foothold to horses, a considerable step in this direction would have been taken. Lord Palmerston several years ago called public attention to the results which followed from the adoption of this system in the cities of Northern Italy. Space is there, of course, more abundant, and traffic is less overwhelming, that in our own metropolis. Yet the principle has already been partially adopted in the East-end of London, in some of the narrow streets of the City, and in the construction of the roadway over London-bridge, and there seems no reason, despite the narrowness of our streets, why some systematic attempt should not be made to introduce it elsewhere. Justice can only be done to the principle by its application to wide thoroughfares, as in Milan, where there are three or four parallel lines of wheel-track of this description. Sir John M'Neil's experiments demonstrate that by this means a saving is effected of more than half the necessary horse-power. In the roadways which are now laid down upon this principle curbstones to the trams are dispensed with, and vehicles move freely from one part of the road to the other. In order to give the system every advantage in working, it is necessary, of course, to regulate and proportion the gradients, to take every opportunity for widening the streets, and to adopt in connection a scientific system of street-cleansing. In this last department of the Report, the comparison of the existing condition of things with that which might be is none the less striking. Thirty-five years ago Sir Joseph Whitworth directed his attention to the bad economy of cleansing the streets by manual labour. His very simple machine, going at the rate of no more than two-and-a-quarter miles an hour, would do in fifteen minutes the scavenger-work done by a single man in a whole day. The reduction of the time occupied in street-cleansing is of the greatest economical value, and speed is of especial importance in preventing the vitiation of air by the dispersion of pulverised animal matter. Nothing, however, is of so much importance, whether for the maintenance of the thoroughfare in a serviceable condition or for sanitary purposes, as the free use of water. It seems a simple lesson that a broom and a dry mop are insufficient to cleanse a paved courtyard or a wooden floor, and that precisely the same principle is applicable, and in a higher degree, to open thoroughfares. It seems as clear as in the case of road construction that the application of a modicum of science to the removal of mud, and the use of jets for the thorough surface cleansing of the streets, would be attended with the most beneficial effects, both sanitary and economic. The neglect of street-cleansing is the most fruitful cause of street accidents. Two hundred persons are annually killed, and upwards of ten times that number are annually maimed or injured, in the streets of the metropolis, and the majority of these accidents happen upon what are called "greasy days," or days of excessive slipperiness, caused by defective cleansing. The numerous accidents and injuries to horses and to vehicles are to be set down to the same account. Health, life, and property are daily sacrificed to the maintenance of the present system, and it is not easy to see what balancing gain comes by it. The Society of Arts boldly follow out this view to its natural conclusion.

The general conclusions of the Report are in favour of an application to Government with a view to get rid of the "disorderly and discreditable administrative conditions" which lie at the bottom of all the mischiefs which

are here so scientifically exposed. It is idle, of course, to expect any general improvement while a single street remains under the control of fourteen separate Vestries or independent authorities, and is often longitudinally divided between two parishes, one of which cleanses and paves its portion of the street at one time and one at another. The first step would evidently be to procure the establishment, if not of a Metropolitan Municipality, at least of some kind of Metropolitan Road-trust. If such a reform could be effected, science believes that it might find its opportunity. We have no doubt of this, but we are unable to see so far into the future as the Society of Arts. The object, if that can be called a single object which involves such vast and manifold changes, has receded, if anything, from our view during the past twelvemonth. In default of prospects for the future, we are fain to concentrate our attention on facts of the present. We wonder whether Mr. Foster, while writing this admirable and exhaustive Report in the Society's Chambers in the Adelphi, was aware of the preparations which were making for the works which during the past week or two have been in process of execution in the Strand. One-half of the most crowded street in London has been broken up to admit new gas mains, and the other half to admit new water mains. The time selected for these operations is about the busiest time of the whole year, and the hours during which they have been carried on—though at four o'clock in the morning it is as light as at noon—are the busiest hours of the day. The works themselves are designed and carried out in every respect in the good old fashion. The new mains are deposited as usual in trenches cut deeply in the ground, instead of being laid in chambers, with easy access for the purpose of repairing breaches; and when any defect occurs the whole street must be once more torn up to rectify it. The pavement is roughly replaced, but not without an understanding that it is destined at some not distant day to come up and be relaid, until which time the whole traffic of London will toil over its mile or so with more than usual waste of force and production of misplaced matter. At this spectacle the Society of Arts may well feel their courage sink within them. Statistics, medicine, natural philosophy, engineering, and the cognate sciences are enthroned in the Adelphi, but the parochial, or, as the Report, with a certain disregard of etymology, writes, the "vestral," element is rampant in the Strand outside; and where shall we find an authority competent and ready to arbitrate between them?

The working population of Paris, according to M. Maxime's recent statistics may be reckoned at 816,080, nearly equally divided between the sexes, out of a total population of 1,851,792 souls. This number does not apply exclusively to the great industries connected with weaving, the iron manufacture, the preparation of raw products, or the building trade, the latter giving employment to only 293,691 men; 522,349 persons owe their daily bread to the manufacture of small articles, in which Paris excels.

The value of the steam engines exported from the United Kingdom has remained stationary this year, and has, indeed, slightly declined. It amounted to May 31st this year to £1,090,717, as compared with £1,253,484 in the corresponding period of 1874, and £1,106,431 in the corresponding period of 1873. Our exports of steam engines have increased this year to Russia, France, and Spain, but decreased to Germany, Italy, Egypt, Brazil, British India, and Australia.

Two new and important deposits of graphite have lately been discovered in the district of Trautenau, Bohemia. The thickness of one of them is 8 metres (26 ft. 3 in.), and of the other 1·6 metre (5 ft. 3 in.). In both beds the graphite is said to be very fat, and to furnish an excellent raw material from which to make a lubricant for machinery.

FIRST DRILL REVIEW OF THE LONDON SCHOOL BOARD BOYS.

The exertions of the Society of Arts, which have [illegible] over many years,* to introduce drill generally into all schools, have borne fruits which were successfully exhibited in the Regent's-park on Thursday, the 22nd [illegible] last. On this occasion the London School Board held its first review of boys. The preparations were simple and little notice given, but some thousands attended. This review was considered rather as a rehearsal than a full performance, and was held with a view to a display next year on a larger and more complete scale when the Society's flag and prize will be competed for.† The following account is taken from the *Daily Telegraph*:—

Drill inspection of 5,762 boys belonging to the Board Schools of London was held yesterday in the Regent's-park; and the schools were attended by [illegible] bands—namely, those of the *Goliath* training ship, the Forest-gate School, the Boys' Home in the Regent's Park-road, and the Strand Union School at Edmonton, with the fife and drum band from Plumstead. The boys began to assemble at half-past twelve, and as they came on the ground they took up a position with Primrose-hill on their right and the Zoological-gardens in the rear. Eight schools took part in the drill—that is to say, the Tower Hamlets, Southwark, Chelsea, Lambeth, Greenwich, Finsbury, Hackney, and Marylebone. The divisions formed up in contiguous quarter column, each company being forty strong, twenty front rank and twenty rear, a master and two pupil teachers to each company. At the saluting-point, marked by a Union Jack, were Sir Charles Reed, the President; Mr. [illegible] Vice-President; the Rev. John Rogers; Sir Henry Cole, on the part of the Society of Arts; Mr. Macgregor, of "Rob Roy" celebrity; and Mr. G. H. Croad, [illegible] of the Board. When, at two o'clock, the whole [illegible] of boys had formed up, under the command of [illegible] Instructor Sheffield, late Sergeant-Major of the [illegible] Life Guards, the rain had begun to clear away, and the few light straggling showers were scarcely perceptible. The boys, carrying their canvas bags of [illegible] were in excellent spirits, their cheering was lusty and in capital time, and their marching was highly creditable to themselves and their masters. In this last, no doubt, they owed something to the bands. That of the *Goliath* is well known; and the young musicians from the Boys' Home, on the other side of Primrose-hill, have attained such precision as entitles them to be ranked as among the first juvenile bands in London or England.

After marching past, the schools took up their position facing the saluting point, and were addressed by Sir Charles Reed, Mr. Currie, the Rev. John Rogers, and Sir Henry Cole. Sound advice, suitable to lads in their position, was conveyed in simple language; and a proof that it did not fail in impressing the young hearers was afforded by their spontaneous cheers at all the salient points. They had expected a few friendly words from Mr. Macgregor, who, however, disappointed them by his unwonted silence. The last-mentioned of those gentlemen who spoke, Sir Henry Cole, made an announcement to the effect that the Society of Arts would give a prize of £20 and a banner, to be competed for in 1876. A holiday was granted the boys for the day; and when they had testified their pleasure thereat, by tossing up their caps in a manner that had a strange and surprising effect, owing to the great number of those who threw them, the assembly dispersed.

This inspection, the control of which came under the School Management Department, was well calculated to

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* See Reports of Drill Reviews, 1870, 1871, 1872, *Journal*, vol. xviii., p. 693; vol. xix., p. 626; vol. xx., p. [illegible]

† See *Journal* of the present year, p. [illegible]

how the advantages of such physical training as is applied in drill. The instructor already named, Mr. Sheffield, whose exertions yesterday in the saddle were recognised in complimentary terms by the gentlemen representing the Board—Sir Charles Reed calling on the boys to give three cheers for their "Major-General"—holds three classes a week for the masters at three several centres; and all are obliged ,to attend till they obtain certificates of proficiency. Two large classes, each numbering 400, of the pupil-teachers are also instructed in drill by Mr. Sheffield. The smart look of the lads, their readiness to obey the word of command, their firm, well timed step in marching, agreed well with their appearance of health and vigour. It will be no easy task to adjudge the Society of Arts' prize, so high and so level seemed the efficiency of the eight schools who competed; and the losers may be consoled by a knowledge not only that they did their best, and did well, but that the fact is fully recognised by all who saw them.

LONDON SOCIETY FOR THE EXTENSION OF UNIVERSITY TEACHING.

The following is the report of the executive committee appointed to promote the establishment of this society:—

The executive committee having considered the matters referred to them by the general committee have agreed to recommend the adoption of the following draft scheme:—

1. That a society be incorporated under "The Companies' Act, 1867," with the title of "The London Society for the Extension of University Teaching."

2. That the society consist (1) of subscribers and donors; (2) of persons nominated by contributing corporations, societies, trustees, and firms, as hereinafter mentioned.

3. That the object of the society be to extend University teaching in the metropolis in as close connection with the Universities of Oxford, Cambridge, and London as may be possible.

4. That to this end the management of the society, financial and general, be entrusted to a council of thirty-two members, of whom twenty-two shall be elected by the society at its annual meeting, and ten shall be nominated, one by each of the following educational institutions of the metropolis:—Bedford College, Birkbeck Institution, City of London College, College for Men and Women, King's College, London Institution, Queen's College, Royal Institution, University College, Working Men's College.

5. That the council frame rules and regulations, satisfy itself as to the needs of various districts for University education, and stimulate the formation of Local Boards, communicate with the Universities and existing Institutions, appoint the lecturers and examiners on the nomination of the University Board hereinafter mentioned, arrange for the payment of the lecturers and examiners, and determine the fees to be paid by the students.

6. That the council put itself into communication with the Universities of Oxford, Cambridge, and London, to request them to form a joint board, who shall nominate such teachers and examiners as the work of the society may require, and shall advise the council generally upon educational matters.

7. That the object of the society be carried out—(*a*) By lectures and tutorial instruction. (*b*) By periodical examinations of the students.

8. That in arranging the operations of the society, it be the duty of the council—(*a*) To establish new centres where necessary. (*b*) To utilise as far as possible the machinery of existing Educational Institutions.

9. That, subject to conditions to be fixed by the council, persons attending the lectures and classes be enrolled as students of the society.

10. That subscriptions and donations be invited; and that every donor of fifty guineas, and every annual subscriber of two guineas, be deemed a member of the society; corporations, societies, trustees, and firms having the power to nominate one such member for every donation of one hundred guineas; and that each member have a voice in the affairs of the society, and have the right to attend its meetings and to vote at the election of the council.

On behalf of the executive committee,

GEORGE J. GOSCHEN, *Chairman.*

July 6th, 1875.

USES OF THE EUCALYPTUS.

The useful purposes to which the Eucalyptus can be turned have been frequently mentioned by the *Journal Officiel* of Paris. Since its introduction from Australia into France, this tree has been successfully grown in Algeria, and reference is again made to its many valuable qualities. The varieties are numerous, but five are especially selected, viz., the *Eucalyptus globulus*, *rostrata*, *gigantea*, *obliqua*, and *amygdalina*; each one being remarkable for its gigantic proportions and rapidity of growth. The Eucalyptus often attains the height of 50, 60, and sometimes 100 metres, with a circumference of 28 to 30 metres, and under favourable conditions makes one metre per month. The *globulus* is the most capable of cultivation in France, and possesses more useful qualities than any of the other kinds. The wood is excessively hard and durable, the only rival being the teak tree; it is free from knots, and is easily split or sawn, and the planks cut from it not unfrequently measure 40 metres in length. It is not liable to the attacks of insects, and withstands equally well the influences of salt or fresh water. When young it is very pliable, and the ordinary strength of a man will not suffice to break one of the branches. There are great powers of absorption possessed both by the leaves and the roots; and this most valuable of its qualities enables the tree to be employed as a means for converting damp and unhealthy localities into dry and salubrious ones, a question most interesting to all persons. It has been asserted that to the presence of this tree alone Australia owes its healthful climate, and although somewhat of an exaggeration, yet no doubt can exist respecting the health-producing powers that must be accorded to the Eucalyptus. The experiments made in Algeria, Corsica, and at Cannes, have been attended with equally extraordinary results. In medicines it is much valued, and many preparations obtained from it are successfully administered in severe maladies. The leaves can be formed into cigars and cigarettes, which are found useful to alleviate spasmodic coughs. In the forests of Europe, where the oak threatens to disappear, no better tree could be chosen to fill up the many vacant spaces. For all maritime purposes it is equally well adapted, either for making of jetties, dykes, breakwaters, or the construction of vessels. Already the steamers that ply between Australia and Great Britain are built of this timber, and also the Hobart Town whalers, which are proverbial for their solidity. For architecture, joiners' work, bridges, and embankments, for coach-makers and wheelwrights, where only the hardest woods are in use, the Eucalyptus can be turned to a thousand profitable accounts.

The *Mining Journal* announces the arrival of the first shipments of Tasmanian tin. The metal is reported as of excellent quality, being soft and of very good colour. It is not expected that the shipments from Tasmania will be to an extent for the present to influence our market, as the whole quantity arrived and coming forward this year will probably not exceed 300 tons.

PHILADELPHIA EXHIBITION.

The following account, extracted from the *Press* of Philadelphia, for June 21, gives an account of an entertainment provided for Mr. P. Cunliffe Owen and other members of the Executive of the British Commission for the Philadelphia Exhibition, upon their leaving America :—

On Saturday morning, June 19th, a breakfast was given by the directors of the Union League to the members of the British Centennial Commission. Some fifty or more gentlemen, prominently representing the leading interests of the city, literary, scientific, commercial, and others, met to welcome the distinguished English guests, and say a kind word at parting on the eve of their leaving us.

The members of the Commission are—Mr. P. Cunliffe Owen, Executive Commissioner; Colonel Herbert Sandford, R.A., and Mr. Cundall. Mr. Cunliffe Owen and Col. Sandford sail for Europe this week, to return at the close of the year. Mr. Cundall will remain, superintending the erection of the English buildings in the Centennial grounds.

Among the gentlemen present on Saturday morning were:—Hon. Henry C. Cary, Mr. John Welsh, Morton McMichel, Hon. A. E. Borie, Hon. John P. Verree, Messrs. James L. Claghorn, E. C. Knight, Charles E. Smith, E. S. Clarke, S. C. Perkins, Clement Biddle, Dr. John L. Lecoute, Mr. Francis Wells, Matthew Baird, Ex-Governor James Pollock, A. S. Goshorn, Director-General; Messrs. William D. Lewis, Isaac Hinckley, W. W. Nevin, William Brockie, Thomas A. Scott, George Whitney, Dr. William Camac, Hon. Charles O'Neill, Messrs. William B. Bement, Henry C. Gibson, Joseph A. Campbell, Jacob Riegel, John O. James, Fairman Rogers, S. A. Caldwell, Thomas Cochrane, Thomas Robbins, J. F. Smith, J. E. Mitchell, William Massey, S. E. Stokes, Seth J. Conely, General George Cadwalader, President Allen, of Girard College, and others.

Invitations had been sent to the Hon. Asa Packer, General Robert Patterson, Joseph Patterson, Esq., Hon. Joseph R. Chambers, William Sellers, George W. Childs, F. B. Gowen, and others, from whom letters of declination were received.

After a pleasant interchange of greeting at one o'clock, the guests sat down to a morning entertainment in the dining-room of the League-house.

The heavier duties of the table over,

The Hon. John P. Verree, President of the League, briefly welcomed Mr. Owen and his fellow-commissioners, assuring them that Philadelphia would always remember their visit this spring, and await impatiently their return.

Mr. Owen replied with much warmth and feeling, expressing his deep appreciation of the attentions he had received in our midst. Mr. Owen took occasion in this connection to refer to the great solicitude and interest always felt in those world expositions by the late Prince Albert, to whom the industrial and commercial interests of the whole world were largely indebted for this conception of the International Exposition idea, and the movement which has carried it into successful execution now by the leading nations of the civilised globe. Mr. Owen said he desired to seize this occasion to express to Philadelphia, through such a representative body as the Union League, his appreciation of the warm welcome which had been everywhere tendered him in this city. It was for nothing he had done or could do. He could not take it as rendered to himself and his associates, but only through them to the Government and people he represented.

Ex-Governor James Pollock, in a few well-timed and graceful remarks, proposed, "The Health of the Queen of England." To this toast Mr. Cunliffe Owen replied, acknowledging earnestly the compliment, and begged to offer "The Health of the President of the United States."

Hon. Charles O'Neill, M.C., as the representative of the Government, personally responded. Mr. O'Neill dwelt at length on the excellent understanding which has always existed between the administration of England and the United States, and acknowledging on behalf of the authorities at Washington their appreciation of the earnest attitude of England towards our centennial enterprise.

Mr. W. W. Nevin, being introduced, said—For a long time since the Union League has been the channel through which announcements have been made to Philadelphia of all great movements which affect her interests, and I take pleasure this morning, at the instance of the President, in making a formal announcement of the inauguration of another great public institution, which will mark this year in our history, and for which the city was indebted to the personal efforts of Mr. Owen. It is Mr. Owen's work for Philadelphia in his private capacity—his contribution to us as a citizen. Mr. Owen, the speaker stated, had been so impressed with the capacity of Memorial-hall for a great permanent repository, like the Kensington Museum, that he determined it should become the Kensington Museum of Philadelphia, and had by his enthusiasm on the subject aroused the active interest of our wealthiest citizens, and finally by his own personal efforts had inaugurated the project, and secured the subscription of a large sum of money from our most solid men. Acknowledging this earnest work of fellow-citizenship, Mr. Nevin proposed "The People of the United States to the People of Great Britain."

Mr. Wm. Brockie, of Scotland, but for fifteen years an adopted citizen of Philadelphia, responded. Mr. Brockie told with feeling the story of his warm reception in Philadelphia as a citizen, the strong relations of friendship and business which had grown up in the comparatively few years of residence in his adopted land, and spoke of the goodwill of the people of all lands in the coming solution of all questions which in the past had needed the arbitrament of the sword.

Mr. William D. Lewis, the venerable orator of a past generation, recited his experience as when first called to acknowledge feelingly the hospitalities tendered him in England on a visit there. These reminiscences attracted the pleased attention of the company, who heard them with marked interest.

Mr. Francis Wells, in response to a toast to "The Press of Philadelphia," made some pertinent remarks. Brief speeches were also made in response to complimentary toasts by **Colonel Herbert Sandford, R.A.**, [illegible] **William Massey, Mr. Cundall**, and others.

About four o'clock the company separated.

Commenting on the above, the same paper observes:—One of the speakers at the League breakfast on Saturday morning made announcement of a fact which is worthy of all the extended notice which the press of Philadelphia can give it. All of our readers know where the Kensington Museum is in London, but perhaps few who have visited it ever dreamed that we would have anything of the kind in Philadelphia, in their life-time at least. We are to have such an institution—to begin it at once, and we shall owe it to the energy and friendly interest of our distinguished guest, Mr. P. Cunliffe Owen—a foreigner in form, but not in heart. Mr. Owen, at first sight, was struck with the potential capacities of Memorial-hall for such a purpose, and so impressed was he with the conception, that with ceaseless enthusiasm he pressed it home on all the leading men of Philadelphia with whom he came in contact, and finally himself drafted the project of a paper on which the initial subscriptions necessary to carry out the idea have been secured. It is a most pleasant duty to acknowledge so graceful and substantial a work done for our good city.

NOTES ON BOOKS.

Keramic Art of Japan. (Part I.) By G. A. Audsley and J. L. Bowles, *Liverpool, published by the authors. London: H. S. Sotheran and Co.* 1875.—This is the first instalment of the work, which is to be completed in seven parts. The intention of the authors is that it shall include an essay on Japanese art generally, and a "Dissertation on the Keramic Productions of Japan." The former portion of the work is to be illustrated by thirteen photo-lithographic and autotype plates, besides wood engravings printed in colours. The latter is to contain thirty-five plates, printed in colours and gold, as well as fifteen autotypes. The work is in folio. Dealing with the productions of a country as rich in decorative art as Japan, there can be little doubt that the authors of this elaborate work will find abundant material. It is only within the last few years that the art productions of Japan have become really familiar to us, and they do not seem to have been competently treated by any writers on the subject. Messrs. Audsley and Bowles hope to supply this want in our literature by making their book a "comprehensive grammar of Japanese ornament," as well as a description of the pottery and porcelain of that country. This first part contains the beginning of the "Essay on Japanese art," as well as portions of the "Dissertation on the Keramic Productions." The illustrations to the former show specimens of the various arts most in favour with Japanese artists, while the letter-press gives a description of them, noting the several points of dissimilarity between them and the fretwork of western nations. The illustrations dealing with the more special subject of the book, show specimens of "Kaga Ware" (two coloured lithographs of vases, and a heliograph showing several smaller pieces), "Satsuma Faience" (two, a vase and a flat dish), and "Owari Porcelain." Each has its descriptive letter-press. This brief sketch of the contents of the first part may serve to show the general scope and extent of the book.

OBITUARY.

Rev. S. Clark.—The Rev. Samuel Clark, M.A., was born at Southampton, in 1810. He graduated at Magdalen-hall, Oxford, in 1845; was Vice-Principal of St. Mark's College, Chelsea, from 1846 to 1851; Principal of the National Society's Training College, Battersea, from 1851 to 1863; Vicar of Bredwardine, Hereford, from 1863 to 1871, and was collated to the rectory of Eaton Bishop, Hereford, in June, 1871. He was the author of several articles on Biblical Archæology, in Smith's "Dictionary of the Bible;" "The Bible Atlas," with Notes and Dissertations, published by the Society for Promoting Christian Knowledge, 1862; "Commentary and Critical Notes on Leviticus and the portion of Exodus relating to the Mosaic Law," in "The Speaker's Commentary;" "The School Physical Atlas;" "Atlas Illustrative of the British Empire;" and other elementary works, published by the Society for Promoting Christian Knowledge and the National Society. Mr. Clark was for many years Chairman of the Society's Board of Examiners, and acted as Examiner in English Language and English Literature.

The telegraph lines of New South Wales are now stated to extend over 7,553 miles. The receipts last year were £39,379 19s. 2d.; the number of messages transmitted, 369,001; the number of employés, 329.

GENERAL NOTES.

Cotton Mills in India.—The manufacture in India of cotton goods, according to figures received, is rapidly growing. Altogether there are 25 cotton mills in India in full operation, working 600,000 spindles and 7,000 looms. The spindles produce about 130,000 lbs. of cotton thread a-day, of which about 50,000 lbs. are used to produce cloth. These mills are chiefly in the Bombay Island, where a new spinning mill, just opened by a wealthy Hindoo, and working 25,000 spindles, makes a total of 17 working mills. Up country there are several others—one at Surat, two at Broach, two at Ahmedabad, one at Julgaum, one in the native State of Bhownuggur, and one at Madras. Extensions are also rapidly going forward. Eight extensions are in course of construction at Bombay, chiefly on share capital, and these will provide at least for the working of 40,000 more spindles and 1,345 looms.

Sanitary and Educational Exhibition.—An exhibition of sanitary, educational, and domestic appliances will take place, from the 6th of October to the 16th, in the Corn Exchange adjoining the Dome of the Pavilion, Brighton, in connection with the Social Science Congress to be held contemporaneously in that town. The object of the exhibition is to bring under the notice of the public generally, and particularly those who are interested in social, sanitary, educational, and economical questions, the latest scientific appliances for improving the public health, promoting education, and advancing social economy. These will be classified under the following heads, viz.:—1. Warming, ventilation, and lighting. 2. Domestic appliances and economic apparatus. 3. Sanitary architecture and appliances. 4. Sanitary engineering and methods for disinfecting. 5. Food and clothing. 6. School furniture and educational apparatus. The exhibition will be opened with an address, to be delivered in the Dome. Lectures on the various classes of exhibits will be given during the period of exhibition.

Illumination by Electricity.—It is well-known that, under the influence of a strong electric current, a body which is a good conductor, when connecting the two poles of the current, may be heated to such a point as to become luminous. This phenomenon is turned to account by Mr. Lodygin, of St. Petersburg, for obtaining a constant light, which is both reasonable in cost and also capable of being used under all circumstances. Instead of producing the electric light by means of the wearing away of the electrodes, as has hitherto been the practice, that is to say, by the ignition of the particles of charcoal which are transported from one pole to the other in a body of air heated to a high degree between the electrodes, Mr. Lodygin employs a short stick of charcoal in a single piece, and reduces the area of its section between the two electrodes in such a manner that it offers considerable resistance to the current; so that the portion between the two poles, being heated to a high degree, becomes luminous just as a metallic wire would do. The lamp consists of a cylindrical glass vessel, closed with metal covers so as to be air-tight both at top and bottom. Occupying the centre of this cylinder is the stick of charcoal held in its place by two pieces of metal communicating, through the covers, with the two electrodes of the battery. In order to render the light more intense, several sticks of charcoal may be placed in the same lamp; the conducting wire which leads the electricity from the battery communicates with an insulated rod connected with the cover and in contact with the first piece of charcoal; the electric current then passes into the second piece of charcoal through the lower cover, and from thence to the next lamp, or to the battery. On account of the heating of that part of the charcoal which is reduced in thickness, the surface rapidly becomes oxidised when in contact with the oxygen of the air, and the charcoal is consequently worn away, a circumstance which would tend to considerably limit the duration of the lamp. To avoid this drawback, however, the lamp is filled with nitrogen, which is prevented from escaping by the two air-tight covers; in this manner oxidation cannot take place, and the pieces of charcoal preserve their original dimensions. The experiments have given such good results that the inventor has been awarded the Lomonossov prize by the St. Petersburg Academy of Science.

Ranee-Khet.—This place is a new hill sanitarium in Kumaon, North-West Provinces of India. It is situated about thirty miles north of Nynee Tal, and fifty miles south of the snowy range of mountains. It has only been in existence as a station for the last four years, before which time it was a mere jungle. But it is now a flourishing station, with accommodation for a European regiment; and new barracks are being added, so that it will soon be able to receive two regiments at once. It commands one of the finest panoramas of the Himalayan snows, as nearly 200 miles of the range can always be seen. Ranee-Khet is likely to become the most important military hill station in India. Its elevation is between 5,000 and 6,000 feet above the sea, and its climate, even in the summer months, is pleasantly cool. This station owes its origin to the late Lord Mayo, whose policy was to quarter as many European troops as possible in the hills. That system will no doubt lessen the mortality and add greatly to the comfort of the British Army in India.

Lighting of Railway Carriages by Gas.—The Central Swiss Company has recently made some experiments in lighting railway carriages by gas, the results of which are highly satisfactory. The gas is enclosed in a special receptacle for each carriage. The gas which burns best is that obtained from the refuse of oil, the volume for an equal light being only one-fourth that of coal gas. The inventor is Herr Hirzel, of Zurich, a Leipzic professor. The process consists in forcing by the aid of a self-acting apparatus the refuse of fat substances, or of petroleum, &c., into retorts, which are heated in furnaces in the same manner as retorts for coal gas. Over the furnace is a hydraulic main for preventing the gas evolved from returning to the retorts. The gas next passes into a purifier, and lastly into a gasometer, the dimensions of which are much smaller in proportion than in those for coal gas. The counters, regulation of pressure, &c., are the same as in ordinary gas works. A flame of an intensity equal to eight flames from carcel oil costs about three halfpence an hour, including the cost of works, interest on capital, and labour. With 220 lb. of refuse, from 2,400 to 2,600 cubic feet of gas are produced; and a flame equal to 10 carcel flames consumes about a cubic foot an hour. The gas thus obtained is compressed by means of a pump to 10 or 12 atmospheres in reservoirs fixed under the carriages, whence it is led by pipes to the burners, after having passed through a pressure regulator.

Tempered Glass.—M. A. Bauer, who is also engaged on this problem, and who is stated by the *Revue Industrielle* to have solved it in a manner similar to that of M. de la Bastie, has just made known the result of his investigations on the subject. He prepares the articles of glass by first heating them until they become soft, and then plunging them into paraffin, kept at a temperature of 200° Cent. (390° Fahr.) The glass object must no longer be gradually cooled, as has hitherto been the practice, but at first quickly up to a certain point, and then very slowly. After this operation the glass cannot be cut by the aid of a diamond. The scale of hardness proves that its consistency is considerably increased; besides, its density is raised from 2·429 or 2·438 to 2·469 or 2·468. It is at present difficult to give a satisfactory explanation of this hardening of the glass by tempering. It was formerly thought that glass was a perfectly amorphous and homogeneous substance, but, in 1852, Herr Leydolt demonstrated, by the action of hydrofluoric acid, that all our glass, although it may show no sign of crystallisation, is composed of a mixture which is partly crystallised. When an article made of glass is heated up to melting point, or only up to such a point as to become soft, and then allowed to cool very slowly, it combines in its elements and forms crystalline groups. This is an experiment which Réaumur had already tried in the hope of manufacturing with the glass a kind of porcelain, called, even to this day, Réaumur porcelain. In 1874, Herr Siegwart proved by experiment that this action of combination takes place very easily when glass is heated slowly; sometimes, indeed, the crystallised portion may be observed, in which case the glass has received the epithet of "devitrified." In accordance with recent experiments, it would seem that glass in the state of fusion is an almost homogeneous mass, which, in cooling, experiences certain combinations. When the cooling takes place with a certain degree of speed, there is not time for these combinations to take place, so that the glass would remain homogeneous; this circumstance is probably, on the one hand, the cause of the great hardness of tempered glass, and, on the other, that of its peculiar mode of rupture.

Aeronautics.—A new steering baloon, by Smitter, is being exhibited, suspended in the middle of the Alcazar, in Paris. The measurement is only 6,000 cubic feet, but the baloon is so light, that when filled with pure hydrogen it must float. A considerable sum of money has been invested in it, and great ability has been displayed in the construction. Although no practicable result in open air may be hoped for, it is a wonderful piece of clockwork. In connection with this subject it is stated that a firm of engineers have been experimenting privately at the Crystal Palace with an aerial steamer of a novel and promising character, weighing 160 lbs. Experiments are stated to have proved the capability of two vertical screws, each 12 feet diameter, to raise a weight of 120 lbs.; the steam-engine, with water and fuel, forming part of the weight so raised to the extent of 80 lbs. The power exerted by it is equal to 2¼ horses. The communication of motion is given by a vertical axis emanating from the car.—*Nature.*

Vitrebert's Method of Distinguishing Phormium Tenax from other Fibres.—The fabric is immersed in a solution of an aniline colour, either fuschine or aniline blue (with the latter the reaction is less striking) containing about a decigramme of colouring matter per litre of water (·67 grains to a pint). It is left for some hours cold, or at a temperature of 70 to 80 degrees Centigrade (158° to 176° Fahr.), when it is washed with water, and the fibre is examined. All the fibres of the *Phormium tenax* (New Zealand flax) will be found highly coloured, while those of hemp, flax, &c., will remain white or of a colour similar to the raw material. This test is said to be preferable to that by nitric acid, and, besides, the fact of the substance having been bleached does not interfere with the reaction. After contact with the colouring matter, if care be taken to wash the fabric with soap, the difference of colour is much more decided, the hemp turning very white, while the *Phormium tenax* remains red. Ammonia serves also to distinguish the *Phormium* from hemp; when the tissue has been bleached, all that has to be done is to immerse it in this alkali; the *Phormium* immediately resumes the colour it possessed before being bleached, while the hemp shows no appreciable change.

Value of Metals.—The following table of the respective values of metals is given by an American paper. The dollars have been reduced to their equivalent in English money for the convenience of readers. The first four of these metals are so rare as to be sold in minute quantities, yet their rates are given for the sake of comparison with the others:—

Value per pound Avordupois.

	Dollars.		£	s.	d.
Indium	2,522	..	525	8	4
Vanadium	2,510	..	520	16	8
Ruthenium	1,400	..	291	13	4
Rhodium	700	..	145	16	8
Palladium	653	..	136	0	10
Uranium	576	..	120	0	0
Osmium	325	..	67	14	2
Iridium	317·44	..	66	2	8
Gold	301·45	..	62	16	[illegible]
Platinum	115·20	..	24	0	0
Thallium	108·77	..	22	13	[illegible]
Chromium	58·	..	12	1	8
Magnesium	46·50	..	9	13	9
Potassium	23·	..	4	15	10
Silver	18·85	..	3	18	[illegible]
Cobalt	7·75	..	1	12	[illegible]
Cadmium	6·00	..	1	5	0
Bismuth	3·63	..	0	15	[illegible]
Sodium	3·20	..	0	13	4
Nickel	2·50	..	0	10	5
Mercury	1·25	..	0	6	[illegible]
Antimony	·36	..	0	1	6
Tin	·33	..	0	1	[illegible]
Copper	·25	..	0	1	[illegible]
Arsenic	·15	..	0	0	[illegible]
Zinc	·11	..	0	0	[illegible]
Lead	·07	..	0	0	[illegible]
Iron	·02	..	0	0	1

URNAL OF THE SOCIETY OF ARTS.

No. 1,185. Vol. XXIII.

FRIDAY, AUGUST 6, 1875.

...ations for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

...OCEEDINGS OF THE SOCIETY.

COMMERCIAL EXAMINATIONS.

...nce the Society of Arts' General Examinations ...established in 1856, the Universities of Oxford ... Cambridge, the Science and Art Department ...he Government, and other public bodies, follow-... the example of the Society, have instituted ...minations, which, to a certain extent, supply ...place of those of the Society of Arts. None of ...m, however, are specially adapted to young per-...s entering commercial life, whether as clerks or ...erwise, and the Council have therefore decided to ...blish examinations of a commercial character, ...ving that such examinations will be of great ...tical benefit, and specially within the province ... Society established for the encouragement of ...s, Manufactures, and Commerce.

...he subjects for examination will be as follows:—

1. Arithmetic.
2. English (composition, correspondence, and précis writing).
3. Book-keeping.
4. Commercial History and Geography.
5. Shorthand.
6. Political Economy.
7. French.
8. German.
9. Italian.
10. Spanish.

...ertificates will not (as heretofore in the General ...aminations) be given in separate subjects, but in ...der to obtain a "Certificate in Commercial ...owledge," a candidate must pass in three sub-...ts at least, two of which must be Arithmetic and ...glish.

...he papers set in most of these subjects will to ...me extent differ from those of former years, in ...ing specially adapted to test the candidates' ...owledge from a commercial point of view.

...rizes will be given as heretofore. The regula-...ons are now under consideration, and the Pro-...amme will be published as soon as the details ...ve been finally arranged.

CANTOR LECTURES.

The second lecture of the course of Cantor Lectures on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft," by the Rev. Arthur Rigg, M.A., was delivered on February 15th, 1875, as follows:—

Lecture II.

On Tools used in Handicraft.

HAMMERS.

It is curious to notice that the only mechanical tools for external use with which man is provided by nature are the hammer, a compound vice, and a scratching or scraping tool. These are in the hand; and in the various contrivances which have from time to time been introduced to notice of compound tools, none have surpassed in comprehensiveness of variety these three in one. As a vice, the hand is worthy of a very lengthened notice; as a hammer alone it is now our concern. Whilst for impact upon a substance softer than itself the fist can deal an appreciable blow, yet upon one harder than itself the reaction of the substance transfers the blow to the flesh and bone of nature's hammer.

When the materials of which this earth is composed are regarded as those that may be useful to man (if only he had them in such a form as could be handled and used), and when, further, the very procuring of food by the slaying of animals, is one of the essentials of man's existence, it will be admitted that a very early want of mankind would be a means for possessing himself of these without inflicting damage upon his bodily framework. Now, although the arm and hand are contrived with a perfection of adaptability to motion as well as facility for holding, yet they are quite unsuited for the purposes alluded to. Indeed, it is clear, that in none of the years in which the human race have dwelt on the earth could man have won those materials and that food which were essential for his welfare, unless, availing himself of the holding power of the hand, and the rapid motions of the arm, he could supplement these by means for gaining what these alone could not acquire.

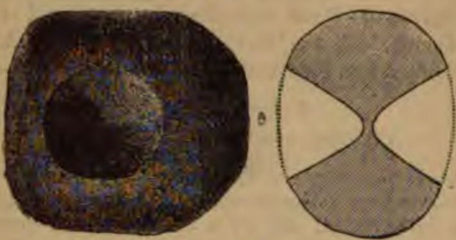
Hence amongst the contrivances which have come down to us from those ages before history was written, or the use of metals known, are found stones shaped, we may suppose, by the action of water, and so rounded as to fit the hand. These stones are called by antiquarians "mauls," and they were probably held in the hand, and struck against that which otherwise could not have been broken. In these "mauls" is the original hammer.

Graduating requirements of the social state of our pre-historic ancestors, as we would our own, this maul might occasionally have proved too heavy, but more frequently too light. For that tapping action which in our minor wants is often more requisite than blows, they seem to have devised an ingenious appliance consisting of a stone specially prepared for this somewhat delicate operation.

Through the kindness of Mr. Evans, who has collected and engraved a number of the ancient stone implements found in Great Britain, the Fig. 3 is a reproduction of one from his book "The

Ancient Stone Implements of Great Britain," published by Messrs. Longman.

Fig. 3.



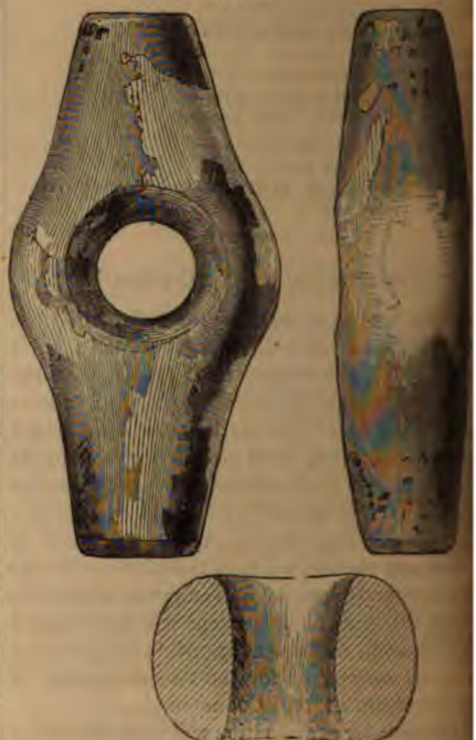
This is supposed to be one of these tapping hammers, held between a finger and the thumb, it bears traces of wear as if employed in striking against a cylindrical or sharp surface. The mode in which the recesses for the finger and thumb may have been formed has exercised much ingenious surmise.

When now we pass from this light to very heavy work it will be obvious that to hold a stone in the hollow of the hand, and to strike an object with it so that the reaction of the blow shall be mainly met by the muscular action of the back of the hand, and the thinnest section of the wrist, would be not only fatiguing, but might be injurious to the delicate network of muscles there found, and so damage this part of the hand. It may have been from such effects that even in the stone age, there are traces of "mauls" which have double ends and are held by the middle. A blow given by such is counteracted not only by the increased mass of material, but also by the changed position of the hand and wrist in relation to the direction of the blow. When held in the hollow of the hand, the resistance was met by (say) a depth of tissue of about three-quarters of an inch, but when held as the maul now alluded to must have been held, this resistance is met by a depth of tissue of about three inches. Hence whilst mechanically (owing to the mass of stone) and muscularly (owing to the position of the hand in reference to the direction of the blow) the "maul" in this second stage is a decided improvement upon its primitive form, we cannot but admit that experience would soon suggest that even thus there was wanting sufficient energy to overcome resistances, and that the double-headed maul might be improved.

If any one has been required to use a stone in the hand as a hammer, and continued the occupation, he might well long for a changed mode of applying his muscular energy.

Even the pre-historic races, of whom mention has been made, discovered that whilst the hand possessed inimitable contrivances for grasping, and whilst the arm possessed equally inimitable contrivances for rapid motions, both jointly failed in giving the maul the power that would often be required. In that stone age ingenuity had so busied itself as to lash withies round such mauls as were found suitable, much after the manner in which smiths at the present day lash withy round the heads of their cutting and punching tools and swages. Indeed, there are traces of even a higher advance, for what seem stone mauls, or hammers, are found with holes through them, suitable for handles, and these holes are, in some instances, coned, and as well adapted for hammer handles as the best-made metal tools in these days. One such stone hammer-head is shown in Fig. 4.

Fig. 4.



The original is in the British Museum, and w[illegible] found in the Thames. The double-coned hole f[illegible] the attachment and wedging-up of a handle [illegible] very admirably formed. Indeed, the very [illegible] of the hammer is worthy of much commendation. How they contrived to fix a handle in a double coned hole in a stone maul is more th[illegible] we know. The surmise of the antiquaries may or may not commend itself to the me[illegible] chanics of the nineteenth century, but th[illegible] will be interested in what was perhaps a ve[illegible] ancient practice, and although novel in this generation, it would be unwise to secure any patent right in it. They say that finding the branch of tree about the size of the smallest part of the e[illegible] of the maul, the stone was hung on it, and after few years the growth of the tree fixed the handle in the maul, and then the branch was separated by some of the sharp stone implements they u[illegible] for such purposes, and thus almost as the fruit [illegible] the tree the branch and maul became one—handle and hammer.

A tool which has thus descended to us from geologically pre-historic times has doubtless undergone great changes, not only in form, but also in appended contrivances. As new wants arose, new means for gratifying them must b[illegible]

furnished, and thus the maul—in the hands of Adam's first descendants—is, after some thousands of years, passing from human hands to the more powerful and less easily fatigued hands and arms of machines and steam. Our concern in these lectures is only with the tool as men used it, until James Nasmyth was one day detained at home by the rain, and made that graphic sketch which introduced the maul to steam machinery.

In the stone hammers alluded to there are presented to the tool fancier greater curiosities than the hammers themselves; for not only are there external concavities and peculiar shapes for adaptability to the hand, but there are holes bored through the stone as perfectly, as cleanly, and as well finished as the best of modern machine appliances could accomplish. How to form these concavities and holes now-a-days, some roughened, some smooth, and some even oval, would not be very obvious to the majority of workmen without what may be called machine-driven tools. All the concavities do not seem to be consequent upon grinding, for either originally or from age some are as rough as sand-paper, whilst the stone itself is comparatively smooth. Now had this roughness been a consequence of time and wear it would have affected the whole surface. But such is not the case. A recently-patented, and to this generation novel discovery, seems to be suggestive of a process the men in these geologically prehistoric times might have used. The process has, too, this element to recommend it, viz., little (indeed we may say no) machinery is required.

Those who visited the Exhibition of 1873 might have noticed some peculiarly roughened glass and cut marble; also holes bored in steel files by the operation of a sand-blast. Now, if the operation of boring by this process be watched, it will be found that the commencing hole is gradually enlarged, and if the process be continued until the abrading power of the sand grains is nearly neutralised, by the reflected and re-reflected particles against the sides of the holes, further penetration will cease. The ingenious re-discoverer of this power of driven sand has met the difficulty by turning over the material in which the hole was being bored, and commencing to tunnel, as it were, another hole to meet the first one. The effect of these two operations will be the production of a hole coned from both sides, leaving a large end of the cone at each surface; the meeting of the cones being formed by the intersection of the two borings. Therefore, if the operation of a stream of sand, driven by air or falling from a high place, or even mixed with water, and dropping from above be used, then, not only have we a ready available means of boring surface-holes in what antiquarians call tapping tools, but also in those "whorls" of which many are found about the size of these tappers. The "whorls" appear to have been used to add weight to, or load drills. Similar whorls are still thus used in Africa. They also contributed to steady the action of drilling tools, in a manner similar to that accomplished by a fly-wheel in the best constructed Archimedean drills. Nay, further, our pre-historic ancestors had only to watch those effects of water and sand with which the geologists tell us they were encompassed on a scale of magnitude to which all our terrestial arrangements may be called puny. Such watchings would supply hints for the making of many of those holes found in stone and other hammer heads, and in implements the use of which we cannot divine. Nature abounds even now in hints, and it seems strange that, familiar as we all are with the scooped-out hollows in the rocks of waterfalls, the penetrative properties of driven sand were not utilised until they were patented in the nineteenth century.

The operations of sand driven by the winds, or mixed with falling water, would certainly produce such concave recesses as are found on the two sides of these tapping hammers, and by almost obvious contrivances the short and small perforations which connected these into a whorl could be made by the same means. When, however, the exquisitely finished stone hammers and the holes through these are examined, this mode of perforation fails to account for what may be observed. Some of the holes are coned from both sides, being wider at the two outside ends, and connected in the middle by either a cylindrical hole or the coning of the two external cones into one perforation; such have most probably been bored either partially by the sand process now described, or entirely by a rotating stick or stone with sand and water. That some simple but very tedious process of perforating even hard stones existed, there is little doubt, and the practises of (so called) savage races confirm this view. The holes in the stone implements vary from 1-16th of an inch in diameter to 2 inches, and dealing first with those which are parallel through pieces of very hard and tough stone of the size of a carpenter's large or a smith's ordinary hand hammer, it may be said of the group of such holes that with all our modern machine appliances they could not have been more perfectly formed. Many of them do not bear any traces of what may be called "hints" as to how they were made; they are as smooth and almost as polished as the holes in a set of Whitworth's gauges. A few, however, speak a language of hieroglyphics which a mechanical eye can certainly decipher.

Exclusive of the sand process there are three other modes of perforating, which in those geologically pre-historic times might have been adopted. One, the process of "jumping;" second, the process of using a flat and pointed drill; third, a rotating tube. Now, an examination of the marks within the holes is sufficient to decide whether the "jumping" or the rotating tool has been employed. The jumping tool is used generally in quarrying and blasting, and although there is a certain rotatory motion given to it by the workman, yet the striæ or lines left on the sides of the formed hole will appear as scratches parallel to the axis of the perforation. In the cases under present consideration such linear scratches have not been observed. We may, therefore, dismiss this mode of drilling. The marks which are observed are as circular scratches round the insides of the holes. A rotating stick or tube worked with sand and water would produce these marks. There are also holes which have not been completed, and in some of these the borer has left the well known cored projection rising from the base of the hole when the boring tool is tubular and

does not perforate the material. In one case this cored elevation has sides parallel to the cylinder, showing very clearly that the tubular borer had a smooth interior with sides parallel to the exterior. In another case the core is coned as though the tool were carelessly made, or only hollowed, somewhat after the plan of a tinman's punch. Such holes are evidently bored with some hollow tool, and not finding in the stone age any trace of these hollow boring tools—nor even material of which such boring instruments could be made—the supposition that such holes were bored in the bronze age, before stone implements had passed away, is a very feasible suggestion.

There are, however, other peculiarities in these holes which a mechanic's eye would soon observe. Not only are there circular scratches which the tube-boring process might produce, if a large or rough piece of sand got in, but there are sometimes deep recesses in the sides of the hole not thus easily explained. Again, there are in one case two holes evidently intended to meet, being bored from opposite sides. They have run astray, and, not meeting, have been abandoned. The holes can be seen to the very bottoms. Mechanics will know that the bottoms of these holes are formed by the end of the drill, and the form of the drill may be decided from an examination of them.

The two holes referred to have been formed by a drill, either flat or shaped like an ordinary counter-sink. It may have been the end of a stick used with sand; it may, however, have been of a very different material. Again, if after drilling to a certain depth with such a drill of a flat form, either the careless sharpening, or the adoption of another drill, in which the radii from the axis of rotation to the final cutting edges of the drills are not equal, be introduced, then the hole will not be true. In one hole is a recess, as though this careless form of flat-pointed drill with somewhat angular projections had followed a truly-formed drill. There is, however, another reason for concluding that these pre-historic stone implements have been drilled with a flat drill carelessly sharpened, or whose point of rotation has been lost. Those who are accustomed to lathe or machine drilling, and who have ever worked carelessly, will know that instead of forming a circular hole, as it might be expected a rotating drill must do, the careless fitting in the square holed chuck, coupled with careless grinding of the drill, or absence of uniform density in the material being drilled, combine to produce a rude triangular hole. Such a hole is formed in one of these stone implements. If formed when archæologists suppose, viz., in pre-historic times, the men seem to have used such drills as we now use, at least shaped as we shape them, and of a flat material with cutting edges.

That (assuming the genuineness of the specimens) the people in these geologically pre-historic times bored stone in one of the ways we now use, seems clearly deducible from these facts. There is, however, a still higher puzzle in the hole in the double-edged axe of greenstone, found at Hummanly, in Yorkshire, to be alluded to again. It is oval and tapering slightly from each face to the middle. The figure of the implement is in all respects judicious and suitable. (See page 802, Fig. 9).

So far as forms and weights of hammers are concerned we may conclude that, where the earliest traces of the existence of men on the earth are met with, even there are hammers in all respects formed as modern hammers are formed, differing, it is true, in material. It must be borne in mind that the material a people use is that which they can obtain. Although a work formed by combination of separate parts in those early ages has not come down to our time, we are not left in much doubt as to some of the uses of these hammers, for they were employed in shaping material suitable for cutting instruments. Hence the great number of flint implements found in various parts of Europe and America. These flint implements may be enumerated as axes, adzes, chisels, saws, spear and arrow-heads, &c.

Now, amongst or in the neighbourhood where these are met with are found hammers of various stones. In the Christy collection of the British Museum is one of "jade" which might have been so used. A characteristic of "jade" is that it is "hard and tough" (indeed at this day in New Zealand the native tribes use the stone under conditions requiring such properties). Thus there is evidence to our hands and eyes of the mode in which flint implements were made before history was written, and it may be many thousands of years ago.

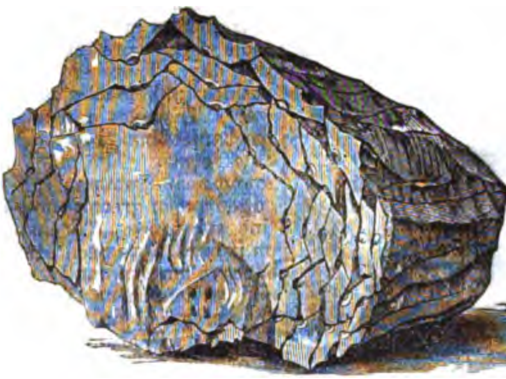
A rough lump of flint stone seems to have been taken, and then by blows from one of the stone hammers the outer irregular projections were knocked off, and the mass of remaining flint assumed a form somewhat cylindrical and fluted in concavities, the projections between the concavities being brought to a rough edge.

It must not be thought that to accomplish this required what we should call ought of artistic skill. The peculiar fracture of flint being conchoidal, similar to that which may be observed when a piece of sealing-wax or hardened pitch is broken, and the suggested mode of the formation of flints (being usually an aggregation of saline deposit around some nucleus of sponge or other organism), removes it from any of the characteristics of crystals. Hence, by a suitably directed blow, with an instrument of suitable form and material, an elongated piece, carrying with it the external angular projection of the concavity, was knocked off. Such flakes, of which many are found, are called flint knives. They were again fractured and formed into arrow and spear heads, and other instruments for war, or chase, or domestic use.

The manufacture of gun-flints, once extensively carried on in England, but now followed only at Brandon, in Norfolk, accords (so far as we can judge), even in minute particulars, with the practices adopted in the pre-historic stone age. On the table are not only all the tools actually used in the manufacture, but specimens of the progress of the manufacture, from the rough natural lump of flint to the finished gun-flint. It will be noticed that, with the exception of a short, roughly-made "chisel"—but it is more like the under swage used in a country blacksmith's shop—all the other tools are hammers of very primitive and rude construction. These hammers differ in weight and form of face, and are used according to the stage of manufacture. Without entering into details of this most primitive if not the most ancient of the many manufactures now carried on in England, it may be

stated that the flint knappers at Brandon can produce from sixteen to eighteen thousand gun-flints per week—the results of pure hammer work. The annexed wood-cut, Fig. 5, may convey an idea, 1st, how the rough nodule of flint is prepared; and 2ndly, how the flakes are "knapped" off preparatory to their being converted into gun-flints at the present time;

FIG. 5.



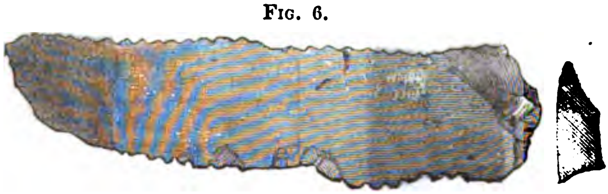
Flint core, with the flakes replaced.

and to conclude from these how the "knives" and "saws" of pre-historic times were made does not make any excessive demand upon "the scientific use of the imagination." The speed with which flint implements can be formed may be inferred from the fact that the whole operation of fashioning a gun-flint from one of these flakes occupies less than one minute of time. These comparisons of tools used at the present time, where gun-flints are made, with those known to belong to the stone age of pre-historic times, and which are found in the post-tertiary geological formations, force upon us the conviction that in the handling of nodules of flints and fashioning them into articles of utility, men in this century are following the very processes and using tools of similar form with those used where the very first traces of the human race are found.

Nor are there knives only which are made of flint; there is every reason to conclude that these flint flakes were fashioned to be used as roughened scrapers. There are those which appear to be so—very small and fit only to scrape smooth the smaller branches of trees. It may suffice for this lecture to say that small flints with roughened edges not only are found, but in a good light there are traces of that kind of polish on these roughened edges which we find about the teeth of saws when the instrument is used and the teeth are very blunt; they may have been used for sawing across or scraping arrows, as well as small branches of trees.

The woodcut illustrations of this portion of these lectures have been taken from the book referred to. They clearly illustrate to a reader that which the original implements would do to a spectator. These three figs. (Figs. 6, 7, and 8) are typical of a great variety. Fig. 6 is a flint

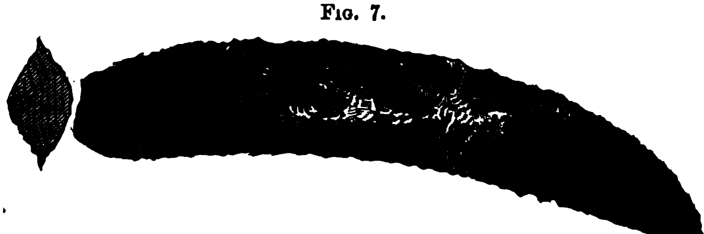
FIG. 6.



flake found in Yorkshire. On the right is a section, and it will be observed that the lower portion has been formed as an edge. There are, however, very clearly formed indentations or pieces whence small flakes have been struck or pressed off. These give to the implement a rude, but not ineffective purpose as a saw, and as such it is supposed to have been used.

Fig. 7 is somewhat similar to the former, but the flake is curved in direction of its length, and

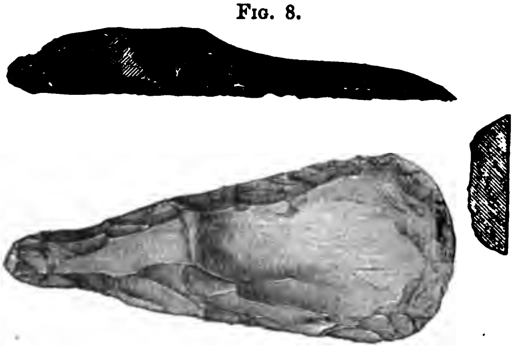
FIG. 7.



there are not the serrated edges which are seen in the former fig. Further, the end to the left is a thick one, so as to form a handle, and the mode of using this tool was probably the same as that in which we now use some of our hooked pocket knives.

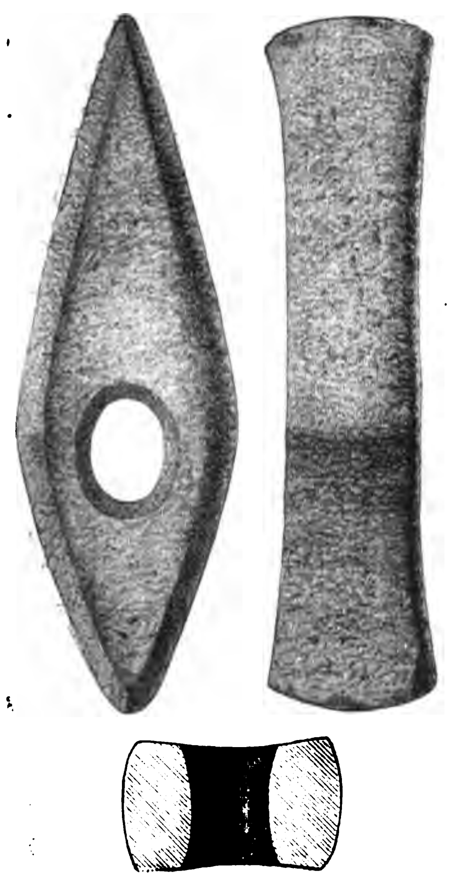
In addition to the flint saws illustrated in the previous figures it may be well to ask you to look at this flint adze found in Cambridgeshire. Not

FIG. 8.



only is it formed with more and varied curves, but it shows great handicraft skill in so arranging the intensity and direction of the blow that the flat or under side of the flint, as shown in the upper fig., should have been knapped at one stroke, and that other strokes should have been so well-directed as to produce the upper side, one portion of which forms the handle, and the other portion is bevelled on one side only, as our chisels, adzes, and sometimes axes are.

FIG. 9.



Hammers or mauls are not the only handicraft tools of these pre-historic times which remain until this day. There are axes, chisels, adzes, needles, besides implements used in hunting, fishing, and war. The axes and adzes bear traces of skilful mechanical construction in the adaptation of suitable forms. The one represented (Fig. 9) was found near Hummanly, Yorkshire. It is a double-edged axe of greenstone—a hard, granular crystalline substance. The handicraft labour expended on it must have been great, for the two faces are concave longitudinally, so that it expands towards and so lengthens the edges, which in the length are convex, as axes and adzes are at the present day. It will also be observed that the shaft-hole is oval, and tapers slightly from the two faces to the middle. How these oval holes were formed we know not; it is, however, no disparagement of a

FIG. 10.

mechanic's skill at the present day to say that many would be perplexed to execute an order for an axe of greenstone like the one now described. There is also one of the same material (greenstone) found in Guernsey. It is worthy of comparison with that just described as illustrating the ingenious devices as regards forms by which the makers of these tools suited them to the variety of work they had to execute. The tool is eleven inches long, and two and a-half inches across, and combines tools not unusually combined and with similar curvature at the present day, viz., an axe and a pick.

Numbers of needles, chiefly of bone, are in the British Museum; the eyes are really most perfectly and smoothly formed. The one represented (Fig. 11) was found in Kent's Cavern, Torquay. The

Fig. 11.

point is broken off, and what remains is nearly seven-eighths of an inch in length. There is one in the Geological Museum in Jermyn-street, imbedded as it was first observed in the surrounding strata, as is clearly visible, especially under a magnifying glass.

The adze seems to have been the edge tool most generally in use. This tool differs from what we call axes or adzes. It was very much smaller, and in all respects, a one, and not as now-a-days, a two-handed tool. The name seems to be applied to either those with the edge of the blade in the plane of the handle or those in which the edge is at right angle to this plane. Further, there is this peculiarity: all, or nearly all the adzes in use 3,000 years ago, had the handles placed at an acute angle with the plane of the material constituting the cutting edge of the adze. These handles are fastened on with thongs of either animal or vegetable fibre, probably bound on when wet, which in drying contracted, and held the metal firmly to the stock or handle. If you look on the diagrams in the room at the posture assumed by the Egyptian artisans, especially the class who used adzes, no words of mine are requisite to put before you the suitability of the tool to the work being executed, and the mode of using it. Even at the present day travellers inform us that the adze is used by cabinetmakers in Egypt exactly as it was in the days of which we are speaking. The handles of these bronze tools are chiefly of the woods of the country (*acacia* or *tamarisk*.)

As to the power of these bronze adzes. The Egyptians had no planes as we have, their work had to be finished, so far as cutting tools are concerned, with adzes, and very excellent and highly finished work it is. Occasionally we see in the work of the modern wheelwright and carriage-builder well-formed and finished articles, even when the tool has not been followed by that destroyer of handicraft skill, sand-paper. When, however, the work seemed to require a finer surface than the adze could give, it was treated with two tools which did the work of our chisels and planes. These tools were, one as though it were the bronze of the adze separated from its handle and used either as a chisel pushed before the workman, or as a scraper. From the position of the man (see Fig. 3, p. 42, Vol. 2, Wilkinson's "Ancient Egyptians," and also Vol. 3, p. 170) it may most reasonably be inferred that the former was the practice. Even this was followed by a tool which to some extent resembled in form a plane, and yet discharged a purpose very similar to what is now required when a workman covers a piece of cork with sand-paper and uses it for final polishing. This tool deserves further notice, and, although some of the remarks may be inferential only, yet there are such instructive conclusions that even the inferential character may be permitted. In the tools used by the Egyptian fullers for smoothing cloth is one of this form. Nothing is more probable than that the carpenters or cabinetmakers adopted this type of tool as the one to be used by them, making it, of course, in such stone as might be most suitable. If, now, this be the case, then we can trace without any far-fetched or improbable supposition how that beautiful plane referred to in the first lecture as brought by Sir Edward Belcher from Icy Cape was designed, for it is neither more nor less than the fuller's cloth-cleaner from Egypt.

It must not be considered that because no reference has yet been made to hammers in connection with chisels that the benefits of percussion over and above thrust were not known. Such is not the case. Hammer-struck chisels were very general. The mallet itself is in both form and material a very old tool. Those figured on the tombs of Egypt might have been drawn from our stonemason's mallet; they are so like them. Of those exhibited in the case in the British Museum, it may be said that were they taken and used by the stonemasons at the Law Courts they would hardly attract attention, except that a master or foreman would complain that however skilled the mason might be with the edge of his chisel, he was very negligent about the head of the same chisel. The Egyptian mallets—hammers we may call them—are indented in a deep circular ring, as though used all round against the very jagged head of a metal chisel. The photographs of these mallets are hung on the walls of the room. They, with other tools, are photographed on one sheet, by Messrs. Mansell, of Percy-street.

Even when necessity (the mother of invention) has suggested these tools, there remains this curious anomaly—why should our geological ancestors have laboured and acquired the art of drilling in such perfection? Strange at first sight seem those large and well-formed holes in stone. To make these holes does not apparently meet any social wants which men in a primitive state were likely even to imagine, let alone gratify. There was, however, one want which perhaps mankind more than any other group of animals required, that was the artificial production of fire. It is a question whether any race of men have ever been found to whom some means or other of producing fire was not known. The ingenuity of a contrivance in primitive times for this purpose is now, and will be as long as the world lasts, an interesting question to all who care for handicraft tools, and therefore, although to be too briefly handled, it must not be omitted.

The plan to which the greatest antiquity attaches was probably that which has been occa-

sionally met with in New Zealand and the Sandwich Islands. It consists in rubbing a blunt pointed stick along a groove of its own making in a piece of light and very dry wood. Thus fire was produced. Long, long before the Egyptian tombs were formed, this plan, although still existing, had given way amongst nearly all people to a process of drilling; indeed, it would seem that the necessity for producing fire originated the drill, a tool second only in antiquity to the hammer, and one which had evidently been used in forming the holes of some of the hammers and needles of the stone age.

Captain Cook describes one among the native tribes of Australia. He says, they take two pieces of dry soft wood—one is a stick about eight or nine inches long, the other piece is flat; the stick they shape with an obtuse point, and pressing it upon the other, turn it nimbly by holding it between both their hands as we do a chocolate mill, moving the hands downwards to increase the pressure. Thus, they get fire in less than two minutes, and increase the smallest spark with great speed and dexterity.

The geographical range of this simple "fire drill" is great. It is in use in Australia and Tasmania, Sumatra, and the Carolines. It has been found in Northern India, and amongst some of the oldest tribes of Southern India; it is in the retired districts still employed by the wild Veddahs of Ceylon. It has prevailed in South and West Africa and the Canary Isles. It has also been found among the Esquimaux and Indian tribes in North America. To twist a cord or thong round the stick, and whilst one person presses on the top and two have hold of the respective ends of the cord, and by a see-saw motion cause the stick to rotate, such was an early advance in the fire-producing drill. It is said that in modern India, in some retired districts, butter churns are now thus worked, and that thus the Brahmins produce the sacred fire.

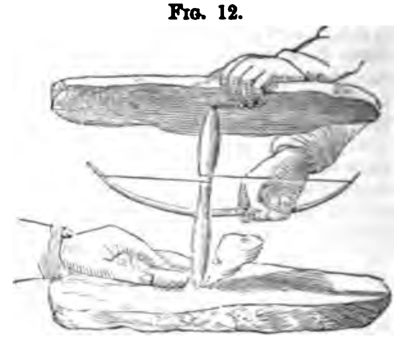
To progress from a plan which required three persons to unite in order to produce fire, or drill holes to schemes which dispensed with one, or even two, was likely to commend itself. Hence, whilst the fire-drill is still a universal tool, the modes of rotating the drill, and producing the requisite pressure, are various.

To dispense with one of those who pulled the thong to cause rotation, seems to have been been accomplished by the introduction of the bow, which gave sufficient tension to the string to make the drill spindle rotate. The practice then introduced was the one illustrated on the annexed wood-cut, Fig. 12.

How soon it was perceived that the pressure thus effected by a stone and the hand might be accomplished by a different arrangement of the bow cannot now be ascertained. Sure it is that even at the present time the Esquimaux have dispensed with the mode of producing pressure here illustrated, and adopted a novel substitute. A piece of hard wood is formed to the curve of the mouth, covering it as a respirator does, and having in addition a projecting back piece which is held between the teeth; into the front of this wood one end of the drill spindle is inserted. [A complete drilling apparatus of this construction, now in my hand, has been kindly lent by Dr. Rae, who accompanied Sir Edward Belcher.]

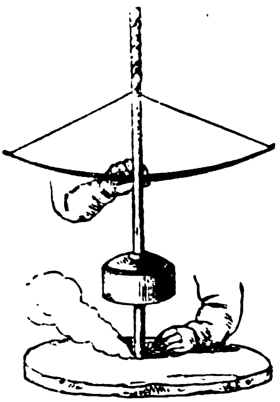
Thus arranged, the driller's head was over the hole, and his eyes directed to the drill-point. In all respects the attitude for a drilling instrument was a good one. The tool could be watched and

Fig. 12.



its direction preserved. Upon the muscles of the neck alone, acting through the teeth and gums, devolved the whole of the pressure. Such drilling mouth-pieces are in the British Museum.

Fig. 13.



The contrivance for drilling by the pump-drill is one of great antiquity and world-wide celebrity. It is well-known and used in the East, and in some South Sea Islands it is used, being pointed with a piece of hard stone, or horn, or shell, instead of steel. It is employed in Navigator's Island, in the South Pacific, for drilling the fish-hooks made of shell, for which it is well adapted. This pump-drill, constructed exactly as figured here, is still to be found in the London tool shops. It is the form of drill apparatus generally handled by those who repair broken china or glass. The absence of a guide, or pressure, or steadying centre for the upper end allows a freedom of play at the drill, which seems to be a recommendation in the class of work now referred to, and varieties in pressure and speed are within easy compass.

Ingenuity, or a disposition to alter and so perhaps improve upon existing arrangements, is as natural to the human mind, as the taking of food or the breathing of air. The hand-drilling as described seems to have been improved upon in the hill country, on the west of central South America.

There the practice is to take an elastic stick about eighteen inches long, and the man presses one end against a plate on his breast, and the other, which is blunt pointed, he presses in a hole in a piece of wood, and then rapidly turns the curved part and so obtains fire. Whether this suggested the carpenter's brace, or the carpenter's brace suggested this, those who are competent must decide.

Wallace, in his account of the Malay Archipelago, describes a plan of drilling which he found in operation at Sombork, an island to the west of Java. To Messrs. Macmillan (the publishers of the work) we are indebted for the illustration.

Mr. Wallace writes, that one of the princes showed him the guns made by native workmen; the barrels were twisted, well finished, and almost six feet long, the stock ornamented with silver and gold. The workshop and tools were shown. The former, an open shed with two mud forges—the bellows, bamboo cylinders with feather pistons. Mr. Wallace asked how the guns were bored; he was told "with a basket of stones," and taken to see one.

Through the bamboo basket was stuck a pole about 3 feet long. The bottom of the pole has an iron ring and a hole, in which four cornered borers of hardened iron can be fitted. The barrel to be bored is buried upright in the ground. The shaft is held by a cross-piece of bamboo with a hole in it, and the basket is filled with stones to get the required weight. Two boys turn the bamboo. The barrels are made in pieces about 13 inches long, and are first bored small, and then welded together upon a straight iron rod. The whole is

Fig. 14.

afterwards worked by borers of increasing size, and in three days the boring is finished. The tools from first to last were hardly sufficient for an English blacksmith to make a horse-shoe.

There is, however, an illustration of a process of drilling which may (if true) aid in establishing the position that the drilling of holes by the twirling of a hard or hot substance must in ages long past have been of quite as universal use as it is at this time. The day is a little after the period when the Egyptian figures and drawings introduce us to the mode in which it was then practised, but prior to the dates of Herculaneum and Pompeii.

Homer (who wrote about 950 B.C.) is describing the treatment to which Ulysses subjected the one-eyed Cyclops. The story may be briefly told. Ulysses, wandering after the siege of Troy, which siege took place about 1200 B.C. (1875 + 1200), 3,075 years ago, visits the cave of a one-eyed Cyclops. The giant is a cannibal, murdering and eating some of Ulysses' companions. They cannot escape out of the cave, because a stone was placed before the outlet, and it was far larger than they could move, and Ulysses suggests a plan by which they shall let the giant retain his strength, and yet lose his power to harm them. He takes a stick, when the giant was out, and Pope translates—

> "The narrower end I sharpen'd to a spire,
> Whose point we harden'd with the force of fire."
> *Odyssey, Book* 9, *line* 386.

Having watched until the Cyclops returned, and was asleep, Homer continues (as Pope translates), that Ulysses and his companions take action thus:—

> "The stake now glowed beneath the burning bed,
> (Green as it was), and sparkled fi'ry red.
> Then forth the vengeful instrument I bring;
> With beating hearts my fellows form a ring.
> Urged by some present god they swift let fall
> The pointed torment on his visual ball.
> Myself above them rising from the ground,
> Guide the sharp stake and twirl it round and round,
> As when a shipwright stands his workmen o'er,
> Who ply the wimble, some large beam to bore;
> Urged on all hands, it nimbly spins about,
> The grain deep piercing, till it scoops it out;
> In his broad eye so twirls the fiery wood;
> From the pierc'd pupil spouts the boiling blood,
> And as when arm'rers temper in the ford
> The keen-edg'd pole-axe or the shining sword,
> The red-hot metal hisses in the lake,
> Thus in his eyeball hissed the plunging stake."
> *Odyssey, Book* 9, *line* 449, &c.

This account by Homer of a drilling operation seems to establish that in his day the process of drilling for many different purposes was in general practice.

From the sculptures on the Arundelian marbles at Oxford, which are said to refer to ancient history from 1582 to 355 B.C., it would appear that iron was known 1370 B.C. (*i.e.*, 188 years before the Trojan war). Bearing this fact in mind, it seems to be a well-warranted assumption that when Homer devised this method for blinding Polyphemus he was familiar with the process now adopted for tempering steel. If the quotation from Pope is to be relied on, as expressing Homer's views, the last four lines very clearly express the mode we adopt in order to adjust a combination of hardness and toughness in steel to any purpose required.

MISCELLANEOUS.

THE WHITWORTH FOUNDATION.

Not content with endowing scholarships of the value of £3,000 a-year, and some other supplementary ones of lesser value, to be held at Owens College and other colleges, Sir Joseph Whitworth has made up his mind to bequeath his large landed estates to the public for educational and recreative objects. On his estate at Stancliffe, near Matlock Bath, Sir Joseph has created gardens which stand out unrivalled for a certain kind of beauty arising from a combination of rock terraces and grassy slopes and dells planted luxuriously with American plants. Sir Joseph intends that these beautiful grounds shall be thrown open to the public in perpetuity. Thousands every year flock from Manchester, Derby, and the towns of the district to Matlock and Chatsworth. The railway passes the Stancliffe grounds which are midway between these two places. The laws of mortmain prevent the public from deriving the benefit of Sir Joseph's good intentions by the possession of this estate, and so the Government have wisely introduced a Bill into Parliament to relax the statute and enable the gift to be made.

On 30th July, the Lord Chancellor moved the second reading of the Department of Science and Art Bill, and observed that the Department of Science and Art was incorporated by Royal Charter, under the provisions of which it had acquired buildings in South Kensington, had established a Museum, and had received various bequests. A gentleman whose name was well known to their lordships—Sir Joseph Whitworth—presented to the nation in 1868 an annuity of £3,000 a year, which was vested in this Department of Science and Art for the purpose of founding scholarships to promote the instruction of young men in the theory and practice of mechanics and the cognate sciences. These scholarships had proved to be of great use. The same public-spirited gentleman possessed a considerable estate in the north of England, called the Stancliffe Estate, and he wished to make it over to the public, subject to his life interest, for the purpose of securing this sum of £3,000 a year for the scholarships, and devoting the remainder of the estate to similar objects. This could not, however, be done without a relaxation of the Statutes of Mortmain, and as it was not intended to create a perpetual trust, but to leave the matter always open to the control of Parliament, her Majesty's Government thought those statutes might be relaxed in the case of this or a similar gift. The object of the present measure, therefore, was to empower the Science and Art Department to hold the land subject to the control of Parliament. In conclusion the noble lord moved the second reading of the Bill. The Bill was read a second time.

The *Times* commented upon this proceeding in a leading article which may be worth reproduction on several accounts. It is as follows:—

"The Department of Science and Art Bill, of which the Lord Chancellor moved the second reading yesterday in the House of Lords, appears a remarkable example of the judicious adaptation of generous impulses to wise conditions. Sir Joseph Whitworth in 1868 munificently presented to the nation an annuity of £3,000 a year, for the purpose of founding scholarships to promote the thorough training of young men in the theory and practice of mechanics and the cognate arts and sciences. The generous patriotism which prompted such a gift has, we hope, been duly recognised, and it may also be hoped that Sir Joseph Whitworth has already received some of the reward he would chiefly value in observing the encouragement his scholarships have afforded to mechanical genius. It enhanced the generosity of such a gift that it should be made in the lifetime of its author; but Sir Joseph Whitworth has other than temporary objects in view, and is not content that his design of promoting the interests of his profession should cease with his life. He is desirous, accordingly, of making over to the Department of Science and Art an estate he possesses in the North of England, subject to his life interest, for the purpose of securing this endowment of £3,000 a year for scholarships and devoting the remainder of the estate to similar objects. The law of mortmain, however, places jealous restrictions on such grants of land for charitable purposes; and it has been necessary to apply to Parliament for a Bill to authorise the proposed endowment. To judge by the Lord Chancellor's explanatory statement, this application has been accompanied by a remarkable modification in the terms of the proposed trust. It is not, he says, intended to create a perpetual trust, but to leave the matter alway open to the control of Parliament. Under this condition, one of the chief evils which the Statutes of Mortmain were intended to counteract will be obviated; for if it be expressly stated that the trust is placed under Parliamentary control, Parliament can have no difficulty in regulating its use in accordance to public policy. It is clear, therefore, that the Statutes of Mortmain may be justly relaxed, and the Science and Art Department may be fairly empowered to hold the land.

"Several interesting questions which as yet seem far from their solution are raised by such a benefaction given upon such condition. The example, indeed, may go very far towards answering the question, which has of late been much discussed, as to the wisdom of admitting endowments for the encouragement of learning or art. A vigorous school have maintained that it is more healthy for each generation to be called upon to meet the demands of its own day, instead of being hampered up by endowments which perpetuate, more or less, the condition of other days. A benefaction like Sir Joseph Whitworth's shows that this question, treated thus in the abstract, is quite unpractical. We are furnished with as strong a proof as could well be offered that the old instinct of making such benefactions is too deeply rooted to be eradicated, and that it must be accepted as a fact to which we must accommodate ourselves. It would seem, indeed, that the objection, taken in the breadth with which it has been often urged, runs counter to the first law of civilised societies, which is that of accumulation and inheritance. In no other particular does each generation depend solely upon its own resources, whether of possession or of organisation. The very food we eat is brought to our mouths by an elaborate system of trade and commerce which all the genius in the world could not create afresh. It has its roots in past generations, and it grows not merely out of inherited capital, but out of inherited systems and aptitudes. In fact, it is a mere figure of speech to talk of successive generations, for one generation shades imperceptibly into another, and has to live with it, accept its customs, and modify them by slow degrees. The world at any moment is composed of an indefinable number of generations dovetailed into each other; and the success with which this union is effected is the test of the degree of civilisation which has been attained. In stagnant countries the old generations repress the young; in revolutionary countries the young cut themselves loose from the old; and the art of statesmanship is to make institutions change with the continuity of human life. The endowment of a particular branch or mode of learning is, in its essence, simply a means of insuring that the intellectual acquirements and habits of one generation shall be better available for the benefit of the next; and in itself such an arrangement seems in accordance with the general rules of civilised life. But, at all events, if in the present day, and with full knowledge of all the doubts which have been raised on the subject, a man like Sir Joseph Whitworth presents the nation with an endowment of £3,000 a year for the encouragement of his

n science, we may be sufficiently assured that in some m or other such bequests will always be made. Sir ph Whitworth is not the man to undervalue the wer of independent and original energy. In the dis- eries and inventions by which he has revolutionised mechanical art he was aided by no public benefac- rs. What has been done can be done, and another itworth, it may be believed, would again arise with- special encouragement when the occasion for his ius occurred. But Sir Joseph Whitworth evidently ieves that we are more likely to obtain him, or likely obtain him sooner, and at a less cost, if we foster the liminary studies from which his genius must take its rt. By means of scholarships a number of young n can be pla ed on a vantage ground from which it ght, at all events, to be more easy for them to advance. point of fact, many men who have attained great dis- ction in their several pursuits have bitterly felt the ecessary difficulties which they had to encounter at outset, and we owe, perhaps, to a wish to protect ers from similar discouragements many of the best ndations we possess. Sir Joseph Whitworth cannot know the practical value of such assistance at the t of study, and his verdict must outweigh the theo- s of many mere reasoners, however able. His con- ion seems to be that endowments are necessary in er to insure the scientific as well as the practical dy of a profession; and this, in other words, is but a y of expressing what we have just been saying of importance of each generation taking its start from accumulated knowledge no less than from the accu- lated property of its predecessors.

"The only practical course, therefore, is not to attempt ppress, or even to discourage, such endowments, but egulate them. We have had abundant instances of years of the manner in which what the Lord Chan- r describes as a 'perpetual trust' has hampered, ead of fostering, the development of the future. It ot merely that so much money has been wasted, but lete rules and exploded systems have been a lasting acle to the growth of thought and to the intelligent ptation of new generations to new necessities. The of mortmain has not been sufficient to avert this ger, and great institutions like our universities and lic schools have from time to time come to a dead- k. Being established with no other dominant object view than that of perpetuating the systems of the t, a troublesome outcry has always been raised when as become necessary to adapt them to the present. England we have always succeeded in the effort, and, h some errors, have insured the continuity of the old the new. But it would undoubtedly be a great ad- tage if some method could be found of creating en- ments in a form which, while insuring their general tion to the purpose of the founder, would facilitate ir modification from time to time without the formid- proceedings which have been necessary in our most rtant reforms of late years. We know not at present ther the manner in which Sir Joseph Whitworth's te is to be conveyed to the Science and Art Depart- t will offer any solution of this problem, but from terms used by the Lord Chancellor it would seem some such object has been kept in view. If the t is directly expressed as being subject to the constant trol of Parliament, it will be the fault of the public if the uest ever becomes, so to speak, locked up in obsolete ms, and is applied to retard rather than promote pro- ss. Sir Joseph Whitworth has, it would seem, in any e, set an example, not merely of munificence, but of spirit in which munificence may be most wisely dis- yed. He trusts the Legislature not to divert his en- ment from the main object; but he trusts it also to pt it to the varying circumstances of successive times. the particular conditions of his trust we are not at ent informed, but of the wisdom as well as generosity ich has dictated it there cannot be too warm a recog- ion."

Sir Joseph's act stands alone for the liberal confidence it manifests in the wisdom of public opinion, expressed through Parliament, for regulating from time to time the administration of his foundation. "Pious founders" generally wish their intentions to be carried out for all time, however useless and unsuitable they may become.

PRIZES FOR GLASS WORKING.

An Exhibition of glass manufactures will be held at the Alexandra Palace, commencing on the 20th September, 1875, and closing on the 16th October, 1875. Prizes are offered by the Glass Sellers' Company in the following classes:—

Class 1.—*Flint Glass.*—Blown, Pressed, Cut, Engraved, Etched, and Coloured.—The Company's gold medal will this year be awarded to the exhibitor of the best specimens of work in flint glass. First prize, silver medal; second prize, bronze medal. Will be awarded to each of the divisions, No. 1, 2, 3, and 4, for—1st, purity of metal; 2nd, elegance of design; 3rd, durability; 4th, cheapness.

1. Decanters, water bottles, water jugs, biscuit boxes, custards, sugars and creams, cheese stands, jug stands, spirit bottles, champagnes, goblets, jam pots, cruets, butters, incorporators, ice spoons, water sets, liqueurs, dishes, jelly sets, finger cups, marmalades, tankards, mustard spoons, wines, hocks, plates, salts, ice pails, knife rests, liqueur sets, match cups, clarets, tumblers, comports, mustards, honeys, celeries, mugs, inkstands, and ink bottles for the pocket.

2. Candle cups, chimneys, lamp brackets, gas globes, perdifumes, gas brackets, lamp wells and globes, candle shades, consumers, chandeliers, silvered decorated glass.

3. Insulators, telegraph glass, lenses, ship lights, figures, pen trays, confectioners' glasses, pillar and other glass for shop and house decorations, door handles, evaporating discs, watch glasses, optical glasses, electrical discs, bath dippers and dishes, finger plates, experimental glasses, astronomical and lighthouse glass, photographic, dolls' and human eyes, cellar lights for gratings, lactometers.

4. Flower baskets, epergnes, troughs, specimen tubes, vases, plateaux, hyacinth glasses, fruit and flower stands, fish globes, aquariums, spun glass.

Class 2.—*Window Glass of Every Description and Miscellaneous.*—First prize, silver medal; second prize, bronze medal. Will be awarded to each of the divisions, A B C D—1st, purity of metal; 2nd, finish; 3rd, adaptability; 4th, cheapness.

A.—British plate, rough cast plate, patent plate, patent rolled plate, rolled cathedral, $\frac{1}{8}$ to $1\frac{1}{2}$-in. thick or upwards.

B.—Sheet and crown glass—ground, enamelled, fluted, coloured, stained, enamelled, polished, &c.

C.—Miscellaneous—Tiles, slates, rolling pins, milk pans, fern shades and stands, pastry pans, propagating glasses, grape and bee glasses, aquariums, cloches, cucumber tubes, flower pots, pen rests, rulers, gauge tubing, domes, shades, plate glass and other reflectors, lenses, hand glasses, fern cases.

D.—Polishing, cutting, drilling, bevelling, engraving, etching, silvering (hollow and flat), glass letters, roughing.

Class 3.—*Articles in Stained Glass.*—Ornamental Glass.

Subdivision A.—Ecclesiastic.—For the best executed subject for a church window, 36 by 18. First prize, silver medal; second prize, bronze medal.

Subdivision B.—Domestic.—Modern Style—Figures, flowers, fruits, or other subjects, 30 by 18. First prize, silver medal; second prize, bronze medal.

Subdivision C.—Public Buildings.—Embossed, etched, or patterns worked in acids without the aid of firing, 24 by 12. First prize, silver medal; second prize, bronze medal.

Subdivision D.—Brilliant cut glass and engine turned centres, engraved rosettes and borders. First prize, silver medal; second prize, bronze medal.

Subdivision E.—Leaded Windows.—In sheet, crown, and cathedral; plain and decorated, 24 × 24. First prize, silver medal; second prize, bronze medal.

A special prize of ten guineas is offered by the Master for the best specimen of painted stained glass, in any style, which may be exhibited in subdivisions A and B of Class 3. A special prize of twenty guineas is offered by the directors of the Alexandra Palace Company to the exhibitor of the best specimen of work in any of the classes. In addition to the above prizes, the company's "certificate of merit" will be awarded to any exhibitor whose articles are commendable. The judges are the Master, wardens, and court of assistants for the current year. Proper forms for entry may be obtained of the honorary clerk, Mr. R. Harding Evans, 52, King William-street, E.C.

SILK SUPPLY.

The following is an account of some results of Mrs. Bladen Neill's efforts to introduce silkworm grain into Victoria:*—

The Victorian Ladies' Sericicultural Company, Limited, was established in Melbourne in 1873, to promote the cultivation of silk in the Australian Colonies, with the view of thus providing a suitable and profitable means of employment for educated women of small means, and for young girls, who, though willing to work, are too often unable to find any appropriate means of livelihood. In the establishment of an industry of this kind in Australia, a prospect is offered to many women and girls in the United Kingdom. who may hereafter be induced to emigrate with a resonable and confident prospect of suitable employment to look forward to.

As the movement aims to increase and cheapen the supply of raw material required in the silk trade, it is hoped that manufacturers and merchants will render assistance.

One of the objects in view is to assist the establishment of the silk growing industry in Australia, by sending out to the ladies and girls now at work there some of the latest and most approved apparatus used in Italian and French *magnaneries* and reeling establishments.

Since 1873, the company, formed in Victoria, has met with considerable support in that colony, and is now established on a promising footing. A large grant of land has been obtained from Government, and sericicultural operations have been carried on by a number of ladies and girls for three seasons.

Samples of the silk and cocoons thus produced have been brought to England by Mrs. Neill, who represents the company.

The Ladies' Sericicultural Company hope to effect, in Melbourne, sales of silk goods made in England from raw material produced in Australia.

A quantity of Australian "grain" (silkworm eggs) has been imported into Italy, and has been successfully cultivated on a mulberry plantation near Verona. The produce commands a very satisfactory price on the Continent—1 fr. 50 c. per kilo. having lately been offered for Australian cocoons above the price realised this season for the best Italian cocoons.

The floss and common rubbish are now being made by the Contadini, near Verona, into common strong silk for dresses and coats. The produce of finer quality is being reeled by the Maison Keller, of Milan, and will be manufactured into first-class silks.

The following copies of correspondence are submitted, principally to show the opinion of competent authorities in Italy with regard to the prospects of Australian sericiculture:—

1. From the British Consul in Milan to the Hon. Secretary of the Victorian Sericicultural Company, Limited, Melbourne:—

"Milan, May 11th, 18[illegible]

"DEAR MADAM,—I write at the request of Mrs. Bladen Neill, who is now busily engaged in the neighbourhood of Verona, [illegible] expectation of the successful hatching of the Victoria 'grain.'

"The samples of pierced cocoons brought over by Mrs. Neill [illegible] very fine. I have shown them to friends of mine, who deal [illegible] in that particular product. The opinion generally expressed [illegible] favourable, that sales of such cocoons would be easily effected, [illegible] any extent, in this the most important silk centre of Italy. [illegible] shipments for this market would be 'grain' and pierced [illegible] The import duty on pierced cocoons is *nil*, and if a moderate [illegible] freight from Australia could be secured, considerable [illegible] profits would, I believe, be realised. By once establishing [illegible] decided superiority in Victorian grain and cocoons, the [illegible] would, no doubt, far exceed the supply, at least for the [illegible] Should such a fortunate result be obtained, it would, of course, [illegible] highly important for the future prospects of the [illegible] Company, that a very careful selection of both should be [illegible] shipment to this place. It would be difficult to find in this [illegible] pierced cocoons equal to what Victoria appears capable of producing.

"I beg to enclose a sample of one of the many articles [illegible] manufactured here from the silk of the pierced cocoon. The [illegible] dustry is now carried on most extensively in the neighbourhood [illegible] Milan. The silk itself enters into the manufacture of an [illegible] able variety of fancy articles.

"The labour question has, I believe, been the great difficulty [illegible] with in our colonies in the attempt made to compete [illegible] manufacturers. In this instance, however, the higher price [illegible] for an article of superior quality would, to some extent, [illegible] this disadvantage.

"I shall at all times be happy, if I can be of any service [illegible] promoting the interests of the 'Victorian Ladies' [illegible] Company.'

"I am, Madam,
"Yours truly,
"C. [illegible]"

2. From the Cavaliere Ferrarie, Verona, to Mrs. Bladen Neill:—

[TRANSLATION.]

"Palazzina della Caselli di [illegible]
"22nd June, 18[illegible]

"MADAM,—Before your departure, I desire to let you [illegible] opinion of the quality of the cocoons that you have obtained [illegible] education of your Australian grain, reproduction from [illegible] while you were at my house at Palazzina.

"These cocoons are of so superior a quality, that few [illegible] can recollect to have seen the like for the last twenty years.

"They are hard, silky, of a fine grain, compact, of [illegible] tageous colour, and reel down to the chrysalis, which is [illegible] The weight of the cocoon is thus due to the silk. I am [illegible] convinced, after having heard the opinion of various Milan [illegible] chants, to whom I have sold my cocoons, that in making [illegible] 'education,' in the same place next spring, you can bring [illegible] advantage to our Province, and to the whole of Italy, [illegible] bad result which the Japanese races have produced this year.

"I do not persuade you to try another education [illegible] other motive than the mutual advantage of our country [illegible] Australia. I advise you also to show the samples of silk [illegible] from your cocoons to the large manufacturers of England, [illegible] be convinced of their merit at the first glance.

"If your education succeeds well, the importation of Australian grain will meet with no difficulty, as we have already had [illegible] here this year, where several persons have asked to be furnished [illegible] me for the next spring.

"I profit by this opportunity to wish you every [illegible] the good work merits, which you have undertaken for the [illegible] your sisters in Australia and in Europe, and which [illegible] draw towards you the sympathy and concurrence of all [illegible] feeling.

"Accept, Madam, the assurance of my esteem, and of the [illegible] consideration with which I am,

"Your devoted Servant,
"ANT. F[illegible]"

3. From the British Consul, Milan, to Mrs. Bladen Neill:—

"British Vice-Consulate, Milan,
"7th July, 18[illegible]

"DEAR MADAM,—The two samples of Victorian cocoons [illegible] sent me have given so much satisfaction at Milan, that offers [illegible] been made by important silk houses here for large quantities, [illegible] a price higher than can be obtained for any other [illegible] this the most important silk district in Italy.

"We must therefore conclude that Victoria is equal to producing silk equal—perhaps superior—to the best qualities [illegible] The two samples are evidently a reproduction in Victoria of the highly esteemed races of Fosombrone and Milan [illegible] were known here before the appearance of the disease, [illegible] years ago.

"The very favourable result already obtained will no doubt [illegible] to cultivation on a much larger scale in the Colony of Victoria. [illegible]

* See *Journal*, vol. xxi., p. 391.

fitable market is always open here for grain and cocoons at a h price.

"With regard to pierced cocoons, I must call your attention to machinery employed by Mons. F. E. Gaddani, of this city, for ing this class of silk.

"It was the custom, some years ago, to consider everything that not in reality constitute the beautifully formed shroud, in which worm imprisoned itself, as of little use to the spinner; but a y important branch of trade has in the course of a few years ng up; and it may with perfect truth be said, that at the sent moment, everything is profitably utilised, from the floss (or e, as it is called in the trade), to the final piling covering which after the process of reeling, found to envelope the chrysalis.

"You cannot too strongly impress upon the mind of all persons gaged in the cultivation of silk in Victoria, that the word ste,' still technically used, has in reality become a misnomer.

"Sincerely wishing you every success in your generous efforts to nd in Victoria such an important branch of industry,

"Believe me, dear Madam,
"Yours very faithfully,
"THOMAS KELLY."

4. From His Excellency Sir George Bowen to Her Majesty's Consuls :—

"Melbourne, Victoria,
"30th December, 1874.

"I have great pleasure in requesting the kind attention of Her esty's Consuls to Mrs. Bladen Neill, in any continental city that may visit.

"Mrs. Neill has a world-wide fame as a successful sericiculturist, her efforts to introduce the silkworm into Australia, and to a new and valuable industry in this country, are beyond all ise. I cannot speak too highly of them; and I feel assured that r Majesty's Consuls will procure for Mrs. Neill any information may be in their power.

"G. F. BOWEN,
"To Her Majesty's Consuls, &c. "Governor of Victoria."

5. From Sir George Verdon :—

"Melbourne, Australia,
"31st December, 1874.

"As President of the Victorian Ladies' Sericicultural Association, ve the honour to introduce the founder of the company, Mrs. den Neill, and to solicit on her behalf such advice and assistance she may need during her stay in Europe, in the prosecution of mission.

"Mrs. Neill desires to have the grain and silk produced in tralia tested and compared with the productions of other tries; and as her endeavour to promote sericiculture is regarded the Colonial Governments, as well as by the public, as an important public service, I beg leave to commend her to the consideration of the Departments of Trade and Agriculture in the countries may visit.

"GEORGE VERDON, K.C.M.G., C.B., F.R.S."

Ladies and gentlemen who desire to assist in the elopment and better establishment of the industry ve referred to, are requested to communicate with s. Bladen Neill, 27, Princes-gardens, South Kensington, S.W.

GEOGRAPHICAL CONGRESS AND EXHIBITION AT PARIS.

[FROM A CORRESPONDENT.]

This scientific gathering was formally inaugurated in e Salle des Etats at the Tuileries, on Sunday, the 1st August, in the presence of Marshal de MacMahon, sident of the Republic, the Ministers, Ambassadors, d a large assembly of savants and celebrities, mostly tinguished men of science in the particular sphere dicated by the title.

The first Geographical Congress, it may be remembered, was held four years ago, at Antwerp, in 1871, the occasion of a celebration in connection with the mory of the renowned geographers, Orteluis and rcator, to whom that city erected a monument. M. Charles Ruelens, Conservator of the Antwerp tional Library, was one of the first and most active omoters of the idea, to bring together in re-union, that festival, all the living notabilities whose names re associated with the progress of geographical knowledge and discovery, inclusive of ethnography, cosography, navigation, and commerce generally — a mewhat wide range. The Emperor of Brazil, Don dro, was present at the first Congress, which set the ample of conferring honorary or material distinctions, by awarding three grand gold medals, the recipients being Dr. Livingstone, M. Francis Garnier, and M. Ferdinand de Lesseps, of whom, unfortunately, two have since then been lost to their countries, England and France, and to the world at large.

That the country, of which the capital has been selected for the second session of this Congress, should have been aroused to a peculiarly lively, and so to say personal interest in the special objects of such an international scientific association, was a natural consequence and corollary of the rude enlightenment, as to the superior geographical and topographical attainments of the Germans, enforced on the French nation by the stern lessons of the war of 1870-71; and this may be said without any derogation to the latter country, inasmuch as it is admitted by their writers in the press. In consequence the central committee, appointed at Antwerp—as it were to maintain and keep alive the sacred fire—presided over by M. Van Haan-Steenhuysen, who had occupied the chair on that occasion, found the Geographical Society of France, and its president, Vice-Admiral Baron de la Roncière la Noury, willing and eager to locate the second session of the Congress at Paris, and the ceremony of Sunday was the crowning of that work.

The retiring president made a valedictory address, in which he pronounced the customary obituary eulogiums on the members removed by death, notably Elie de Beaumont, d'Avezac, d'Halloy, and Francis Garnier; made reference to M. de Lesseps, and his modesty in declining the honour of having the Suez Canal named after him as the "Bosphorus de Lesseps;" and paid the necessary compliments all round to the country which now entertains the Congress, and to its national representatives of various kinds; finally handing over to his successor a commemorative medal, and resigning to him the functions of the chair.

The distinguished French naval officer who then, metaphorically speaking, hoisted his pennant on board of the geographical flag-ship, has but just returned for the purpose from a cruise in the Mediterranean, the waters of the Levant, and the genuine Bosphorus, in command of the experimental squadron or squadron of evolutions. In his inaugural address he contrasted the peaceful words, scientific proceedings, and humanitarian purposes of the present, with the opposite utterances of political presage which, during the closing years of the Empire, had served to render the Salle des Etats memorable, and even thrown Europe into the toils of diplomatic intrigue and the convulsions of war.

Addresses were then given by the various vice-presidents representing the geographical societies of the different countries taking part in the Congress, viz. :—MM. de Richthoffen (Germany), the well-known traveller in China; Sir Henry Rawlinson (England), the details of whose title to fame need not be specified; Semenoff (Russia); Correati (Italy), formerly Minister of Public Instruction; de Beaumont (Switzerland); Hunfalvy (Hungary); Veth (Holland); Schweinfurth (Egypt), president of the newly-established Geographical Society of Cairo, noted for his African explorations in the countries of the Niam-Niams, the anthropophagist Mombouttons, and the pigmy Akkas.

The secretariat comprises MM. Waldemar Schmidt, Denmark; Coello, Spain; Vasconcello, Portugal; De Saussure, Switzerland; Maunoir, the Secretary-General of the Geographical Society at Paris; Duvergier, noted for his travels among the Touaregs; Grandidier, the explorer of Madagascar; Dr. Hamy, an anthropologist attached to the Natural History Museum, Paris; and Demarsy.

The sectional labours of this meeting are divided into seven groups, as follow :—1. Mathematical geography, geodesy, and topography. 2. Hydrography, and maritime geography. 3. Physical geography, including botanical and geological subdivisions, also general anthropology, geology, and meteorology. 4. Historical geography, ethnography, and philology. 5. Economic

geography, commercial and statistical. 6. Teaching and diffusion of geographical knowledge. 7. Explorations and travels, for scientific, commercial, and picturesque purposes. Great Britain is represented by Colonel Montgomerie, as Commissioner, and by Sir Henry Rawlinson, as President of the Royal Geographical Society, as also by many other well-known names.

As a supplementary and most valuable adjunct to what may be called the didactic business of the Congress, the practical element is represented by an exhibition of almost everything connected, either directly or indirectly, with the geographical sciences, as enumerated and subdivided in the above-mentioned sections, to say nothing of a great many things as to which the connecting link is left to the indulgent imagination to supply.

The space occupied by the representative exhibits of England, or rather Great Britain, cannot be regarded as large, in proportion to her material position, from the geographical point of view; and if the native Briton, from the patriotic standpoint, should on a cursory examination experience a tendency towards a vague feeling of discontent, there are not wanting sources of consolation to him, or her, as the case may be, for the quasi-scientific Englishwoman is by no means a *rara avis*. For example, if he or she be an ardent follower, on paper, of the pioneers of discovery, say in Central Africa, the manuscript maps and charts of celebrated explorers cannot fail to create a great, even if melancholy, interest: among these are original topographical drawings of Livingstone, Burton, Speke, Baker, Grant, &c. If Arctic research be the special object of interest, there is the map of the North Polar regions, whereon to trace by anticipation the track of the expeditions which have so recently quitted our shores.

Is the visitor a Russophobist? then is there abundant material for reflection in the admirable maps of Central Asia, and the countries bordering on India, the frontier states, the integrity and autonomy of which we should be glad to know secure from the far-reaching paw of the bear. And it is well worth a visit to Paris to be accompanied around this department alone by the British Commissioner, to hear him discourse of remote and little-known districts as familiarly as if it were only his native country—to hear of the Chinese express messenger route along the mountains on the northern slope of the Himalayas, the southern boundary of Thibet or Chinese Tartary; along which relays of horses are stationed, and the messenger rides for 1,500 miles, night and day, with his garments sealed over the despatch, not to be touched or broken until he arrives at his destination, in a condition into the details of which it would be well not to inquire too closely. Recent occurrences, now matters of history, invest with a specially interesting character the maps depicting the south-western frontier of China, Burmah, Karennee, and the place where Mr. Margary came by his death: also, on the north-east of the Himalayas, the country of Koshgaria, and the plains of Yarkund, on which their Russian and Chinese neighbours are alike believed to look with longing gaze and covetous preparations. A large compilation map, with a corresponding longitudinal section, here show the complete breadth of the Himalayan system of mountains, at their narrowest point, from the Punjab to Yarkund, a distance of 400 miles, constituting a journey of three months' duration at the least; also various other portions of that gigantic mountain range, of the Valley of Kashmir, &c., the orography of which has been delineated, on a scale believed to be very much larger than has previously been attempted for peaks so lofty, culminating at a level of 25,000 to 29,000 feet in height above the level of the sea, *i.e.*, double the height of Mont Blanc, and having giant glaciers, in length from twenty to thirty miles.

The French Society for the Promotion of Aerial Navigation has, it is stated, lately received 37 proposals from physicists and engineers offering to solve the problem of maintaining life in the higher regions of the atmosphere.

METALLURGY IN JAPAN.

The following is quoted by *Engineering* from a thesis prepared by a Japanese student, graduated at a United States college:—

Iron ores are very abundant in the Japanese Islands. The chief ores of Japanese iron industry are magnetic iron ore, specular iron ore, and brown hematite. The first is found in two varieties, one of iron-grey colour and the other black. Masses of this ore in the state of magnetic polarity, generally called lodestones, are found in the eastern part of Nipon, Sendai, and Nambu. They are very highly esteemed for the steel manufacture, for swords and compass needles. Japanese furnaces are small in size and simple in structure, although the principle is the same as that of the blast furnace used here and in Europe. The walls of the Japanese furnace are built with fire-proof clay, and sometimes with a few stones. The shape of the furnace is round at the bottom, having at one side an opening which is closed with a clay stopper. On the opposite side of the furnace wall, a little above the bottom, there are two openings through which a continuous stream of air is passed in the furnace by means of a Chinese bellows worked by men. Before the ores are put into the furnace they are piled up in heaps with coal and calcined, or roasted, so that the water, carbonic acid, and sulphur may be expelled. The Japanese do not know the theory of the puddling process used in the Western countries, but the principle is exactly the same. The cast iron mixed with some sand and some iron scales is melted with charcoal heat in a furnace similar to that already described, and kept in this melted state for several days until the whole mass assumes a fluid appearance. The Japanese method of steel making is entirely different from those usually employed in Western countries. It is done in this way. They mix a certain quantity of pig iron, which contains too great a quantity of carbon, with a certain quantity of bar iron, which has too little carbon, and cover the mass with borax and smelt in a small crucible of fire-proof clay for more than a week. The borax is used to dissolve any impurities in the slag. When the metal is separated from the slag floating on the surface, it is taken out and hammered hard, and alternately cooled in water and oil many times. After the steel has been cast in that method, it is cemented and tempered. The method of cementing consists in covering thickly the hammered steel with a liquid mixture of clay, loam ashes, and charcoal powder. When this layer is dried the whole is heated red hot and then cooled very slowly in warm water. The steel is now ground on a whetstone. The steel thus made is not very elastic, but is very hard. The explanation is that either the Japanese do not understand the tempering process, or they are unable to remove entirely the impurities from the steel. I have often heard Japanese blacksmiths say that watch springs can never be made in Japan, for Japanese steel is not elastic. The Japanese take great care and time in steel manufacture for swords. For instance, for ordinary knives forging and cooling are to be done only four times, but for swords fifteen times. Copper is and will be the most important metal of Japan. It is found in almost every province. For roasting they have a furnace covered with a shed, provided near the bottom with several openings for the draught of the air. Five alternate layers of ore and wood are placed in the furnace and burned.

The revenue of the Suez Canal is well maintained. In the first five months of this year, 714 vessels passed through the canal, as compared with 560 in the corresponding period of 1874, and 565 in 1873. The aggregate receipts of the first five months of this year were £[illegible],647, as compared with £447,303 in the corresponding period of 1874, and £405,892 in 1873.

THE FORESTS OF AUSTRIA-HUNGARY.

The forests of Austria-Hungary are chiefly peopled by trees of the "pointed-leaf class," and those that clothe the sides of the mountains of the higher altitudes, are almost exclusively of the *Pinus picea* family. Of such are composed those that flourish in the marshy soil of the Sudetes, of the Reisen and Lichten mountains, the Alpine, Bohemian, and Carpathian forests, as well as those in the north-east of Moravia, in Eastern Silesia, on the frontiers of Gallicia, the Bukowina, and Hungary. In the so-called Alpine districts, such as Upper Austria, Salzbourg, the Tyrol, Styria, Carinthia, and Upper Carniola. The larch (*Larix Europea*) is largely disseminated among the pines, and may again be found in large quantities in portions of the Sudetes, in the vicinity of Freudenthal, Facquendorff, and Valbersdoff, where the specimens of this tree are remarkably fine and plentiful. Next to these in magnitude and dissemination must be classed the common pine (*Pinus sylvestris*), with which the sandstone mountains of Northern Bohemia abound. It is also to be found in plentiful quantities in the sandy or silicious lower strata of the Lower Bohemian mountains, in Moravia, Eastern Silesia, Gallicia, Bukowina, and Lower Austria, as well as the steep declivities and summer spots in the Alps. It grows generally in large powerful masses, in various degrees and proportions, mingling sometimes with trees of other families, and impressing its character upon the general aspect of the places in which it grows.

The fir tree (*Pinus abies*) is seldom found in large collective quantities on a separate area. It is generally intermingled with other trees of different families, and wherever the beech tree overshadows the mountains, or in ground formerly peopled by beeches, there will the fir chiefly flourish. The Western Carpathians, some of the central mountains of Silesia and Bohemia, the Wiener forest, and portions of South Carniola, furnish the finest and most abundant specimens of this tree. The black pine (*Pinus nigrans*), as regards industrial purposes, is to be only found in Lower Austria, in the Steinfeld, near Weiner-Neustadt, Moedling, and Pottenstein. The remaining members of the pine family exist in too small quantities to be of importance for industrial or useful objects. Among the "broad-leaved" trees, the first to mention is the red beech (*Fagus sylvatica*), with which a great portion of the Carpathian mountains, of the central mountains of Moravia, Silesia, and Bohemia, is covered, and more especially the basaltic heights of Northern Bohemia, of the Wiener-Wald, Southern Styria, Carniola, and along the littoral of the Adriatic. By the side of the red beech, in more or less quantity, are found the heather beech (*Carpinus betulus*), the field elm (*Ulmus campestris*), the maple (*Acer pseudo-platanus*, and *Platanoides*); also the lime tree (*Tilia parvifolia*), particularly in the south-eastern part of Lower Austria, in Southern Styria, Carniola, and also the littoral. Here and there the chestnut tree (*Castanea vesca*) is intermingled with the above. The ash tree, the field elm (*Ulmus effusa*) are found in soil of a coarser quality, and on more level ground. The field maple (*Acer campestris*) is common enough in the valleys of the above-mentioned provinces, and grows generally on the low level soil that borders the rivers. It is to be found mixed among alder poplars, willow trees, and different other specimens of soft timber and bushes on the banks of the Elbe, Danube, Thaja, and of the Galician rivers. The mountain ash and the birch tree (*Betula alba* and *Betula pubescens*) are always to be found mingling among the other forest trees.

The oak especially flourishes in the valleys and along the river courses, and also in the slopes of the advanced ridges of mountains, conjointly with the beach. Large quantities of oak are to be found in the lower regions of water courses which have become fertilised and enriched by alluvial deposits, as in Bohemia, Moravia, Silesia and Lower Austria. It grows in considerable luxuriance on the plateaux and slopes of the undulating hills in these provinces, both in the rich loam and in the sandy soil of which the land is alternately composed. On the littoral of Goritzia and Montana there are still some specimens to be found of this precious tree, but they remain there more as relics than in sufficient quantity for useful purposes. The same thing may be said of the culture of this tree in Lower Carinthia, Gallicia, and the Bukowina. On some of the mountains there is a sufficient growth of it, mingled with beeches in the valleys, and with pine trees on the higher ground. On the mountains the *Quercus robur*, or grape oak, chiefly abound, while, in the valleys and along the river courses, the *Quercus cerris* and the *Quercus pendunculata* are invariably to be met with, the former being held in slight esteem as a workable material. The class of oak tree found along the littoral of the Adriatic is the *Quercus rubescens*.

In parts of Bohemia and Hungary, Mr. Ffrench states that entire forests have been so completely destroyed and uprooted, that it is very doubtful whether the land is susceptible of again resuming its tree-bearing qualities. Among several of the proprietors there is a feeling of regret at the barbarous havoc that was made of these forests, the more so that, in many cases, the poverty of the soil renders it almost useless for agricultural purposes, and consequently, unproductive; whereas, if clothed with the products which nature had implanted there it would still yield considerable revenues. In order to encourage the replanting of the forest ground which had been cleared for agriculture, prizes or rewards have been given by the State to persons who have made successful attempts to this end and object, and of these prizes several have been lately held forth. Inspectors appointed by the Government have been named in all the provinces. In the Tyrol, the Littoral, and Dalmatia, they are supported by sub-inspectors, whose business it is to survey, watch over, and insure the strict enactment of these forestial laws. They are empowered to assist the communes and proprietors of small forests by their advice, and to form registers containing the results of all scientific and useful investigation. Societies have been formed for the furtherance and development of agriculture, and especially of forest culture: they receive pecuniary subsidies to enable them to form nursery-gardens, schools of arboriculture, out of which trainers and teachers are to be disseminated throughout the empire. Prizes are to be given for the best specimens of seedlings and young trees produced at exhibitions. The teachers in the schools are convoked during the vacation time to meet in some central spot where conferences are held and lectures given in agriculture and arboriculture. These generally last through several weeks, and are illustrated by practical experiments, in order that they may become practically acquainted, in a rational manner, with the essence of what they afterwards have to communicate to their pupils, and thus awaken in them a sympathetic interest for the conservation and preservation of forests in general, and trees in particular.

The expropriation or diminution of the forests in parts of Austria, and more especially in Hungary, has been followed by effects of a serious and baneful nature, such as long seasons of drought and a permanency of tremendous winds which come from the Carpathians, sweeping the whole of the plains of Hungary, filling the air with unceasing clouds of dust, and considerably increasing the development of pulmonary disease, especially in the towns which are now totally unprotected: in this account may be mentioned Pesth, Presburg, and Vienna, which are perfectly intolerable in spring, summer, and autumn.

The last report of the directors of the South-Eastern Railway Company states that they have resolved to subscribe £20,000 for the making of a shaft and preliminary experiments in reference to the proposed Channel tunnel.

CORRESPONDENCE.

COMMUNICATION BETWEEN PASSENGER AND GUARDS IN RAILWAY TRAINS.

SIR,—Recent circumstances have drawn fresh attention to the question of communication between passengers and guards in railway trains. Some years ago I suggested that a looking-glass should be fixed on each side of the engine, so as to reflect the entire length of each side of the train, and that those glasses should be so placed as to be easily seen by the engine-driver and stoker. With such an arrangement, properly adjusted, it is obvious any signal, such as the waving of a handkerchief, or putting forth a hat from any carriage window, could not, by its appearance in the reflecting glass, fail to attract the attention of either the driver or his assistant. This arrangement was tried some years ago, on an engine between Coventry and Leamington. The guard and engine-driver were delighted with it, but for some reason, unknown to me, it was suppressed by some one in authority at Euston Station. I have heard of its being since used successfully on some continental railways.

It is simple and inexpensive, and, I beg to submit, worthy of a fair trial.—I am, &c.,

GEORGE D. LONGSTAFF.

Wandsworth, August 2, 1875.

CACAO CULTIVATION IN CEYLON.

SIR,—You were so good as to find space in the *Journal* of February 19th for some remarks on the cultivation of cacao, urging its introduction into India. I referred incidentally to its growth in Ceylon, from which island was imported into this country, in 1871, a sample of a dozen bags of very fair quality. I have now met with some further information, showing the progress made in its cultivation since, in the report of the Director of the Royal Botanic Gardens in Ceylon.

As far as cocoa is concerned, the plantations which have already been formed have come on so well in parts of the island too hot for successful coffee cultivation, that it may be expected there will soon be a good deal of land devoted to the production of this useful article. More than 40,000 seeds and plants have been distributed from the Government gardens at Paradeniya during the past year, and demands have been made for the seeds of the coming crop.

This account of material progress seems to me very encouraging, which we may hope will lead to the introduction of cacoa in other directions.—I am, &c.,

HAHNEMANN EPPS.

Hampstead, August 2nd, 1875.

GENERAL NOTES.

Lighting Street Lamps by Electricity.—The *American Artisan* describes a method now on trial at Providence of lighting lamps by this means. A small electrical coil is attached to each lamp, and this is connected to wires from a battery at the central office. The gas tap is opened and closed by compressed air, and the same action closes the circuit which is at once broken by the attraction of a magnet releasing the catch of a spring lever, when a spark passes, lighting the gas. The same lever which breaks contact also makes contact with the wire leading to the next lamp, where the process is repeated, and so on through all the lamps of the circuit. To extinguish the lamps the air pressure is reduced, and the taps closed, the circuit being previously broken at the battery. This brings the mechanism into position for lighting again. An indicator at the central office marks each break of the circuit, and consequently shows the lighting of each lamp or the place where anything is out of order. To judge from the drawings and description, the apparatus is somewhat complicated, but it is said to work easily and regularly in practice. This method, it may be remembered, differs considerably from that described in a paper read before the Society in 1873, in which a small battery was affixed to each lamp, and the circuit was closed by pressure of the gas itself, raising the surface of the exciting liquid into contact with the elements. It should be added that the American method is the invention of Mr. Bean.

Birmingham Japan Trays for Japan.—Among the curiosities of the export business now being done in England, we (*Engineer*) have to state that for some time past at least one of the Birmingham japan firms has been quite busy in making japan trays for Japan. They are iron japanned, and in sets of the usual sizes, viz., 14 in., 16 in., and [illegible] in. The patterns are designed to suit the market, being chiefly a mosaic of Japanese characters, inlaid with gold, and there are as many as sixteen colours used in every tray. So elaborate is the artistic work that in decorators' wages alone it costs the makers 18s. per set. We know the price at which the sets are sold by the manufacturers, but it would be unfair to state it. It may, however, be said that, considering the heavy decorative cost, the figure should not lead to any complaint by the merchant. As far as is known, the trade with Japan in this branch is likely to increase, and there is a decided promise in favour of a growing profitable communication between this country and that. It cannot but come about that the makers of hardwares will be benefited by the active business which the sedulous Japanese manufacturers are doing with our own country; but it is sad to see how Japanese art is suffering.

Vintage in Italy of 1874.—The *Gazetta Officiale* publishes the following statistics respecting the vintage in Italy in 1874:—In Piedmont, it was bad in 97 communes, indifferent in 166, sufficient in 282, and abundant in 540. The vintage in Lombardy was bad in 204 communes, indifferent in [illegible], sufficient in 450, and abundant in 470. In the Venetian provinces, it was bad in 114, indifferent in 137, sufficient in [illegible], and abundant in 209. In Liguria the vintage was bad in 10, indifferent in 109, sufficient in 92, and abundant in [illegible]. In Emilia, it was bad in 22, indifferent in 76, sufficient in 75, and abundant in 144. In the Marches and Umbria, it was bad in 16, indifferent in 13, sufficient in 98, and abundant in 292. In Tuscany, it was bad only in 4 communes, indifferent in 24, sufficient in 49, and abundant in 165. In the southern provinces (on the Adriatic), the vintage was bad in 143 provinces, indifferent in 226, sufficient in [illegible], and abundant in 188. In the southern provinces (on the Mediterranean), it was bad in 12 communes, indifferent in [illegible], sufficient in 114, and abundant in 164. In Sicily, the wine crop was bad in 12 communes, indifferent in 50, sufficient in 114, and abundant in 164. In the Island of Sardinia, it was bad in 26 communes, indifferent in 74, sufficient in [illegible], and abundant in 35.

Registration of Trade Marks.—The Trade Marks Registration Bill, as amended by a Select Committee of the House of Commons, consists of 12 clauses. The amendments introduced relate principally to the Sheffield Cutlers' Company, who have for some centuries enjoyed the right of assigning trade marks for steel goods. Their ancient rights are preserved by the amended Bill, which provides that copies of all Sheffield marks now in use shall be transmitted to the registry proposed to be established by the present Bill. Sheffield marks, granted by the Cutlers' Company, may be registered at the principal registry in London for additional security, but no marks for steel goods will be placed on the register in London without giving notice to the Cutlers' Company. The authorities of the Cutlers' Company on their part will be bound to give the Registrar of Trade Marks the notice of all applications for the assignment of marks, and they cannot proceed to assign a mark until after the expiration of a certain time. The definition of a trade mark has been enlarged, and any mark which is now in use as a trade mark may be registered. The Act is to come into operation on the 1st of July, 1876, being six months earlier than the date indicated in the original Bill.

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ommunications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ROCEEDINGS OF THE SOCIETY.

COMMERCIAL EXAMINATIONS.

Since the Society of Arts' General Examinations re established in 1856, the Universities of Oxford d Cambridge, the Science and Art Department the Government, and other public bodies, follow- the example of the Society, have instituted aminations, which, to a certain extent, supply place of those of the Society of Arts. None of em, however, are specially adapted to young per- s entering commercial life, whether as clerks or herwise, and the Council have therefore decided to ablish examinations of a commercial character, lieving that such examinations will be of great ctical benefit, and specially within the province a Society established for the encouragement of ts, Manufactures, and Commerce.

The subjects for examination will be as follows:—

1. Arithmetic.
2. English (composition, correspondence, and précis writing).
3. Book-keeping.
4. Commercial History and Geography.
5. Shorthand.
6. Political Economy.
7. French.
8. German.
9. Italian.
10. Spanish.

Certificates will not (as heretofore in the General aminations) be given in separate subjects, but in der to obtain a "Certificate in Commercial nowledge," a candidate must pass in three sub- ts at least, two of which must be Arithmetic and glish.

The papers set in most of these subjects will to me extent differ from those of former years, in ing specially adapted to test the candidates' owledge from a commercial point of view.

Prizes will be given as heretofore. The regula- ons are now under consideration, and the Pro- amme will be published as soon as the details ave been finally arranged.

MUSICAL SCHOLARSHIPS OF THE SOCIETY OF ARTS.

It is proposed to form a fund, to be subscribed among the members of the Society of Arts, for the purpose of establishing scholarships open for competition among qualified persons nominated by the Society for examination in such competition. Members willing to make donations or give subscriptions in aid, are requested to communicate with the Secretary.

The following subscriptions have already been promised :—

Lord Alfred Churchill (Chairman of Council), for 5 years, yearly	£5
Sir Henry Cole, K.C.B., for five years, yearly	5
E. C. Tufnell " " "	2
Peter Graham " " "	2
Andrew Cassels " " "	2
E. J. Reed, C.B. " " "	5
R. Rawlinson, C.B. " " "	2
Edwin Lawrence " " "	2
Edward Brooke " " "	5
Hyde Clarke	5
F. A. Abel, F.R.S.	5
Seymour Teulon	5
Major-General F. Eardley-Wilmot, R.A., F.R.S.	5

CANTOR LECTURES.

The third lecture of the course of Cantor Lectures on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft," by the Rev. ARTHUR RIGG, M.A., was delivered on February 22nd, 1875, as follows:—

LECTURE III.

On Hammers.

It is hardly possible to draw a distinction between a tool and a machine; the former is more simple than the latter. They so merge each into the other that it is difficult to say where the one ends and the other begins. A lathe, for example, is a handicraft tool, and yet in its ramifications and developments it becomes a very complicated machine. As a machine we are not concerned with it—as a tool it might legitimately be classed in this course of lectures. It was, however, one of the earliest to be erased from the first list; now, however, it has for associates a goodly number of tools in far more general use than itself, which one by one have been set aside. It may be asked, What is a tool? How is it defined? Questions not easily answered. For our present purpose, it will suffice to state that an implement by which the power of man is enabled to change the physical forms of materials is a tool. If to this implement there be added appendages, which either extend its range or vary its mode of application, these appendages are "contrivances." There may, however, be contrivances not connected with tools as now defined, and then they are elevated to the dignity of tools. For example, a chisel or a hammer is a tool; the boxing with which the former is surrounded, as in a plane, and the handle attached to the latter, are contrivances, for by them the modes

of application of a chisel and the powers of a hammer are extended and varied. A vice, a soldering bit, a nail, a square, are not tools, but "contrivances" only.

Viewed thus, it may be said that by means of tools and contrivances man is enabled to increase and vary human power, to economise human time, and to convert substances apparently the most common and worthless into valuable and useful products. Without tools the hand would be nearly powerless; add to it a hammer and a cutting instrument, and its capacity is increased many fold. Whoever contrived rollers as a means for moving heavy blocks of stone added a contrivance which very largely extended the powers of men. Whoever first applied grease to bearings and surfaces enabled man to utilise a much larger portion of his power. Whoever first, in truly geological prehistoric times, made an eye and a point in and on a strip of bone or shell, gave to man as a tool an invention far exceeding in importance and value anything yet accomplished by heat or electricity. Whoever in these same times applied a barb to a spear and a hook, introduced a contrivance of very high and inestimable importance.

The most ancient of tools is the hammer. In all parts of the world and amongst all people hammers may be found in use. So general are they that even the name "hammer" seems to have a pre-historic origin, for etymologists tell us that the word "hammer" is common to all the northern languages.

A tool more simple and more useful than the primitive or handicraft hammer cannot be found. Yet it has been so little esteemed during the countless ages since the first was made, that so far as your lecturer's researches have penetrated, the hammer does not possess any literature. This may be illustrated by reference to the Encylopædias, *e.g.*, "The Penny Cyclopædia" in its thirty volumes, and the "Edinburgh Encylopædia" do not contain in alphabetical order the word hammer. The "Encylopædia Metropolitana" and the "London Cyclopædia" dwell upon the word hammer chiefly in its figurative sense. "Rees' Cyclopædia" has hammer "an instrument of iron with a handle of wood, used in most mechanic arts to beat, stretch, drive, &c., &c." The "Encyclopædia Britannica" and the "Oxford Cyclopædia" use terms similar to those employed in Rees. "The English Cyclopædia," speaks thus disrespectfully of this most primitive, ancient, and universal tool—

"Hammer.—It will not be necessary to notice the hammer as a mere tool, but its importance as a machine renders a description necessary."

More recently, and in a book specially devoted to the tools and contrivances used by artisans, and which volume has both a table of contents and a comprehensive index, the hammer is not even named in these. Like the scaffolding of a building, the simple hammer seems always to be cast aside, and the writers of the articles in the "Encyclopædia" have correctly interpreted the universal treatment. The machine contrivances worked by other than human power, and to which they attach importance, are those with which this course of lectures is not to be concerned.

Before considering such views as may have suggested many of the various materials and forms of hammers now in use, it will be well to regard the hammer in, and of, and by itself. We are so apt to look upon it as a rude implement, necessarily associated with a superior class of finishing tools, that the materials, forms, and scientific principles involved in its construction and use, not only as an adjunct to other tools, but as a self-independent and final tool, are much overlooked.

In some handicrafts, and those too involving a high class of finished work, the hammer is the only tool employed. That great artistic skill in the use of the hammer, as a finishing tool, can be acquired is manifest from the beautiful illustrations of répoussé work now on the table. These, which have been kindly lent by Messrs. Elkington, are electro-deposits from hammered work, executed by a person now in their employ. The details of the ornamentations are not only minute, but they so harmonise as to give elegance and expression to the whole, exclusive of the form of the vessel on which this hammered work is effected. The variety of shape is mainly accomplished by changes in the form of the "pane," of the hammer, and in the weight of it. These changes of "pane" are sometimes effected by separating the pane from the hammers, and then the separated piece is called a "punch." Thus contrived, the same hammer-head may be said to have many panes; as in some of our pocket-cases, one handle has many instruments adapted to it. [The pieces exhibited were large salvers, with embossed pannelling. On these embossed compartments there were various details of ornamentation. One was a rose-water dish of German silver (gilt and plated) the result entirely of hammered work so far as the ornamentation is concerned. The other two were salvers, or dishes, the results of electro deposit upon copper moulds, the moulds having been formed chiefly by hammering, part of which hammering had been afterwards chased with small tools.] There are also here a number of unfinished specimens of hammered work, kindly sent by Messrs. Hardman, of Birmingham, and Messrs. Hart, Son, and Peard, of London. The former are illustrative, not only of the adaptability of hammers for accomplishing many useful works, but of the malleability of the metals brought under their blows.

But we should be ignoring the skill of those who have gone before us, if we allowed ourselves to dwell exclusively upon the work done by hammers as finishing tools in modern days. As the hammer was in all probability the first formed of handicraft tools, so it was with equal probability the first tool used for the formation and ornamentation of articles which, whilst still intended for use, were also regarded as worthy of ornamentation.

It may, perhaps, appear somewhat out of place to refer to the shield of Achilles, so fully described in the *Iliad* of Homer, book 18, in the last 150 lines.* But if any one can appreciate the value of a hammer—as an independent tool—then he will read either the original description of the metal work on this shield in the language of Homer himself, or, failing in ability to do that, he will be amply repaid by a thoughtful perusal of the translation, given by either of our late Premiers, Lord Derby or Mr. Gladstone.

* See Lord Derby's *Iliad*, book 18, line [illegible] &c.

Homer flourished about 960 B.C., (*i.e.*, 960 + 875) 2,835 years ago, and although the shield to which allusion is now being made may not have been actually fashioned, nevertheless, the description is of that which a hammer was poetically supposed capable of accomplishing. Indeed, the forge in Homer's day is described as not inferior to some of those at our large armour-plate and "Woolwich Infant" manufactories.

The late Earl of Derby gives us as Homer's description of the forge at which Vulcan wrought—

"The bellows then directing to the fire,
He bade them work; thro' twenty pipes at once
Forthwith they pour'd their diverse-tempered* blasts;
Now briskly seconding his eager haste,
Now at his will, and as the work required.
* * * * * *
Then on its stand his weighty anvil placed;
And with one hand the hammer's pond'rous weight†
He wielded, while the other grasp'd the tongs.
And first a shield he fashioned, vast and strong,
With rich adornment . . . . .
. . . of five folds the shield was form'd;
And on its surface many a rare design
Of curious art his practis'd skill had wrought."
Book 18, *line* 528, *&c.*

The account of the shield itself is too long, but Mr. Gladstone‡ has condensed (as a table of contents) the incidents embossed upon it by hammering and inlaying. These incidents, it will be observed, are very unlike the "various shields" in the hosts of Satan, for the latter were "with boastful arguments pourtrayed" (Milton's "Paradise Lost," Book 6, line 84).

The scenes wrought upon the shield of Achilles are—1. The earth, sea, and heavenly bodies. 2. In a city at peace there are—(*a*) Marriage festivities; (*b*) A judicial suit or trial. 3. In a city at war there are—(*a*) A scene before the ramparts; (*b*) An ambush and surprise; (*c*) A bloody fight. 4. The ploughing of a field. 5. The harvest and the meal in preparation. 6. The vintage, with music and a march. 7. A herd of cattle attacked by lions. 8. Sheep at pasture and their folds. 9. The dance. 10. The great ocean river encompassing the whole, as, in the mind of Homer, it encompassed the earth.

Mr. Gladstone remarks:—"Never was outward fact so glorified by the muse. Nowhere in poetry is there such an accumulation of incidents without crowding. Of the twelve pictures on the shield, almost everyone contains a narrative." All this is described as the result of hammer-work.

Although hammers and hammer-work have been in past ages thus highly esteemed, yet whilst hitherto, in modern times, literature has disregarded the tool pure and simple, the wealthiest in the land pay very marked respect and honour to the tool itself. The diamond within gives to the casket its worth, and the value of a gem may often be inferred from the setting in which it is placed. Judged by this standard, the hammer holds a patriarchal pre-eminence amongst tools—a pre-eminence to which its antiquity and usefulness fully entitle it. Not royalty alone, but all who derive their authority either from royalty or wealth, and who adopt an English view, that honour is shown by excessive display and paraphernalia, cover with valuable cloth the box containing the hammer to be used in case their carriage meets with an accident. The sides of this cloth which covers the hammer, and the doors of the carriage which enclose the owner, are alike emblazoned with heraldic arms. Is it from deferential respect to this most ancient of tools that on the hammer-cloth is often a more expensive emblazonment than on the doors of the carriage?

For examples of the use of hammers in the production of works of great variety and extent on a large scale, see the ancient hammered wrought-iron gates, hinges, panels in the architectural room in the Museum at South Kensington, or (only of a different character, but still hammered work) the gates recently erected near the courts in Lincoln's-inn, also the various suites of mail and chain armour in the Tower of London, also the iron panels on the table, especially the beautiful iron spray formed out of the solid, without either welding or brazing; also the raising and embossing of metals to which your attention has already been directed; the formation of gold leaf, the springs of carriages, and the stiffening of saw-plates.

The nature of the work to be done by hammers calls for very great differences, not only in the form, material, and weight of the hammer-head, but also in the appendages to these. There are the material and form of the handles, the angle at which these handles should intersect the axial line of the hammer head, the position of the centre of gravity with respect to the intersection of this axial line, the length and elasticity of the handle. If the centre of gravity is not in the central line or longitudinal axis of the hammer-head, then there is a tendency to bring the hammer down on the edge of the face and not on the face. If this defective construction were great, the muscles of the wrist may not be strong enough to counteract the tendency. If the defective construction is slight, then the work is often marked with angular indents. Arrangements, too, may be required for modifying the intensity of the blow, whilst retaining the effects resulting from a heavy hammer where a light one would be inefficient.

As the principles which govern the operation of small things may be best studied in large ones, so here. For this purpose we may at the outset regard the hammer as a weight at one end of a rod, of heavy or light, of elastic or non-elastic material, the position of the hand on this rod varying according to requirements (as the fingers of a violinist on the strings of a violin) and so modifying the effects of the hammer. Speaking generally, the effect is produced by allowing what we must call the head to fall through a space, and then come in contact with the material to be influenced by the blow. Perhaps, the objects to be accomplished by the blows of hammers are more varied than those to be effected by any other single tool. It may be questioned whether there is any handicraft operative who carries through any branch of his trade without using what he calls, or what we may call, a hammer. Although under this general name each artisan understands a certain tool employed in his own trade, it does not follow that he generalises, and so extends his views as to comprehend all the varieties, both in material

* The expression must be limited to the intensity of the blast, although it reads as if Homer was as familiar with "hot-blast" as we are; perhaps, he may have been.

† It would not have accorded with the acknowledged power of Vulcan to have represented him as needing the help of a sledge-hammer man.

‡ See *Contemporary Review*, 1873-74, p. 329.

and form which present themselves between the heavy two-handed maul and the smallest tapping hammers of the jeweller and watch-maker, file-maker, and diamond-splitter.

It is curious to see how in the same trade the hammers are for different purposes made of different materials. The engineer (for example) uses hammers faced with steel hardened, the stone-breaker (or mineralogist) hammers faced with steel softened (or rather not hardened). Again, in another part of his progressive work, the steel hammer with which the engineer commenced his operations gives place to a bronze or a copper one, and this is sometimes displaced by one of lead alloyed with tin, and the usual handle entirely discarded. It then assumes in all respects save material the form and mode of handling as described in the account of the pre-historic stone maul. This leaden cylinder, about two inches in diameter and six inches long, is the primary form of this second maul, which is about three and a-half inches in diameter and three inches long, the ends, as you observe, being very much spread out. There is no handle to this tool; occasionally it is made of a mixture of lead and tin, in order to impart a hardness not possessed by lead alone. To strike where required the bright part, in the erecting of heavy machinery, the engine-fitter makes use of the contrivance now before you.

The plumber dismisses all these, and for direct action upon the material employed in his trade he uses a hammer of wood, discarding not only the

Fig. 15.

Fig. 16.

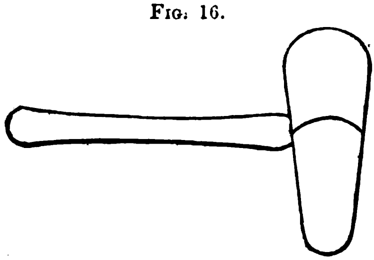


Fig. 17.

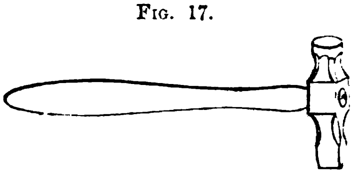
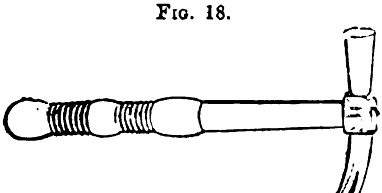


Fig. 18.



material, but also the form of hammers used in allied crafts. Indeed one of his hammers (Fig. 15) serves a double purpose, for if at one moment it is a hammer, at the next it is used as a swage. Fig. 17 is his ordinary hammer, but when carrying on his allied trade as a glazier, not content with this, even the handle (Fig. 18) is finished in an unusual manner, probably for convenience in holding putty which he often carries "dabbed" on the handle. In some cases, as in the working of copper vessels which have been silver-plated or gilt, the coats of the precious metals are so thin that, although the weight of a hammer head is required, yet even the wooden hammer of the plumber, or the still softer leaden hammer of the engineer, is equally unsuitable, and therefore the workers in these metals cover the face of their hammers at times with one or more layers of cloth held on by a ring which slips round the ordinary hammer-head as the hoop on a child's drum. The covering of the hammer-head with cloth, to preserve the material on which the blow is struck, is not, however the only use made of a jacket over the hammer. For one purpose when a leather jacket is employed, even a leaden hammer might prove inconveniently noisy.

In a case brought before the Lambeth Police-court on 19th January, 1875, Edward Simpson (shoemaker) and others were charged with house-breaking. The implements used in this occupation were produced, and the newspaper report states that "one feature of the exhibition was a leaden hammer capped with leather, which it was stated was used for the purpose of driving wedges into safes, the leather causing the blows to be almost noiseless."

The veneering hammer, again, is compound, one end being formed of metal and the other of wood. This hammer is used, the one—or metal—end as a squeezing hammer (if such a term may be employed), the other as a tapping hammer, in order to ascertain by the sound produced where the veneer is adhering, and where it is not.

The stonemason seems to claim a universal choice, both of material and form. As to material, he has and frequently uses hammers made of wood, of iron (steel-faced), and of an alloy of lead.

In some cases the hammer and the anvil mutually change places, the hammer of wood, the anvil of metal, or the converse. Nor is the wood always of the same character. As varied as are the characters of the woods themselves, so varied are those chosen by different crafts for the employments of each craft. Even the varying density of the woods gives place more frequently than otherwise to lead, and we meet with metal hammers used on lead covered anvils.

In the last journals of Dr. Livingstone, he mentions (page 89) that on one occasion he saw a Bushwoman, in Cape Colony, using as a digging hammer a round stone with a hole through it. Through the hole a rod was inserted. The end of the rod was used for digging, the weight of the stone assisting the muscular effort. He also states that these people prefer stone hammers and anvils because they do not burr up as iron ones do. In vol. i., page 146, there is a wood-cut illustrative of the mode in which these stone hammers and anvils are used. It differs materially from the plans supposed to have been adopted in the stone

age. The hammer stone seems to be selected with careful reference to its shape, which approximates to that of a truncated cone. It is then bound round with the strong inner bark of a tree, and handles being formed of loops on opposite sides, the man, using both hands, raises the stone hammer above his head, and thus by muscular exertion, aided by gravity, he gives a blow of the requisite intensity. A heavy stone sunk in the ground forms the anvil. The bellows consist of two goatskins, with sticks at the open ends, which are opened and shut at every blast.

On page 155 of the same journal, is the wood-cut of a mallet used by the same people for separating and softening the fibres of bark by a process of tapping. The head of the mallet is often of ebony, with the face cut into small furrows, smaller, but similar to those used on our meat hammers. There is before you what we may call a mallet (although differing in form from those we use) which was brought very many years ago from Otaheite. This also is cut on its four sides into small longitudinal furrows; each side is not an exact counterpart of the other. There is also here the felted cloth made by the use of this mallet from the bark of trees. The mode of proceeding in the manufacture is identical in principle in the interior of modern Africa and in long past days in Otaheite.

Turning to the most primitive hammer, the doubled-up hand (the fist), we find a compound material, flesh and bone. It cannot be supposed that such an instrument was made to be used as a hammer. It is, however, so used, and although the hand as a tool is essentially a vice, yet it may have been the suggesting type of those compound or comprehensive *multum-in-parvo* tools which can only be useful under circumstances of emergency. It is curious how modern practice has utilised this natural hammer by at one time endeavouring to destroy the effect of its bony parts, retaining only the fleshy, and at another time neutralising the fleshy, retaining only the bony. These converted hammers are both used in the "jousting sciences"—"the noble art of self-defence." Even the bony parts of the hammer become more soft and elastic than the fleshy parts by means of this boxing-glove, and the fleshy parts become more hard than the bony by means of this "knuckle duster." In some cases, the workman transfers the putting into action of the hammer to the foot, and thus sets both hands free for manipulating the article to be operated upon. The hammer now assumes the form and mode of action of a pile driver, except that in this case the face may be formed in swage fashion, the height to which the hammer can be raised before being set free being at the will of the operator, and thus blows of varying intensity may be discharged upon the article placed under it. If, as in the case of raising metals by stamping, suitable and progressive dies or outline forms of the inside and outside of the object are prepared, then the introduction of these under the pile-driven form of hammer enables the workman to change the shape of the metal without cracking or fracturing it. Thus thimbles and extinguishers are made.

In this case the hammer is without a handle, and operates in the most simple way possible, viz., by the direct uncontrolled and unadded-to force of gravity, and, as we shall see hereafter, furnishes the principle upon which to calculate the power of all hammers. The value of a handle, even to this primitive pile-driven workshop tool appears, however, to have been duly appreciated, and the handicraft contrivance called an "oliver" seems to have displaced the primitive form, except in places where wrought-iron nails are forged.

The "oliver," as described by Mr. Holtzaffel, and figured on page 963, Fig. 973, "Mechanical Manipulation," is a simple and useful substitute for a sledge hammerman, enabling a single workman to accomplish what is generally considered a two-handed operation. This simply-constructed foot-worked "oliver" has been adopted as the type of one introduced into small works and set in operation also by the foot, which in this advanced form of the instrument regulates the admission of steam to the driving parts.

In one respect hammers may claim for their device the homœopathic axiom, *similia similibus curantur*, for as hammers drive nails, so here in my hand is a hammer contrivance for extracting nails. [A two and a-half inch nail was driven into a block of wood and then drawn.] Messrs. Churchill, of Wilson-street, Finsbury, lent the nail puller, and have also supplied the illustration now printed. The action may be described by saying that in the

Fig. 19.

man's right-hand is a loaded steel rod, which can be driven forcibly down the iron tube in the left-hand. This action sinks below the head of the nail a nipping contrivance, and the hammer-rod being now withdrawn so far as a leather thong permits, a leverage is obtained by which the nail head is seized and the nail withdrawn.

Hammers, with and without handles, are in use—hammers of various weights, from ½ oz. to 10 lbs., and from 15 lbs. to 56 lbs. are now employed as hand-hammers. The angles of attachment of handles to heads are various; the position of the centre of gravity of the head in reference to the line of penetration of the handle is various—the faces have various convexities—the panes have all ranges and forms, from the hemispherical end of the engineer's hammer, and the sharpened end of the pick and tomahawk, to the curved sharpened edge of the adze, or the straight convex edge of the

hatchet and axe; the panes make all angles with the plane in which the hammer moves.

Various as are the uses to which hammers may be directed, yet like many other handicraft tools certain contrivances are requisite in order either to direct or give full effect to the tool itself. Art has given to the hammer-head only the handle as its contribution. Nature supplies other and more essential contrivances. These contrivances are mainly the muscles of the arm, although under certain circumstances other muscles of the body, especially those about the loins, are called into action.

It will suffice for the present purpose to regard the mutual adaptability of the hammer to the muscles more immediately concerned, and of these muscles to the hammer. Five muscles connected with the arm play most important parts in the powerful action of the hammer. These are the pectoral and trapezius muscles—the deltoid, the biceps, and the triceps. Remembering that "work" or "energy" is the result of a combination of weight with speed or velocity, and further, although in the hand-hammer itself there is a very great range in the choice of weight, yet since the maximum range is limited, it behoves us to see how the available velocity can be utilised. It is to say the least curious—to speak more plainly, it is a wonderful proof of the far-seeing skill of the Great Designer of the human frame, that in the arm no provision is made for that one of the two elements in "work" which is derivable from weight or mass alone, and yet there is a perfectibility of contrivances for velocity within the maximum limit. These contrivances, regarded from a mechanical point of view, may be briefly summed up by saying that the tendons by which the muscles are attached to the levers they are appointed to move, are fixed near the fulcra. Thus the very powerful deltoid muscle, which is inserted close to the shoulder-joint, gives a rapid motion in raising the whole arm with the hammer in the hand; or, if the whole arm is not required, then similarly fixed near to the elbow is the biceps muscle, which gives a rapid motion in lifting up the forearm with the hammer in the hand. By one or both of these muscles the handicraft hammer-head is placed in a position of potential energy. If there were no other muscular contrivances, then the actual energy would result entirely from gravity, and the wonderful range of handicraft hammer power would simply be determined by the height to which the deltoid or biceps muscle might have raised the hammer; in fact, man would become a very common place simple pile-driving machine, quite powerless to modify the conversion of potential into actual energy.

Now let us note the action of the great pectoral and trapezius muscles. Suppose the hammer-head is raised by the deltoid, gravity would cause it to descend with a certain velocity, and thereby produce or develop a certain calculable energy. Watch the action; these two muscles, either jointly or separately, harmonise with the tendency of gravity, and cause the hammer to descend two, three, four, or five times faster than it otherwise would have done, thus most materially increasing the developed energy, although not in the proportion of these figures. What applies to these muscles in reference to the deltoid and the whole arm applies similarly to the triceps in reference to the biceps and the fore arm. Thus nature has provided so efficient and so variable a contrivance in order to extend and yet modify the range of energy in the hand-hammer, that through all the countless ages in which it has been used no change has ever been proposed or adopted in reference to the modes of applying and handling the hammer, or in communicating that velocity upon which the amount of energy or work depends when the weight of the hammer-head and length of handle are constant. A careful adjustment of the motive work required from these two sets of muscles is essential to the endurance of the workman.

It has already been observed that one set of muscles is occupied in driving the hammer, the other set in restoring the hammer to a position of mechanical advantage. In more strict phrase, by the one set of muscles actual energy is obtained; by the other set potential energy is had. The breaking of stones on the highway will illustrate the meaning. The hammer used is a small one, the handle elastic and long, thus requiring from the muscles that for which they are adapted, viz., speed, and not power; hence two sets of muscles being alternately brought into play there is no excessive fatigue. The handle is not only long, but elastic, and so the jarring sometimes resulting from blows is checked before reaching the workman's arms. Again, the hammer-head is shaped with a small face and a mass of metal uniformly distributed behind it, similar to some of the flint hammers produced in a former lecture, thus securing that, generally, the reaction of the blow shall be in a line passing through the centre of percussion, in this case the centre of gravity of the head. One consequence of this is that there is less liability to jar and less waste of muscular energy in the blow. Had the face been a broad face, then a blow given other than in the middle of the face would expend much energy in producing jar.

Further than this the stonebreaker's hammer is made symmetrical on opposite sides of the handle; hence he may with equal facility give blows with either face, and (in consequence of the centre of gravity being in or very near the centre of the handle in the head) if it be wished even with the sides of the hammer-head.

Such reasoning as this if followed out may serve to explain why stonebreaking is accomplished by a hammer-head apparently so well-proportioned as regards form, but so ill-adapted as regards weight to the work to be done. The effect of oft-repeated blows either by a large or a small hammer has been noticed, and probably few experiments have proved more expensive.

In the early days of railways (as means of public conveyance) the rails were laid in chairs, which chairs were at intervals bolted to heavy stone blocks, the chairs supporting the rails near the ends. The consequence of the direction of the train upon one set of rails being always the same; the end of the rail along which the train was travelling was raised above the rail on which it was about to travel. If a person stood by the side he would notice that owing to the weight of the train the rails bent, and the ends towards which the engine was moving were therefore raised. Hence, as the engine passed over the end

dropped on the next rail as a hammer, and so amaged and finally destroyed the end of that rail. ne element towards the improvement introduced remedy this, *i.e.*, to transfer the effect of the ow from the rail end to the whole construction, as to take up many miles of stone blocks and troduce wood, thus securing a needful elasticity. This has been further improved by what are lled "fish-joints," which cause the whole length many combined rails to contribute their elasity in order to put a stop to this locomotive ammer work.

IMPACT.

Before considering the elements upon a combination of which the almost extraordinary owers of hand hammers depend, it may be well set aside a few minutes to remark upon the rcumstances under which this power is being tually developed. The development takes place the instant of contact of the moving hammer ith the struck body. Such contacts as those of ammers belong to that department of mechanical ilosophy called "impact." Impact is pressure short duration, so short that, compared with e time in which the velocity of the impinging dy is being acquired, it is inappreciable; or, if e comparison be between the spaces passed rough by a hammer-head before impact and ring impact, then, generally speaking, the disoportion is the same, and the space passed rough after impact is almost inappreciable when mpared with the space passed through before pact.

It may assist in realising the source as well as e magnitude of the power of a hammer, if, deting a little from the strict scientific use of the ords, the dynamical effect of impact be compared ith what may, for the sake of approximating an idea, be called the statical effect of pressure. e are so much more accustomed to associate ower with weight alone, than with mass and locity combined, that perhaps for our present rpose those who may detect a flaw in the followg reasoning will kindly overlook it in the interests those who may thus appreciate a measure for the ergy of a hammer.

Let any one attempt to drive a nail vertically to a horizontal piece of timber by the statical fect of the simple pressure of a load on the head the nail, the load being placed on the head ntly, as weights are laid in scale pans. Let e depth to which the nail is thus moved be easured. Again, let the same nail, under the me circumstances, be driven to the same depth the impact of a hammer-head, then it may for r present purpose be said that the load placed on e nail is a representative statical measure of the pact of the hammer. It will be admitted that, though not faultless, this is a representative and proximately accurate method for comparing e effects of hammers under all ordinary circumances.

Now, although in any given case the work in a ammer consequent upon its mass and velocity ay be very great, yet utilising the whole of e work produced in the expenditure of the cumulated power in the hammer depends upon e resistance met with at the instant of impact. he more perfect this resistance is the greater will the value of the work done; hence the practice of using massive anvils firmly fixed and the necessity for staying all vibrations in the body struck. Let any one attempt to drive a nail in a board not firmly supported, and then by the use of the same means drive a similar nail into the same board supported, and he will appreciate the importance of resistance to the progress of a hammer's motion if the full effect of a blow be desired. The only exception to this is to be found in the blows given to minerals, which are to be cleft and not crushed. In their case it is desired to give only such a blow as shall accomplish the cleaving; any surplusage of energy if expended on the material would of course produce fractures over and above the required cleavage. Provision must be made for the dissipation of this superfluous energy, and it is done by placing the mineral in an elastic holding, the nature of the required elasticity being determined by experience, different substances requiring different elasticities in the supports by which they are being held for cleavage. Were that elasticity not there, then when in consequence of the blow for cleavage only, having accomplished the cleavage and expending the remaining energy upon the mineral, it is obvious that the next weakest line of cleavage would yield, and the next to that, and so on until the mineral would be actually first cleft, and then crushed. Hence destruction rather than fracture would take place.

Illustrations of the principle thus enunciated were before you in the breaking of stones on the highway the elasticity now referred to being transferred from the mineral support to the handle of the hammer which gives the blow, also in the flaking of flints, the elasticity being obtained by holding the mineral in the hand and supporting it on the knees. The splitting

Fig. 20.

of brilliant diamonds is perhaps a case in which these principles and considerations claim the greatest care. Through the kindness of Mr. Montanjees, of Red Lion-street, Clerkenwell, I have in my hands the diamond splitter's hammer, chisel, and

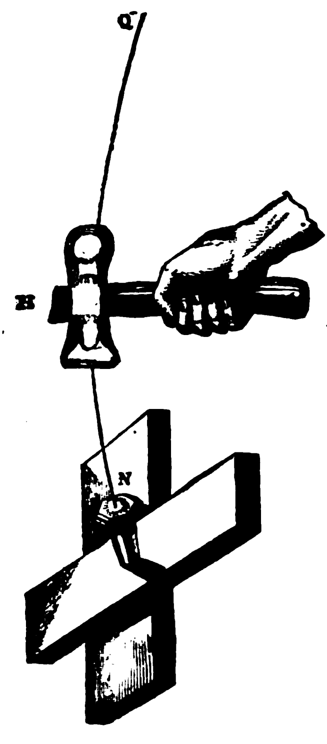
elastic anvil. The anvil is of wood, in shape not unlike a nine-pin, but tapered at the lower end so as to be placed upright in a coned hole in a small block of lead. On the head of the nine-pin is a flat, on which by means of cement the diamond to be split can be firmly fixed. Placed here so that the plane of intended cleavage shall be vertical when the wooden anvil is in the lead block, a deep scratch is made by a second diamond, in which scratch the edge of the splitter's chisel is to be planted. The diamond splitter's chisel is very like an old razor. In the illustration this chisel may be observed in the workman's left hand, in his right he holds in somewhat of a delicate fashion that which is his hammer. The hammer is a plain steel rod about eight inches in length, and tapering from about half an inch diameter in the middle to three-quarters of an inch at the end. The very construction of this peculiar hammer gives the operater a large range for precise and graduated blows; within certain limits, he can most carefully arrange that the path of the centre of percussion, the place of impact, the line bisecting the angle of his razor-like chisel, and the expected plane of cleavage of the diamond shall coincide, hence, with great coolness and the absence of all hesitation, he gives a blow, upon the effect of which many hundreds of pounds may depend. The woodcut (Fig. 21)* represents all

Fig. 21.

the tools used by the diamond splitter; in front is the wooden anvil, and on the left-hand side are the hammer and chisel.

To deal, however, with hammers (including under that term for the present purpose axes, hatchets, adzes, and picks), the following question claims careful consideration. What power or energy is in a hammer of known weight moving at a known velocity if brought to a state of rest by impact on a block? Another question also suggests itself: Can this impact effect of a hammer be converted into simple pressure, and be stated as a load or weight placed, where the impact was requisite, to produce the same effect as the impact did? If the mode of solving the first question be made clear, then the answer to the second can be readily obtained. The measurable elements which affect the result are a variation in the mass of the hammer-head and a variation in the length of the handle. By a varied mass there is a varied weight in the hammer; by a varied length of handle there will, with the same muscular effort, be a varied velocity in this mass, and upon a combination of mass and velocity depends the produced energy. Now if a mass of metal moving at a known velocity strike an object, the energy of that blow results entirely from the conditions at the moment of impact. For example, the work in the hammer, H, as it strikes the nail, N, (Fig. 22) does not depend upon its velocity through

Fig. 22.

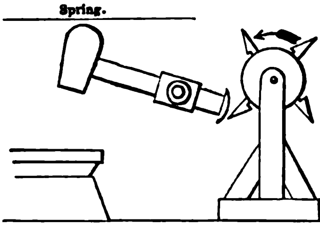


the arc, Q N, but only upon the velocity when commencing contact with the nail. Hence so long as the material which gives the blow and the mass of it are the same, it is not of any consequence how the velocity was accumulated. It may result from centrifugal or rectilinear action; it may result from muscular effort, or from steam pressure, or from gravity.

It may now be obvious that other elements remaining unchanged, whatever accelerates the velocity of a hammer increases according to very clear rules the energy or power of the same hammer. Hence the tendency of contrivances as manifested in the additions to steam as well as handicraft hammers; for example, in the early lift hammers, those which in some parts of the country are still considered as producing the most perfect and best of hammered work, the "wiper" was so shaped as to throw the hammer

* These two woodcuts have been kindly lent by Messrs. Blackie and Son, and are taken from a book published by them, entitled, "Diamonds and Precious Stones, from the French of Louis Dieulafait."

FIG. 23.

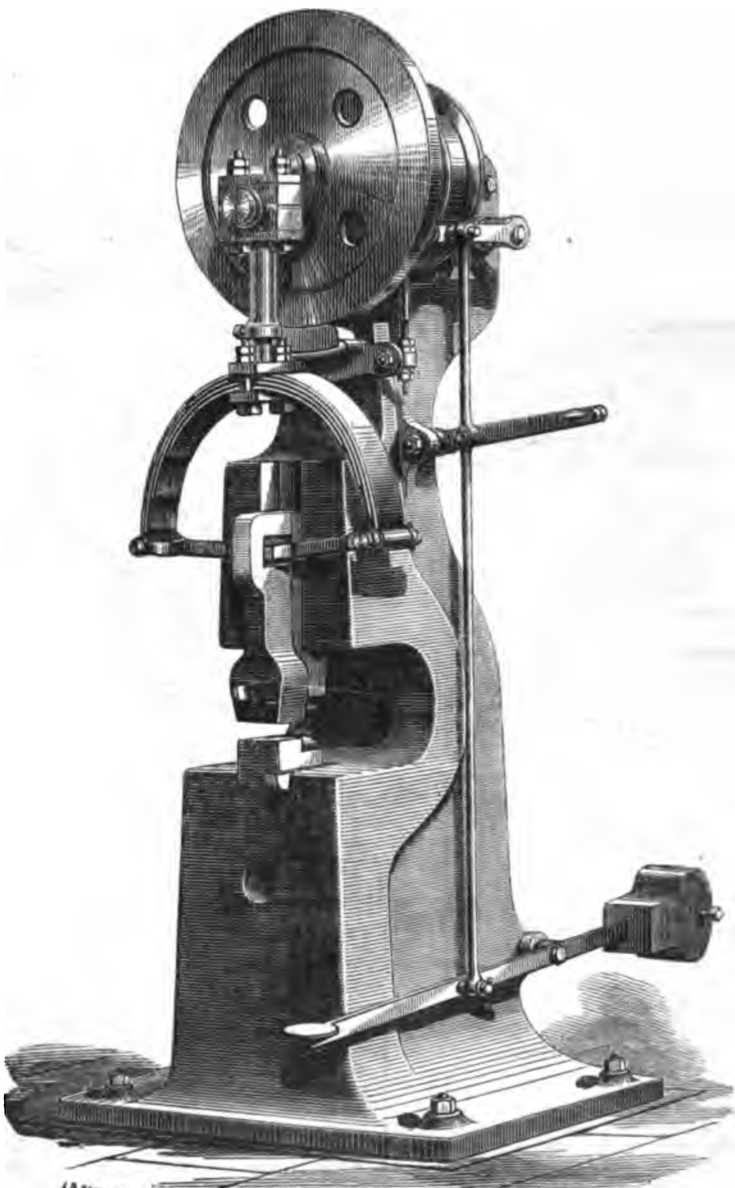


very high. The ascent was checked by a powerful spring, and thus the ascensional energy was reversed and added to the accelerating force of gravity downwards, and so not only was the intensity of the blows increased, but the frequency of them also. This spring took the place of that muscular energy which brought the hammer down with intensified effect.

The diagram does not fully realize this, but may, nevertheless, be useful as an illustration of one of these contrivances. In another arrangement the "wipers" acted upon the hammer-head directly, and threw it very forcibly against a large wooden elastic beam. These constitute what were formerly called "tilt" and "lift" hammers.

Hence, also in steam hammers, all muscular effort to intensify the blow is transferred to the steam, and all consequences of centrifugal action, whether from hand or tilt hammers at the ends of

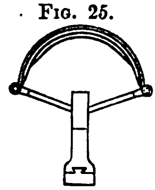
FIG. 24.



arms are removed. Further, in steam hammers, now-a-days, the steam operates to check as well as to intensify the blow. This checking action is called "cushioning," and it seems to do in the steam hammer what holding a flint in the hand does in a flaking hammer, or an elastic handle does in a sledge-hammer, or the cement and wooden anvil does in diamond splitting; it relieves the rigid fabric or erection from jar or destruction. "Cushioning" is brought into play by admitting steam for the purpose of checking the intensity of the blow due to the action of gravity alone, or of steam combining with gravity upon the hammer. Hence the perfect control over large steam or air-worked hammers, and the rapidity with which the intensity of the blow may be changed. Such control as this over a sledge-hammer is beyond our bodily powers. We may intensify the blow of this large hammer, but we cannot, except just experimentally, and for the purpose of display, bring the restraining power of the muscles to diminish the energy of the descending hammer.

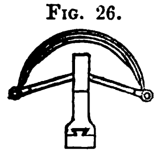
The branch of the subject now occupying our attention seems to have been much dwelt upon by the designer of the Anglo-American dead-blow power hammer, of which a large acting model is on the table. To Messrs. Collier, of Salford, who are the makers, we are indebted for the model. It is driven by a strap, and holds a place intermediate between a handicraft and a power-driven tool (Fig. 25). The principal novelty in it is the intervention of a semi-circular spring between the crank pin and the tup, and the power is obtained as follows:—When the hammer is set in motion, the tup is snatched up by the action of the crank pin, and the spring is compressed (Fig. 25), and, by the combined motion of the spring

FIG. 25.



and crank pin, the tup is thrown within the spring with great impetus. The crank pin then passes the top centre, and the tup is thus met by the spring and thrown into it, causing it to be again compressed (Fig. 26), when by the down-

FIG. 26.



ward motion of the crank pin, the spring throws the tup on the anvil with great velocity.

The number of vessels, sailing and steam, which entered the Danube in 1874 was 1,651, representing an aggregate of 516,962 tons. These figures showed a falling off of 253 vessels and 148,994 tons as compared with 1873; but the diminution only occurred in sailing vessels, the number of steamers showing an increase of 45 and of 44,272 tons.

MISCELLANEOUS.

HALL-MARKS.

It may be remembered that for some time past an offer of a prize for an essay on this subject has remained open. On two separate occasions the Council of this Society has endeavoured to induce some qualified person to draw up a treatise on this subject which, while bringing to public notice any defects in the existing system, might also offer practical suggestions as to the measures required for reform, if such appeared needful. In this effort no great amount of success has been attained, nor is it probable that any practical result may be expected from the offer of the prize. As however the question is one which certainly requires investigation, it may perhaps be not entirely without use if an attempt be made to review the system of hall-marking as it exists in this country, to point out what are generally esteemed deficiencies in that system, and to notice the proposed alterations most in favour among those interested in such matters. In doing this it must be plainly understood that no advocacy of one system over another will be attempted, and that the object of the present notice will be to clear the ground for what it may be hoped will prove a profitable discussion, should one arise. That this brief preliminary sketch may serve to elicit opinions and suggestions from some of the numerous persons whose experiences should give them authority on the subject is the sole intent of its writer.

Before going further, it may perhaps be well to examine shortly the system of hall-marking as we now have it. In doing this it will be necessary to go over ground perfectly familiar to experts, but it appears certain that very little is generally known of the system, and that the public acquaintance with it is really very slight and very confused. There is on the one hand a rather ill-grounded estimate of the value to be attached to a hall-mark, and on the other a very extensive ignorance as to its real meaning. If any alteration is required, it can only be effected by a certain amount of public opinion being directed to the matter, and to obtain such attention is one of the points to be secured. This must be the excuse for re-stating much that is well-known to the trade and others interested in the question.

It is tolerably well-known that only one quality of silver is recognised,* sterling silver, that is to say, an alloy containing 222 dwts. silver, to 18 dwts. copper. It is with regard to this standard that silver is tested, as being what is technically called "Better" or "Worse." With gold, however, there are several standards, most of which are purely arbitrary. For the purpose of estimation, the mass of gold, or gold alloy, is divided into twenty-four imaginary parts called "carats," and the gold is classed according as it contains more "carats," or twenty-fourth parts, of gold or baser metal. Pure gold is 24-carat; gold with $\frac{2}{24}$ths of alloy is 22-carat; 18-carat gold has 6 parts alloy, or $\frac{1}{3}$rd alloy, $\frac{2}{3}$rds gold, and so on. The standards generally adopted are 22, 20, 18, 15, 12, 9, and, so far as hall-marking is concerned, nothing intermediate of these is recognised. Thus gold that fails by ever so little of being 22-carat is stamped as 18-carat (except in the rare case where 20-carat is recognised, of which more presently); if it fails being 18, it is at once taken as only 15 carats fine, and so on. Now, gold about 18 carats fine is practically about the best and most convenient for working. Our gold coinage is 22-carat, but though a sovereign is, from the great pressure it has undergone, strong and tough enough to stand any amount of fric-

* The second or "new" standard, 238 dwts. silver to 2 of alloy, is practically not used.

nal wear, the gold of which it is composed will not r the heat of soldering without being weakened, and for other reasons not so suitable for practical use. standard of 18 carats, then, has some reason to be led a natural one, but the three lower are purely ificial, and have no special reason for their retention. It is thus obvious that a much more complicated tem of marking is required for gold than for silver, re being five standards for gold and one for silver. it is not only the quality of the metal that is shown the mark. The date, the locality, the maker, the of duty having been paid when required, must all shown, according to law, and there are thus five marks least necessary according to present regulations. To lain these, it will be necessary to give some account the different assay offices, and the different rules of h. In the United Kingdom there are ten assay offices; en in England, London (Goldsmiths'-hall), Birmingm,* Chester, Exeter, Newcastle-on-Tyne, Sheffield, York;† two in Scotland, Edinburgh and Glasgow; in Ireland, at Dublin. Formerly also offices existed Bristol, Coventry, Lincoln, Norwich, and Salisbury. None of these offices is in any way under Government trol, except that the two most recently established, at Birmingham and Sheffield (the latter its silver ys only), are obliged once every year to send up to Mint, for trial there, such scrapings as are not used by local assay master, in order to test the accuracy of assay. Should any inaccuracy be found the assay ter is liable to a penalty of £200. The other provinoffices might also have their assay similarly tested order of the Lord Chancellor, but the statute under ch this could be done is practically a dead letter.‡

To give a detailed account of all the different marks varieties of system would be impossible in this place, must be sufficient to indicate the sources of variety. haps this may best be done by taking the different ks in order, 1, Standard; 2, Duty; 3, Date; 4, Place; Maker's name.

1. *Standard.*—Gold is marked with the figures 22, 18, 12, 9. Besides this the two higher standards have, England, a crown, in Scotland a thistle, and in Ire- a crowned harp (22) or a unicorn's head (18); all are stamped separately. Also the three lower ndards have the figures ·625, ·5, ·375 respectively, wing the proportion of gold to alloy (sometimes stamped arately, sometimes together). Dublin also marks a ndard of 20 carats (plume of three feathers), being the y office that does so. It thus has a variable mark, which y be classed as a local mark, for different standards. silver standard mark is a lion passant in England, harp crowned in Ireland, a thistle in Edinburgh, and lion rampant in Glasgow. There is also a new stand- of 11 oz. 2 dwts. marked in England with a lion's d and Britannia, or (in Birmingham and Sheffield) h Britannia alone. This standard is practically not ed. Newcastle also stamps a lion's head on 11 oz. 2 dwts. ver.

2. *Duty.*—This is marked by the Sovereign's head. Dublin also the local figure of Hibernia is a duty rk, owing to the existence unrepealed of two different s of Parliament.

3. *Date.*—This is shown by a letter arbitrarily selected each office for the year. These letters generally, but always, run in series for each office, but those of the ferent offices have no connection or reference *inter se.* en the year does not always agree with the calendar ar.

4. *Place.*—Each assay office has its own mark or rks. Dublin has a mark varying according to the ndard, besides its mark of Hibernia.

5. *Maker's Name.*—This is shown by the initials of the maker.

All these marks are set in shields of different forms, varying according to the standard or the nature of the article stamped. Thus, watch-cases and wedding-rings have generally characteristic differences in their marks from those stamped on other articles. Small articles of silver plate, such as spoons and forks, are frequently stamped differently from larger articles, and so on. When all these sources of variety are considered, it is evident that the result must be a great complexity of system. In practice, the effect is that hardly any, even of the most experienced, can possibly be thoroughly acquainted with all the marks in use.

The question of duty is so closely connected with that of hall-marking, that it is necessary to say a few words thereanent. Here, again, it is difficult to explain the exact rules in force, the exceptions being more numerous than the cases in which the rule is enforced. All manufactured gold is liable to duty (17s. per oz.), when it is required to be stamped. Gold of 18 carats and less is not required to be stamped, and so escapes duty; then the exceptions are such as practically to exclude all jewellers' work, except wedding-rings and mourning-rings (with black enamel). In the case of silver (the duty on which is 1s. 6d. per oz.), the exceptions are more complicated. Watch-cases of both gold and silver require to be stamped, but are specially exempt from duty. The duty is collected by the Assay-office at the time of stamping.

The assays are in practice all made by the process of cupellation, that is to say, a portion of the metal to be assayed is placed with lead in a cupel (a sort of porous crucible), in a furnace. The lead oxidises, leaving the "nobler" metals, and the silver, in a gold assay, is then dissolved out by nitric acid. The articles are assayed before they are finished, being sent in separate pieces, and soldered up after the assay. A certain deduction, as an allowance for waste in finishing, is made from the amount of duty.

Before proceeding to state the objections generally made to our own system, it may be well to note briefly the rules now in force in France, especially as they differ but slightly from those that have been adopted in most Continental States.*

There are in France three legal standards for gold and two for silver, given by Mr. Chaffers as follows:—

Gold 1st.	920 millimetres,	or	$22\frac{3}{4}$ carats nearly.
„ 2nd.	840	„	$20\frac{3}{16}$ „
„ 3rd.	750	„	18 „
Silver 1st.	950	„	11 oz. 8 dwts.
„ 2nd.	800	„	9 oz. 12 dwts.

No articles are allowed to be made of any lower standard, under certain penalties. There is a special mark for each quality, and to this is added a certain small character denoting the local assay office. There is also a maker's mark. These two are applied by a punch on a smooth anvil below. There is also a more elaborate system of marks for stamping foreign imported articles, watches, old plate (verification of standard), &c. These are stamped with a "countermark" on the anvil, so that the piece is marked on both sides, and, to increase the difficulty of forgery, these countermarks are very various and complicated. All the standard marks, however, with which the present article is concerned, are practically but five, or, indeed, two, gold and silver, with numerals appended showing the quality. The method of assay also differs somewhat from our own, specially in the large use of the "touchstone." The method of using this is, of course, well known. The article to be tested is rubbed on a stone, so that it leaves thereon a trace of the metal. This is then touched with nitric acid. If the metal to be tested be gold, the acid has no effect, but any trace of copper is shown by a a green film appearing; if silver is being tested, the acid

* For information as to the Birmingham assay office see Timmins' "Birmingham and the Midland Hardware District." London, 1866.

† So far as the writer's information goes, there is now no work done at this office.

‡ For more detailed information see Lutschaunig's "Book of Hall-marks." London, 1872. Also Chaffers' "Hall-marks on Gold and Silver Plate." Fifth edition, London, 1875.

* Chaffers, as above cited.

causes it to disappear, and the addition of a drop of hydrochloric acid precipitates a white chloride of silver. In experienced hands the touchstone will, to a great extent, show the purity of the alloy, tested by the colour of the metallic streak, and its behaviour under the acid. It can obviously be used with the finished article, and if care be taken in its application, it can be employed so as not to injure the most delicate work of art. In the French assay office great reliance is placed on the touchstone, and so carefully is it handled, that magnifying glasses are used to examine the tiny speck of metal, which is all that the assayer requires to enable him to pass a judgment on the whole. Alone, however, it would not prove by any means a sufficient check against fraud, and therefore the assay office reserves the right to destroy any one of a package of articles sent to be tested, and assay the whole of it, or, in the case of larger articles, to remove sufficient metal for cupellation. This privilege is constantly and regularly exercised, so that the risk of fraud is too great for its frequent practice. Although it is commonly stated that touchstone tests are not absolutely reliable, yet the practice of the French assay office would go to prove the contrary, as it is stated, on good authority, that the errors therefrom fall within the allowance for error permitted by Goldsmiths'-hall. In other points a much tighter hand is kept by Government over the jewellery trade in France than here. The French jeweller is liable at any moment to have any article taken from his stock by an inspector, who purchases it at a certain fixed tariff and carries it off to be assayed. This is of course merely an extension of the system now adopted in our own country to check food adulteration. The rules as to the quality of gold used are also extremely strict, and no gold whatever may be manufactured for home use that is below 18-carat. Plated goods are distinctly marked as "plaqué," and must be clearly announced as such. The seller also is obliged to give the purchaser an invoice on a certain printed official form, declaring the quality of the metal, if gold, and the fact that the goods are "plaqué," if they are so. As a still further protection to the buyer, the sale of genuine and plated goods is not permitted in the same shop.

To put fairly the objections made to our system is a difficult, and a somewhat invidious task. As however the sole object of the present article is to raise the question of the necessity of reform, and its extent if it be required at all, an attempt to do this must be made. The alleged faults may be taken as of two classes; first, in the system; second, in the usual application of that system.

As to the first class, it is obvious that a hall-mark is useless, unless it provides a sufficient guarantee of the quality of the article, and assures the purchaser, beyond all reasonable doubt, of the genuineness of what he has bought. To avoid all fraud is perhaps impossible, just as it is impossible to prevent the existence of forged bank-notes, but a hall-mark should be contrived so as to render fraud at once difficult and dangerous, just as the skilful printing of bank-notes renders forgery next to impracticable. To this end the mark should be clear, easily distinguishable from other marks showing other standards, difficult to alter or obliterate, and simple, so as not to be liable to colourable imitations. The scheme also of marks should not be too complicated, the marks should be as few as possible, or at least the principal marks showing the standard should be as few as possible, and while differing plainly amongst themselves, should be separated by some distinctive character from all others. If these be accepted as the chief requirements of a perfect system, it is fairly obvious that the English system does not possess them, whatever may be its counterbalancing advantages. The synopsis above given of English hall-marks shows that several symbols are often used to express the same thing. Thus a crowned harp in Ireland, a thistle at Edinburgh, a rampant lion at Glasgow, and a crown in England, are all used to express what the 22 added to each of them shows plainly by itself. The system has grown up gradually from forgotten enactments and obsolete privileges, and therefore it is no wonder if it is complicated and involved. In practice it is said that very few are familiar with most of our marks, hardly any with all of them. This being so, it is urged, of what use is this complicated system of marking to the ignorant purchaser, for whose protection it was all devised?

It is stated on good authority, that forgery of hall-marks is very common, whilst it is believed that the Goldsmiths' Company are reluctant to prosecute, and ready to accept even the slightest difference in the mark as a reason for not treating it as forged. How far this practice extends it is impossible to say. Mr. Chaffers states that the forgery of ancient marks is very common, while it is the expressed opinion of many experts that such is also the case with modern work. As to jewellery, there is no control whatever over its manufacture or sale, and it is no secret that so long as an article contains any proportion of gold at all, there are but too many dealers who will advertise and sell it as "gold," "fine gold," "real gold," &c. The difference in value of gold of the different standards is of course well known to experts; the following tabular statement of the value of gold may make it obvious to others who have thought but little on the subject:—

		£	s.	d.	
24-carat	....	4	4	11½	per ounce.
22 "	....	3	17	10½	"
18 "	....	3	3	8½	"
15 "	....	2	13	1	"
12 "	....	2	2	5¾	"
9 "	....	1	11	10¼	"

All this is "gold" and sold as such, but the lowest standard is really not half that metal, not much more in fact than a third real gold. It may be said that this is the purchaser's affair, and that the rule *caveat emptor* applies, but unfortunately there exists an apparent system of protection which too often only serves to throw dust in the purchaser's eyes. It is a frequently expressed opinion among those who ought to know, that hall-marks very frequently do not tell the truth about the material they are stamped on, and that, especially in the lower standards, gold commonly does not assay within one, one and a-half, or two carats of its reputed quality. There is no Government guarantee, and next to no control over the whole trade in the precious metals.

The question of duty also requires consideration. The average amount is stated to be about £60,000 a year. It might be difficult to urge valid reasons for its remission, but the uncertain and arbitrary system under which it is levied certainly requires revision. If anything like a thorough system of inspection were organised, it would obviously require to be self-supporting, and this might perhaps necessitate an increased duty, or what would practically be the same, a heavier charge for hall-marking.

But the loudest complaints arise from the manner in which the system is carried out in practice. It is fairly obvious that the beauty or fit of a watch-case is not improved by having shavings of very appreciable size scooped out of it. Nor, again, is the appearance of a chain any the better because a deep mark is indented on each link. It is strongly urged that the articles might be tested after they are finished, and that in a way not to impair the finish. The plan of testing them in separate pieces allows the use of large quantities of solder, which always contains more alloy than the metal on which it is used, so that, in articles made of separate pieces soldered together, the purchaser never gets gold of the standard marked, but a portion of such gold and a portion of solder. The mere effect of stamping with the heavy English embossing punch is often, it is alleged, injurious to delicate work, and the price of many articles is perceptibly increased by the labour required

make good the damage done by the assayer's stamp. he French stamp is lighter, and marks only a sharp tline, and this is much preferred by the dealers in wellery and plate. These objections are indeed such might be got over merely by improved administration, as they are widely put forward it is as well they ould be stated. It is but fair to add that the writer of has not had practical experience of the disadvantages laded to, but he has the best means of knowing that, hether well or ill-grounded, they are believed to exist, have often formed the subject at least of private mplaints.

It is sometimes urged that there is no real need for ll-marks, and that all that is required is that a stomer should be able to demand from the seller an voice stating the precise quality of the goods sold. If were found impracticable to devise a certain and stworthy system of marking, it would doubtless be ll to fall back on this simple protection, but there is ch obvious advantage in the fact of the article bearing value on its own face, that it may be taken as certain t public opinion will be in favour of the mark as well —not instead of—the invoice which any purchaser can w demand for himself.

The common use of hall-marks shows that the protion is desired, and of their great value, even as they w exist, perhaps few will doubt. There seems no logical ason why a tradesman should be permitted to sell ulterated gold and silver any more than adulterated or coffee, and the fact that articles of the two precious tals are generally considered as so much potential ney, which can at any moment be realised at a rtain known rate, renders it of great importance that ir purity should be put beyond dispute.

To draw up a simple and complete code of marks uld offer little difficulty. It is obvious that one mark each standard through the kingdom alone would be quired. Each assay town would have its own mark. e date letter in all localities would be the same, it be deemed essential to mark the date. It may questioned whether the maker's mark is wanted, if he might not be left to stamp his work for himlf. The duty mark is certainly not of any use. e really knotty point would be the question of stands. Ought we to mark all standards and thus introe an element of complication? The French have plified the matter by abolishing the lower standards. can hardly be supposed that the English trade would mit to such a change, though there is, doubtless, at advantage in the resulting simplicity. In France n the single standard by no means meets with versal approval, and there is a considerable agitation a change of system. Perhaps the most that is cticable is to insist on a perfectly distinct mark for higher qualities.

However, the scheme of marks is nothing. The real r is in the authority by which the scheme is to be forced, and the legislative enactments by which it is be carried out. Before these can be settled much dient inquiry and considerable free discussion will be nted. Whether or no alterations are required, it is at st certain that nobody can fairly point out a scheme alterations likely to command general approval.

In conclusion, the compiler of this sketch wishes to be clearly understood that anything in it that is not re statement of fact is only put forward as suggestive, d in no sense as authorised by any special body, least all the Council of this Society or their Committee pointed to adjudicate on the essays sent in in comtion for the Society's prizes. It is the belief of a eat number of the individual members of the trade that r existing system of hall-marking needs revision. In e hope that attention may be drawn to the matter, d thus either the needed reform may be effected or e non-necessity for reform demonstrated, these few marks have been—perhaps too hastily—strung gether.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A large and influential assembly of the inhabitants of Dover was held on Wednesday, the 11th inst., presided over by the **Right Hon. Earl Granville, K.G.**, Lord Warden of the Cinque Ports, at the Maison Dieu Hall, with a view to the establishing free scholarships at the National Training School for Music, available for the culture of persons belonging to the borough gifted with musical abilities. The proceedings were opened by

Sir Henry Cole, K.C.B., who briefly congratulated the town of Dover upon the fact that it was not only exceptionally healthy, but that it also possessed savings banks, excellent school accommodation, and other educational advantages to a very satisfactory extent. In the matter of music, however, Dover, like many other towns, had not exerted itself, and he therefore had the pleasure of pointing out to its inhabitants the objects of the National Training School for Music, at the head of which was his Royal Highness the Prince of Wales, which had been actively promoted by Earl Granville, and also had the benefit of the patronage of her Majesty the Queen, the Duke of Edinburgh, and many distinguished personages whose names were familiar to the English people. He described in detail the aims of the school which had been set on foot, and he concluded his remarks by referring to the great advantages that accrued from a knowledge of music.

Earl Granville, who was received with loud applause, congratulated his friend, Sir Henry Cole, and the Society of Arts, upon his able explanation of the objects of the institution, and, after candidly admitting that it was best that he himself should be reticent on a subject which he did not fully understand, said that no one could doubt the advantages that would accrue from a National School for Music. As regarded himself, they were all aware that he held one of the oldest offices in the country, an office that dated from the time of William the Conqueror, and one that he believed his friend, the Seneschal of the Cinque Ports (Mr. Knocker), would be able to prove dated from the time of Hengist, and certainly from that of Edward the Confessor. The office, however, had been deprived of its ancient privileges to a very great extent, but he felt that it was, nevertheless, his duty to contribute so far as he possibly could to the prosperity, and to enhance the high reputation of the famous Cinque Ports. In assisting in the establishment of scholarships for the Cinque Ports in connection with the National Training School for Music, he was sure that he was discharging one of his official responsibilities, and he trusted that the suggestions that had been made by Sir H. Cole would meet with public favour. His own observation had convinced him that persons in different situations in life had very varied feelings about music, and he had noticed that among personages eminent in history some had displayed a great passion for it, whilst others had altogether neglected the art. The late Prime Minister, he could say from personal and pleasurable experience, had one of the finest musical voices he (the speaker) ever heard, and he believed that Mr. Gladstone continued to sing to this day. He was happy to add that his own party spirit was not such as would lead him to deny that Mr. Disraeli, though he never had had the privilege of hearing him sing, was not equally harmonious. He remembered having been told of an ambassador who, being asked by the Sovereign to whom he was accredited whether he liked music, replied that he appreciated the calm that followed it much better. And although not acquainted with what Horsa, the first Lord Warden, thought on the subject, he (Lord Granville) was yet certain that Prince Henry, the Duke of York, afterwards Henry VIII.—though, perhaps, in his case the adage that "music soothed the savage breast" was not justified by historical events—encouraged the art to such an extent that, in that particular respect, England was

during his reign far in advance of any other country except Italy. As far as modern times were concerned, he doubted if Mr. Pitt cared about music; but he was pleased to say that the late Duke of Wellington, whom they all held in respect, either from a love of science or from the stern sense of duty for which he was distinguished, devoted himself to the welfare of the institution, which was in his time the sole means of imparting musical instruction to those who were worthy of it. With this example before him, he (the Lord Warden) felt it his bounden duty to encourage the progress of music, and he was sorry to observe that recently it had been somewhat disparaged. When he said recently he spoke of his own childhood, when he was prevented by the kindest of parents from learning music, it being thought that such a practice would distract him from those other studies with which he was perhaps even now imperfectly acquainted. There was also an idea that music made a person frivolous and unsteady, and that it often brought him into undesirable associations; but he believed that the best answer to such criticisms would be that of Dr. Johnson when the question of teaching the labouring classes to read and write was raised, and when that great authority said, "No doubt, if you give a ploughboy a silver-laced waistcoat he will be inordinately vain, but if you give all the ploughboys waistcoats equally smart that feeling will go away." As to the assertion that music led a man into bad company, he himself would reply that the feeling was almost unanimous amongst thinking people that it was an important part of education, that it was a great aid to the discipline of education, that it assisted very much to bring people into good company, where they could enjoy health and profitable recreation, and that it very often encouraged them to no small extent in their religious feelings and religious duties. Having that opinion, he thought that the town of Dover should not be backward in availing itself of the advantages which the training school promised. They were very proud of themselves in Dover. For a lengthened period they had been termed the lock and key of the kingdom, and they had always been prominent in anything that would advance the interest of the town. Sir Henry Cole had already been instrumental in establishing a rising school of art in the town; and he hoped that the worthy knight's greater ambition—that of identifying the town with the National Training School of Music—would be attended with the success it deserved. He (the Chairman) hoped that the people of Dover would have better music and singing in their churches, and they would place themselves in a position to do so if they followed the advice of Sir Henry Cole. He did not believe that there were any English poets, from Chaucer, Spenser, Dryden, Milton, Shakespeare, and Pope, down to the verse writers of this century, who had not expressed themselves as to the advantages of music; and he believed from the manner in which they had listened to his remarks, that the people of Dover appreciated the certain results that would follow a further cultivation of the art. It was suggested in some quarters that the English suffered from a national disadvantage in the study of music. He believed the pronunciation of our language inclined us to shut our mouths, which was no doubt a fatal defect in a singer; but otherwise, he believed that this country had as many advantages as any other. We attracted here, mainly by our wealth, the very best artists, both singers and instrumentalists, and Sir Michael Costa had given his opinion that in natural advantages we were superior to other nations. Baron Marochetti, the eminent sculptor, he might add, had remarked that there was every type of beauty in the English females, and Sir Michael Costa declared that the voices of the English girls, if properly trained, were peculiarly clear and beautiful. With all these advantages, he contended that the institution whose claims Sir Henry Cole and himself had been advocating was one that would be of service to the country, and one that, as Lord Warden of the Cinque Ports, he should be most happy to support.

On the motion of **Canon Puckle**, seconded by Major **Laws**, a committee was appointed for Dover, with which borough the other towns in the Cinque Ports will be invited to co-operate; and after the announcement that the amount necessary for one scholarship had been subscribed in the room, the proceedings closed with votes of thanks to Sir Henry Cole and the noble Lord Warden.

GEOGRAPHICAL CONGRESS AND EXHIBITION AT PARIS.

[From a Correspondent.]

From the economic and commercial standpoint, the maps and surveys of British India here exhibited present several interesting features, notably relating to the district where the cultivation of the invaluable [illegible] has been developed and carried on; likewise the [illegible] growing district of Assam, and the valley of the Burrampooter, whence it is said fully one-eighth of the [illegible] growth of tea is produced, of the finest quality; [illegible] indeed this is a district of vast and growing importance which in the course of time may even eclipse China itself.

Archæologists and biblical students will devote special attention to the series of exhibits by the Palestine Exploration Fund, illustrative of the results obtained by the various expeditions, investigations, and explorations of Major Wilson, Captain Anderson, Captain Warren, Professor Palmer, M. Clermont Ganneau, Mr. [illegible] Drake, Captain Stewart, and Lieut. Conder. The [illegible] important object in this group is the relief-map [illegible] tour-model of the Holy City and its immediate [illegible]

Before quitting the British section, brief reference [illegible] be made to the display of geodetical and other [illegible]ments, which includes Captain George's new [illegible] sextant, self-replenishing artificial horizon, and [illegible] mercurial barometer, made and exhibited by Gould [illegible] Porter, London. In the last-named instrument, [illegible] method of filling the barometer-tube with pure mercury and obtaining the requisite vacuum, by means of a [illegible] cord, which has the effect of breaking up the quicksilver into globules and freeing it from air, is remarkably ingenious and effective, as saving the long and tedious process of attaining that object by the agency of heat.

The share of France herself in contributing to fill [illegible] the wall and floor-spaces with objects of interest and utility connected with the various branches of geographical and cognate sciences, is naturally considerable. The general impression is decidedly favourable and markedly demonstrative of the impulse given [illegible] relation to such subjects, within the last five years; [illegible] exhibits also, unlike what is mainly to be seen in the departments allotted to the other countries, have a distinctively educational character over a large [illegible] Another peculiarity consist in the fact that the Ministry of War is a large and important contributor, contrasting curiously with the pre-eminently pacific character claimed for the whole proceedings. Indeed, to the official department is due the colossus of the exhibition, viz., the large map of France, which occupies the [illegible] wall at the eastern end of the Salle des Etats, behind the platform, and dominates as it were the entire proceedings of the Congress when sitting. In dimensions certainly it is large enough, comprising over 400 sheets (2ft. 6in. by 1ft. 6in.) and an area of over 200 yards, but in point of scale it would be surpassed by the similar works of other nations, Belgium to wit [illegible] 1-20,000th; whereas the large French map above alluded to, of the *Etat Major*, is on the scale of 1-80,000th. As a consequent of the size of the map and smallness of the scale, the general effect is [illegible]

urred and confused; details can only be seen by close amination into each sheet, and at even a very small tance these coalesce and degenerate into a cloudy udge, like the effect of an artist's "stump" on a pencil awing, so that from the hall itself all that is realised the general coast line of the country, and possibly the urse of the chief rivers, the Rhone, Seine, Loire, and ronne, for which even the aid of memory and imaginan has largely to be evoked. But for any extended ception or comprehensive grasp of the physical conuration of France, even of the mountain ranges, the p is as useless as the compilation of so many ank sheets. It would have been impossible, however, the small scale of such detail maps to give the broad ntouring necessary to develop such a general view. vertheless, the visitors, particularly those indigenous the country, come and gaze from the entrance, pay expected tribute of admiration or wonder, and then ceed to descend from the general to the particular, by lking up to it, and poking their fingers at Toulouse; being a fortunate circumstance, in this respect, that locality, rendered so painfully interesting by the cent disastrous inundations, is situated quite at the ttom of the map, and conveniently accessible. One rious feature remains to be noticed, the districts of sace-Lorraine, annexed by Germany, are still shown the eastern frontier, and the new line of demarcation merely indicated by a narrow ribbon of colour.

PROSPECTS OF COMMERCE.

The following extract is from the last report of the rmingham Chamber of Commerce. It is worth the tention of all concerned, which means the whole tion:—

"In reviewing the course of trade during the past six onths, it is impossible to avoid the conviction that the prehensions expressed by the Council, during a period exceptional prosperity, have been more than verified; d there is reason to fear that the losses incurred in the l and iron trades will more than counterbalance the ofits that arose from the forced and inflated state of mmerce three years ago. The relations between capital d labour have been so completely disorganised that covery to a just equilibrium can be obtained only by a g and painful process of disputes, mutual recriminans, and loss; while the portentous fact is daily coming more apparent that, notwithstanding the ss now being incurred by the producers in some of r staple trades arising from excessive wages, short urs, and irregular work, the foreigner is successfully mpeting with us in many of the principal markets of e world, and rapidly destroying the industrial supremacy for which this country has been so long renowned. will, perhaps, scarcely be credited in the latter part the 19th century that, in certain staple trades of this trict, skilled workmen can and do combine to exclude prentices or others who might learn the same handift as themselves, while their employers appear to be werless to prevent this monstrous abuse of the privie of combination. Such things involve the future tinction of trades, and your Council cannot but hope t a sense of self-preservation must shortly come to e assistance of both employer and employed, andproce a more sensible and healthy condition of their utual relations. For some time past a large portion the legitimate commerce of the country has been ndered unprofitable and even disastrous by the enorous operations of insolvent traders, and the revelaons which have taken place recently show to what an arming point the easy abuse of credit had reached. he sound portion of the commercial community, using s own capital or credit with due caution, was powerless meet the reckless competition of those who had nothing lose but the money of others who were weak enough lend it to them. While your Council rejoice that the commercial storm which burst in June has cleared the atmosphere for a time, although at the cost of many millions, they cannot pass over this subject without expressing an opinion that grave moral responsibility rests on those banks and institutions of credit which have employed the funds entrusted to their care in supporting a system of trade manifestly unsound."

THE PROPOSED INLAND SEA IN ALGERIA.

Some time since a project was conceived by Captain Roudaire, of the French Navy, to fill the immense depressions, which are known under the name of "chotts," with water from the Mediterranean. The subject attracted great attention, and was brought before the Academy of Sciences by M. de Lesseps.

After some discussions, during which many objections were raised against the project, an expedition, headed by Captain Roudaire, was appointed to take the levels of the region of the chotts, in order to determine the extent of the area which was capable of being submerged. The expedition included two captains and a lieutenant of the Etat Major, an infantry captain, a surgeon-major, M. Duvegrier, deputed by the Geographical Society of France, and a young mining engineer. The expedition has completed its work, and M. de Lesseps has reported upon it to the Academy.

The operations continued without a breach for more than four months, the entire tour of the chotts having been made, and El Oued and Négrine connected by a tranverse profile, the whole making a distance of 650 kilometres. The result is that the depression capable of being flooded in Algeria forms an area of 6,000 square kilometres, included within 34·38° and 33·51° north latitude, and 4·51° and 3·40° east longitude. In the central portion the depression varies from 20 to 27 metres below the sea level.

None of the fine oases of the Souf would be immerged by the inletting of the sea, the lowest of them, Debila, being 58 metres above the sea. In the Oued-Rhir, the two unimportant oases of Necira and Deudonga would alone be submerged.

It was suggested that the presence of the salt water would affect the wells which fertilise the oases, but M. Roudaire affirms that he found that all the wells, even those nearest to the basin to be inundated, were fed by a source of water higher than the sea level.

The expedition not being able to cross the Tusinian frontier, were only able to examine the western end of the chott Rharsa, but they ascertained that it was also below the level of the Mediterranean, and had an incline of about 2·20 metres per kilometre towards the Gulf of Gabès.

The basins of the chott Rharsa and chott Melrir, although connected by the chott El-Asloudj, are not now in direct communication, for the last-named chott has an altitude of 3·20 metres in its central part, and is, moreover, bounded on the east and west by a chain of dunes, These dunes of Bou-Douil and of Zeninim may be easily cut through at passes of which the greatest altitude does not exceed 6 to 7 metres; the distance to excavate would be 20 kilometres. It is suggested that the chott Rharsa might first be inundated, and then a communication being made with chott Melrir by a cutting, the sea would soon open it to the necessary size and depth.

A great question remains yet to be answered, namely, the amount of difficulty there would be in cutting through the Isthmus of Gabès. Opinion differs upon this point. M. Fuchs, a mining engineer, who has explored the region, gives the isthmus a relief of 40 to 50 metres, but his levels were only taken with an aneroid barometer, and at points, so that the question is still open.

At the present moment an Italian Commission is taking levels in that part, and when the results of their labours are known, the cost of piercing this isthmus,

[illegible] possibility in an economical point of view of carrying out this stupendous project of an inland sea, will be determined.

The existence of the vast depression, which some persons dispute, is considered to be placed beyond all question by the observations of Captain Roudaire and his associates.

CORRESPONDENCE.

RELICS OF THE CZAR PETER.

SIR,—As the Society of Arts has always taken special notice of, and interest in, art furniture of all kinds, it will interest the readers of your *Journal* to know that there is now in London, previous to its removal to St. Petersburg, some furniture formerly belonging to the Czar Peter, and used by him when as a shipwright he worked in Deptford Dockyard. This furniture consists of a sideboard, covered with most curious carving, part of which seems to have been done by the Czar himself; a small book-case, also carved; and a wrought-iron chest, in which the great Peter kept his ready money. These unique articles of furniture have been purchased by a Russian gentleman, M. Gregorio Alexandrovitch Tschertkoff, and on their removal to St. Petersburg will by him be carefully preserved as memorials of the great Czar, and it need hardly be said how highly they will be prized by the whole Russian people. It would seem a pity to let them pass from us without some permanent record of them being made, either by the Society of Arts or by the authorities at South Kensington. They are at present to be seen at the shop of Mr. Selen, 39, Great Russell-street, opposite the British Museum. To those interested in antique furniture these specimens are well worth a glance. They are here but for a short time longer, waiting only some official formalities.—I am, &c., C. B. ALLEN.

August 9th, 1875.

P.S.—It may be mentioned that it was through the instrumentality of M. S. Sanalas, a Russian gentleman, long resident in England, that these curious objects of the furniture of a past generation were rescued from public sale and consequent oblivion.

GENERAL NOTES.

Philadelphia and the Exhibition.—As Philadelphia is to be the seat of the great Centennial Exhibition in 1876, and large bodies of foreigners will doubtless visit it, Consul Kortright in his commercial report on that port just issued, details for their information the following statistics, which give at a glance the general aspect of the city. According to these, Philadelphia has a population of nearly 800,000, and it lives in an area of 129½ square miles. The city has 1,000 miles of streets and roads open for use, and over 500 of these are paved. It is lighted by nearly 10,000 gas lamps. The earth beneath conceals and is penetrated by 184 miles of sewers, over 600 miles of gas mains, and 546 miles of water-pipes. It has over 212 miles of city railways, and nearly 1,794 city railroad cars passing over these railroads daily; 8,025 steam boilers; over 400 public schools, with suitable buildings, and over 1,600 school teachers, and over 80,000 pupils. It has over 34,000 bath-rooms, most of which are supplied with hot water, and for the use of the water at low rates the citizens pay more than half a million of dollars annually; it has over 400 places of public worship, and accommodation in them for 300,000 persons; it has nearly 9,000 manufactories, with a capital of 185,000,000 dols., employing 145,000 hands, the annual product of whose labour is over 864,000,000 dols. It exported in 1873 in value over 24,600,000 dols., and imported in value over 26,000,000 dols.; the amount for duties in gold was nearly 8,500,000 dols.; the real estate as assessed for taxation was over 158,000,000 dols., and there was collected nearly 9,000,000 dols. for taxes. The funded debt in 1873 was 51,697,147 dols., and the annual outlay in 1873, inclusive of interest on debt, was 7,726,123 dols. It has parks and public squares, and Fairmount-park, which is one of them, contains 2,991 acres, and is one of the largest parks in the world.

Consumption of Malt.—In the year ending September, 1874, the common brewers of the United Kingdom consumed 47,219,780 bushels of malt, a quantity which is more by 1,685,894 bushels than that which was used by common brewers in the preceding year. There was more than this increase in England alone, the amount having risen to 41,194,209 bushels. The quantity in Ireland rose to 3,558,657 bushels, an increase of nearly 39,000 bushels; but the quantity in Scotland declined to 2,466,914 bushels, a decrease of above 106,000 bushels. In the Lichfield collection, which of course includes Burton, the quantity was 4,821,367 bushels in 1872 (the year ending with September), 5,530,597 bushels in 1873, and 5,994,150 bushels in 1874. The quantity in the London collection exceeded 10,000,000 bushels in 1874; the quantity in the Dublin collection reached 2,461,061 bushels. The quantity of malt consumed, not by common brewers, but by victuallers and other licensed retailers brewing their own beer, amounted in 1874 to 10,843,493 bushels, or 868,268 bushels less than in the preceding year, the decrease being chiefly among the persons (in England) not victuallers, but licensed to sell beer to be drunk on the premises.

Exhibition in Japan.—At Kioto there is now an exhibition consisting chiefly of native objects. The Mikado exhibits some beautiful lacquer, and there is a good show of specimens of Japanese manufacture. A great curiosity is a model of the war-ships in which Taikosama (the popular name of Hideyoshi) invaded Corea in the sixteenth century. They exhibit a great difference from the modern junk, and are three-masted, with protected batteries of three or four guns on each bow and in other parts of the ship. They must have been formidable vessels in their time. A much more interesting exhibition, or rather museum, is that which has been opened at Nara, which from A.D. 708 to 782 was the residence of the Mikados. In that year the Mikado, Kuanmu, deposited all his treasures in the chief temple of the place, where they were secured in a sort of block-house, raised on pillars ten feet high, careful provision being made for ventilation. This storehouse was repaired from time to time whenever necessary, so that it is now to be seen exactly as it was 1,100 years ago. It was also visited at intervals of sixty years, when the treasures were compared with an inventory. They now form the chief portion of the Nara exhibition. There are plain silver vessels of large size, grotesque wooden masks, perhaps for actors; swords, spears, the tattered remnants of banners, Chinese jade ornaments, inlaid work, court dresses, curious shoes with peaked toes, bronzes; bricks of a white clay, with hunting scenes or combats of animals in relief; common wicker trays, on which offerings of rice were made to the gods, valuable because the year and day of use is marked on each; and a multitude of other articles which it would take a great space to enumerate. Perhaps the most puzzling object is a handsome glass vase with a coloured glass cover. The evidence of course is very strong, but it is difficult to credit that this vase is really 1,100 years old. There are some other objects that excite incredulity, such as a collection of cakes, six inches in diameter, and of the form of a mill-stone with a hole in the centre. These are supposed to have been the Mikado's spare store of soap when he left Nara, and they are so ticketed by the exhibition commissioners. All these "treasures" are arranged round the base of a gigantic bronze image of Buddha, fifty-three feet high, and of the very respectable antiquity of 800 years. The rest of the contents are arranged in covered galleries round the large courtyard of the temple, and include many very curious antiquities, among which may be mentioned a MS. said to be a copy of the Iroha, or Japanese syllabary, in the handwriting of Kobodaishi (A.D. 774 to 835), the famous priest who amalgamated Buddhism, Confucianism, and Shinto for the Japanese.—*Pall Mall Gazette.*

[JO]URNAL OF THE SOCIETY OF ARTS.

No. 1,187. Vol. XXIII.

FRIDAY, AUGUST 20, 1875.

[All co]mmunications for the Society should be addressed to the Secretary [ ] John-street, Adelphi, London, W.C.

[P]ROCEEDINGS OF THE SOCIETY.

EXAMINATIONS.

[I]n reorganising the Examinations of the Society [of] Arts, one division—the Commercial—described [in] recent issues of the *Journal*, has special reference [to] men, although not excluding women, who can [ma]ke capital clerks, if they please, as is well shown [in] France.

A second division, the Technological, is [alr]eady in operation, and applies to Manufactures. [The]se examinations obviously may be attended by [bo]th sexes.

Examinations in Domestic Economy.

A third division of the examinations has been [est]ablished, and will particularly apply to women; [it] consists of the following subjects :—

Clothing and its Materials.
Health.
House-keeping and Thrift.
Cookery.

[W]hilst it may be expected that these subjects [wi]ll be chiefly taken up by women, there is no [rea]son against men taking certificates in them. [In] the Code of the Education Department they are [lim]ited to girls, and this is a good reason why young [m]en should not be excluded from the Society of [Ar]ts' examinations in them, if they please to [att]end to these important subjects. These ex[am]inations will be by papers of questions.

Fine Arts Applied to Industry.

The Society has already held with success annual [ex]hibitions of Fine Art applied to Industry, and [c]onsidering the whole subject of the examina[tio]ns, arrangements are in contemplation for hold[in]g Examinations in Fine Arts applied to Industry. In this way the whole field of Arts, Manufac[tu]res, and Commerce, the special province of the [So]ciety, will be connected with a scheme of annual [ex]aminations in the future.

MUSICAL SCHOLARSHIPS OF THE SOCIETY OF ARTS.

It is proposed to form a fund, to be subscribed among the members of the Society of Arts, for the purpose of establishing scholarships open for competition among qualified persons nominated by the Society for examination in such competition. Members willing to make donations or give subscriptions in aid, are requested to communicate with the Secretary.

The following subscriptions have already been promised :—

Lord Alfred Churchill (Chairman of Council), for 5 years, yearly	£5
Sir Henry Cole, K.C.B., for five years, yearly	5
E. C. Tufnell " " "	2
Peter Graham " " "	2
Andrew Cassels " " "	2
E. J. Reed, C.B. " " "	5
R. Rawlinson, C.B. " " "	2
Edwin Lawrence " " "	2
Edward Brooke " " "	5
Hyde Clarke	5
F. A. Abel, F.R.S.	5
Seymour Teulon	5
Major-General F. Eardley-Wilmot, R.A., F.R.S. ..	5

FREE SCHOLARSHIPS IN COOKERY.

The following are the rules for the competition for the free scholarships, to be held in the National Training School for Cookery, which were offered by the Society of Arts, and announced in the *Journal* of 30th July, page 783 :—

"With the view of assisting this important movement and spreading the knowledge of it, especially among Institutions in Union with the Society, the Council, on the 19th July, passed the following resolution :—'That a notice be published that the Council are prepared to establish five scholarships of the value of £10 10s., giving free instruction to female teachers of cookery to be trained at the National Training School for Cookery; such scholarship to be awarded by competition; the members of the Society of Arts and of Institutions in Union with the Society to have the privilege of naming candidates for competition.' It is expected that any well-educated lady who becomes a certificate teacher of cookery (not a domestic cook) may look forward to obtaining an income of £100 a-year, by conducting a local school where adults of all classes, and the students of public schools, may attend to receive instruction and to practise."

The following are the subjects for the competition in October next :—

Subjects for Examination.

Theory.

1. Reading aloud and recitation, so as to give evidence of ability of speaking clearly to numbers.

2. Writing from dictation, legibly, quickly, and correctly.

3. Arithmetic, four first rules and bills of parcels, and book-keeping by single entry.

Practice.

4. Tests of aptitude for cooking and evidence

of cleanliness, method, and order, to be exemplified by preparations for cooking, and cooking simple dishes, such as potatoes, eggs and bacon, mutton chop or kidney, rice, currant dumpling, &c., and clearing up afterwards.

5. Candidates desiring to compete must be betweeen 20 and 30 years of age; they must send to the Secretary of the Society of Arts, Adelphi, London, W.C., in their own handwriting, the name of the member of the Society of Arts or Institution in Union recommending them, with their own names and addresses, and present occupation if any, on or before the 30th September next. If they are summoned to attend the competitions, they will be required to pay a registration fee of one shilling each before the examination commences.

CANTOR LECTURES.

The fourth lecture of the course of Cantor Lectures on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft," by the Rev. Arthur Rigg, M.A., was delivered on March 1st, 1875, as follows:—

Lecture IV.

On Hammers.

In the previous lecture reference was made to the chief elements which produce the large amount of energy derivable from hammers; these are mass and velocity. Now, for the purpose of comparing the effect of one hammer with another (of the same material, shape, and mass), it is clear we should be able to refer the imposed velocities to some common standard. No artificially produced velocity has been so exhaustively investigated as that of gravity.

It is well known—thoroughly well known—with what velocity a body falling from a measured height will strike the ground. Therefore, the converse is true; knowing any velocity it is easy to ascertain from what height a body must fall in order to acquire this velocity. Hence, to determine the power of a hammer it is usual to estimate, as accurately as circumstances permit, the velocity at the time of impact, and then to consider the problem transferred to one common source of velocity, viz., gravity, and ascertain the height a body must have fallen under the influence of gravity alone, in order to acquire the observed velocity. The reason why this is done will be more apparent if one method of estimating such work as that of hammers be explained. Holding this 2 lb. weight in my hand, and letting it fall through a space of 3 ft., the energy in the weight when it strikes the table is said to be $2 \times 3 = 6$. If through six feet, then the energy is $2 \times 6 = 12$. Again, if instead of 2 lbs. weight it had been one of 4 lbs., then these respective energies would be $4 \times 3 = 12$, and $4 \times 6 = 24$. These resulting figures are called foot-lbs., because they are obtained by a combination of the feet through which a body has fallen, and the weight in lbs. of that body. Now in this act of falling under the influence of gravity alone there is an increase of velocity, according to a well-known law. Custom and certain mathematical considerations have led to the adoption of the height of the fall needful to impart a velocity, rather than the adoption of the velocity as the element to be combined with the mass of a hammer in order to determine its actual energy. Hence, whilst striking blows with hammers we endeavour to note the velocity at the time of impact, it will perhaps now be clear that this is only done in order that from such observed or deduced velocity the height through which the hammer must have fallen under the influence of gravity alone to acquire that velocity may be known. The figures of this resulting height, and not the velocity, are those which enter into the future of the problem now occupying consideration. In handicraft hammers then, whether the velocity be imparted directly from muscular effort, or indirectly, as in the "oliver" and dead-blow hammer, through a combination of mechanical appliances, it will be needful, in order to institute a comparison of energies, to convert the effect of these contrivances into what would be the equivalent to them had unaided gravity alone been the acting agent. To express this otherwise we may say that the simple pile-driving machine is the representative mechanical form into which all hammer work must be converted in order to calculate energy.

It will therefore be well if at this stage we for a while leave the handicraft hammer with its attendant muscular energy, and consider only the action of gravity. So important is it to be clear upon the effect of gravity on falling bodies, that the results of the consideration on which we now enter may perhaps be reasoned out in two independent methods, with a view to make clear by the second method what may not be so by the first. The first method may be called the popular or common sense one; the second the mathematical or scientific one. On a falling body, gravity acts continuously. It is a force which is continually adding to its former effects. Hence the mode of measuring or estimating it must differ from those cases in which a mass of matter is always moving at the same rate, or has been struck by one finite blow. In the case of gravity, if a mass of matter be let fall from rest, then, whilst the velocity at the commencement of the fall is 0, yet at the end of the first second it will be found to be moving at the rate of 32·2 feet per second in England. Therefore adopting the usual plan of average, viz., adding the extreme velocities together, and dividing by 2, we get the space through which the body must have fallen in this second to be $0 + 32{\cdot}2 \div 2 = 16{\cdot}1$ (say 16 feet). Now in the case of a hammer falling vertically, it is possible to add to or subtract from the force of gravity, and the question presents itself, if the intensity of muscular energy or steam, or water, or a spring, or otherwise is (say) doubled, then is the velocity of the hammer doubled? At first sight it would appear to be so, but a little thoughtful reflection will show that it is otherwise.

Suppose such muscular force be exercised as to move the hand through the air at a velocity of 10

feet per second. Now if this muscular force be increased so as to produce a velocity of 20 feet per second, can this velocity be obtained by doubling the muscular effort? Let us see. If no fresh conditions enter, doubling the effort will certainly double the velocity. But fresh conditions do enter. Here is one—in the same space of time twice as many particles of air have to be pushed aside as were pushed aside in the former case, therefore these alone would demand double the original muscular effort. Again, each particle has to be struck or moved aside by twice the force which had been previously used, for if not, then the double velocity would not be attained. Hence it may be deduced that doubling the muscular effort will not double the velocity. Indeed, taking into consideration what has now been said, the conclusion will be that four times the muscular effort will be needed in order to obtain twice the velocity. And similar reasoning would show that nine times the muscular effort would be required in order to obtain thrice the velocity. If, therefore, the same hammer be used, this question presents itself: Is the work done by the hammer increased in the ratio of the muscular effort, or in that of the velocity? In other words, if I exert four times or nine times the muscular effort, do I get four or nine times the work out of the hammer or only twice or thrice the original work?

Now to estimate the work in the blow of the hammer, the space through which the hammer-head must fall, under the influence of gravity, in order to acquire the velocity of impact, must be determined, since, as was previously remarked, under the name of space, and not under that of velocity, the element enters which is used in the calculation of the powers of hammers.

An example of the table alluded in an early part of this lecture may be useful:—

If the velocity per second be	The space through which the body must have fallen will be
10 feet	1·55 feet
15 "	3·50 "
20 "	6·21 "
30 "	14·00 "
40 "	24·80 "

If therefore the velocity of a hammer be doubled, then the work in that hammer, depending as it does upon "space," is increased four-fold; if the velocity be quadrupled, then the work is increased sixteen-fold, as is evident by a comparison of the spaces opposite the velocities in the table, *e.g.*, 10 and 20, 15 and 30, 20 and 40, also 10 and 40; in this latter (40) the space is sixteen times as great as in the former (10). Therefore the work in a hammer is increased in proportion to the muscular effort, and not in proportion to the velocity.

To take another view. Gravity in the cases before us is a force producing motion, and under such circumstances forces are measured by the velocity they can communicate to a unit of mass in a unit of time, in this case to 1lb. in one second. Suppose now that at the beginning of a second a body was moving with a velocity (v), and at the end of the second with an increased velocity (v′), then the velocity communicated would be (v′—v).

If this velocity were communicated to a unit of mass then the measure of the force would be (v′—v). Care must be had not to allow the mind to consider as the same the measure of a force and the measure of the energy of a given hammer. This (v′—v) is the measure of the force only, and it may be represented by V when the body commences its motion from a state of rest. This is the mathematical expression for a force producing dynamic action; it is in fact a mode of expressing the *intensity* only of a force, and is quite irrespective of the energy that force can impart to a mass; because this energy depends not only upon the unit measure of the force, but also upon an element of space, and this latter element is deducible from a combination of the measure of the force with the time during which the force acts, and which force is, therefore, second after second, adding its effect in each second to the accumulated effects of all precedent seconds.

Now it has been already explained that the velocity of a body at the end of one second falling freely from rest, and influenced only by gravity, will be 32·2 feet, therefore the space passed through in this first second is—

$$\frac{0 + 32{\cdot}2}{2} \text{ or } 16{\cdot}1 \text{ feet.}$$

Combine this measure of space with the explained measure of force, then—

$$\text{Force} \times \text{Space} = V \times \frac{V}{2} = \frac{V^2}{2}$$

Now when gravity is the force, it is known from many experiments that 32·2 is the measure of it. In the foregoing equation these figures may be inserted instead of the word "force."

$$\text{Then } 32{\cdot}2 \times \text{Space} = \frac{V^2}{2}$$

$$\text{Or Space} = \frac{V^2}{2 \times 32{\cdot}2} \text{ in the case of gravity.}$$

From this equation we can change the observed velocity of a hammer at the time of impact into the space through which under the influence of gravity alone the hammer must have passed in order to have acquired that velocity. Thus we can divest the problem before us of all those peculiarities which would certainly encumber it if the varying means of producing velocity had to be considered and measured. If this deduced space be combined with the weight in lbs. of the hammer we shall have the measure of the energy of the hammer.

An illustration may make this more clear. Suppose a hammer-head weighs 2 lbs., and the velocity at the instant of the blow was observed to be at the rate of 25 feet per second; now, substituting these figures for the general representative of them, viz., V in the previous paragraph, then the space through which, under the influence of gravity, a hammer-head must have fallen to acquire this velocity will be

$$= \frac{(25)^2}{2 \times 32{\cdot}2} = \frac{625}{64{\cdot}4} = 9{\cdot}7 \text{ feet.}$$

or 10 feet nearly, the work of one blow of that hammer would be represented by 2 × 10 = 20 foot pounds, that is to say, the blow of this two pound

hammer under the circumstances disclosed would produce an effect similar to that of a weight of 20 pounds falling through a space of one foot, or forty pounds through six inches, or two hundred and forty pounds through one inch. So acting is practically changing muscular force and the velocity caused by it into gravitation force and the velocity caused by it. A species of change with which we are all familiar, when gold and copper coins* are changed, the former for their respective values in the latter, or when yards are changed to inches, or lbs. to cwts. When this change has taken place, varying muscular energy, and varying sorts of hammers, are brought to one denomination, and may be compared.

Beside the surface work produced by hammers, there is some hitherto mysterious and as yet uninvestigated internal work done by them. It is easy to make clear the fact, of which, however, no satisfactory explanation has yet been offered.

There is on the table an ordinary magnetic needle, the ends being directed, as usual, to magnetic north and south. If, now, this common iron poker be held in the hand, and the lower end directed towards the north, but inclined about 67° below the horizontal line, the poker may be said to be in the line of the dip of the magnetic needle. Now strike the poker two or three blows upon the upper end with an ordinary engineer's hammer; it will be found that some internal change has taken place. Direct first one end of the poker and then the other to the same pole of the needle, and repulsion will be manifested in one case and attraction in the other. Now reverse the poker, making what was the lower end the upper one; strike it as many blows as were given to it before, apply it to the magnet, and it will be found that both ends attract the balanced needle, thus showing that some change has taken place, for the poker has lost all trace of magnetic polarity. Give two or three more blows, and it will be found that the magnetic effects are the reverse of those in the first case. Such a simple experiment in the private room prepares us for results, equally unaccountable in cases where metals are subject to hammer impact, or that which is equivalent thereto; hence, for example, it is apparent why the compass needle on iron ships may be affected in consequence of the tremor to which the vessel is subjected owing to blows from waves.

Nor is it a question of apparent phenomenon alone which has to be regarded in this inexplicable work of hammers. These magnetic manifestations seem to be accompanied with internal material changes which sometimes make their existence too clear by fractures as unexpected as they are dangerous. Through the kindness of the authorities of the engine-works at Crewe, the diagrams upon the wall enable me to detail to you in general terms the results of many carefully conducted investigations into the consequences of blows as from hammers upon cold metals. In one case an axle of a locomotive tender, with its wheels, of which the diagram is a longitudinal section of full size, was subjected to a series of blows. These blows were successive, periodic, and adjusted. Many experiments were made, and the results tabulated. On the diagram is represented the axle of the tender of a locomotive, the wheels being fixed in their usual places. The dimensions of the axle are 6 feet 11½ inches long, 5¾ inches diameter where the wheel is keyed on, and the axle projects 8¼ inches beyond the wheel. A weight of 60 lbs. was caused to fall from a height of five feet upon the same part of the axle, viz., that marked B in the diagram. In the case of an iron axle, a crack manifested itself after 6,128 blows, and the axle was broken by 9,843 blows. When the axle was of steel, and of the same dimensions, the weight struck 50,000 blows from a height of five feet above the part B. Afterwards 3,040 blows were given by the same weight falling from a height of ten feet; then the axle broke in two pieces across the section marked A in the fig. It is remarkable that in this case there were no previous signs of injury, the sound caused by the blow preceding that which fractured the axle was as clear in its ring as that from the first blow struck. A careful examination of a fracture which has been caused by repeated blows, sometimes shows that the structure of the metal has changed from fibrous to granular, but this change often seems to be only in the line of the fracture, and not to extend to the depth of one-tenth of an inch on either side of it. Calculated according to the principles detailed in this and the previous lectures, the measure of the energy expended before the iron axle cracked is represented by

$$6{,}128 \times 60 \times 5 = 1{,}838{,}400$$

and after being cracked, and before the fracture by

$$3{,}715 \times 60 \times 5 = 1{,}114{,}500$$

making a total energy of 2,952,900. Now before the steel axle fractured, there was expended upon it, first an energy represented by

$$50{,}000 \times 60 \times 5 = 15{,}000{,}000$$

and this was succeeded by

$$3{,}040 \times 60 \times 10 = 1{,}824{,}000$$

i.e., before the fracture, the steel axle was subjected to a total energy of 16,824,000, or the steel axle before it fractured was subjected to about nine times the hammering given to the iron one before the latter cracked.

Results, as yet inexplicable, such as these, make very clear that we have much to learn in reference to the effective energy of hammers upon the materials on which they operate.

In another and even more extensive series of experiments, the effect of what in a former lecture was called the "tapping" action of hammers was investigated, for a metal rod was subjected to continuous and uniform strain whilst rotating. The consequence of this rotation under a strain in the same direction is to bring successively the same parts of the rod into alternate expansion and compression. The arrangement of the series of experiments will be very clear on an inspection of this diagram.

A rod 12¼ inches long and one inch diameter was turned out of one 1⅜ diameter. The larger end was tapped to the headstock of a lathe. At eleven inches from the larger diameter, and at the free end of the cantilever a weight (generally 300 lbs.) was suspended, and the bar continuously rotated. The fracture occurred close to the headstock and. It may suffice to state that an average of a series of

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* If one person has 240d., and another has 20s., and a third has £1, these must be reduced to one metal before comparison.

experiments under similar conditions show that whilst an iron rod broke after 94,385 rotations, a steel one did not yield until 10,248,433 rotations.

An inquiry of much interest with respect to hammers is this—what difference is produced on a material if struck by a light hammer moving at a high velocity, and a heavy hammer moving at a low velocity. Take the problem with figures.

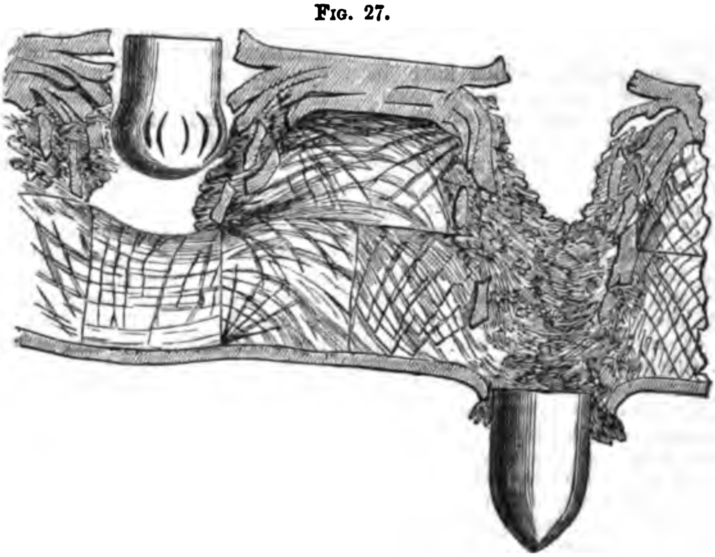
(1) Suppose a hammer weighing two pounds strikes a material with a velocity of 40 feet per second, then the height from which that hammer (under the action of gravity only) must have fallen would be 24,845 feet. The work in that hammer would be represented by $2 \times 24{,}845 = 49{,}690$ foot-lbs. (say 50).

(2) Again, suppose a hammer weighing 10 lbs. strikes the same material with a velocity of 18 feet per second, the height from which that hammer (under the action of gravity only) must have fallen would be 5·0311 feet. The work in that hammer would be represented by $10 \times 5{\cdot}0311 = 50{,}311$ ft. lbs. (say 50).

Thus calculated, these two hammers are said to have the same amount of work in them, or to be capable of doing equal work. However equal in this sense the work done by these two hammers may be, yet in actual practice in the workshop these results are not generally regarded as identical.

Here are a number of croquet balls; let them represent the molecules of a material struck by these two hammers. Here are two balls of equal size, but the weight of one is double the weight of the other. It has been loaded at the centre with lead. You will observe that this row of balls on the table is really resting upon what may be described as a slightly curved concave wooden railway, the curvature just sufficient to keep the balls in contact with each other. Let this ball of light weight roll down and impinge upon the one nearest to it; the tremor passing through the series of balls drives but one ball from the further extremity. Now let the ball of double the weight perform the same operation; then two balls are driven from the opposite extremity. These are the effects, whatever be the velocities of the impinging balls, for not any increased velocity will alter the number of balls set in motion at the extremity, although it will the distance these balls travel. It is clear that the tremor which passed through the balls in the latter case differs in degree, if not in kind, from the tremor in the former case. If, now, you will make a "scientific use of the imagination," these balls in line will be the atoms or molecules of a body, the impinging balls will be hammers of different masses, and as there are surroundings in the molecules which are not in croquet balls, evidence of facts cannot carry us further, and the speculative conclusions of the internal work done by hammers must be left to those who, to their own satisfaction at least, can pronounce upon them. One conclusion may, perhaps, be admitted. In the case of rivetting, it may be inferred that by the use of a heavy hammer, the hot, soft rivet might be made to fill in the recesses of the rivet hole, whilst the lighter hammer would simply close over and finish off neatly the hammered end, without a cup swage being put over it. The heavy hammer transfers (if the expression may be allowed) its mass into the interior of the struck material, whilst the lighter hammer, acting on the same principle, does not put so much of the material in motion. Again, this question of difference in the results is equally apparent in the case of balls shot from rifles against a sheet of glass. In the case of a small ball and high velocity there is as clear a penetration as though the hole had been drilled; in the heavy ball and low velocity there is a destruction and cracking of the material surrounding the hole through which the ball may have passed.

FIG. 27.



It may be said, and with truth, that the form of these bullets exercises a most important influence in the results now dwelt upon, and some may be asking themselves how is this branch of the subject to be connected with hammers? A few more words and we shall see. Through the kindness of Messrs. Spon, the annexed illustrations (from

the "Dictionary of Engineering," published by them) as to the effects of shot with different formed penetrating ends have been lent for this report, and a glance at the figures will show how very much the results are affected by the form of the face of the shot.

Fig. 28

Now to apply the remarks which have been made during the last few minutes to hammers.

On the table are the hammers used in gold-beating. Messrs. Morewood, of Whitfield-street, Tottenham-court-road, have not only supplied these hammers from their workshops, but they have added this further kindness in mounting between glass various stages of the process of gold-beating, and practically to illustrate the operation one of their workmen is in the room with all the appliances needful to show you how their hammers are used.

The faces of these hammers require our first attention. They are slightly convex, and upon the amount of this convexity depends their value. Here is a very old hammer, but still a very good one, better, I am told, than any of its younger associates. Why good? because the convexity of the face, coupled with the weight of the hammer, produces exactly that effect upon the metal which is desired. Perhaps the delicacy of the operation will be more truly appreciated if the process be described, and then witnessed in operation.

The gold-beater's art in the production of gold leaf was practised (say) 3,000 years ago. He uses for the production of the leaf three hammers, with short handles; one weighing 17 lbs., the second 9 lbs., the third 7lbs.

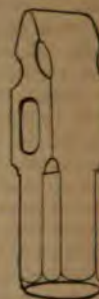
It is a somewhat curious commentary upon the principles which govern our handicraft procedures, that one of the hammer-heads of the gold-beater is heavier than the single-handed sledge hammer of the forgeman and smith, which weighs only 10 lbs. It may be well now to compare these two heavy single-handed hammers.

Fig. 29 and fig. 30 are the heads of sledge hammers.

It will be observed that the centres of gravity of these sledges are below the intersection of the handle with the head. The object of this is that the workman may the more easily and truly bring down the face of the hammer upon the work. Now look at any of these gold-beaters' hammers. This 17lb. one for example. The centre of gravity of the head is about the centre of the hole in which the handle is fixed. The gold-beater prac-

Fig. 29.

Fig. 30.



tically ignores the centre of gravity. Now ob-serve the faces of these hammers; they differ very materially. Old and worn as this one seems (and Messrs. Morewood tell me it has been in their workshops for fifty years) it is somehow regarded as the best hammer on their premises. This seems to result from the form of the face. The sledge hammer face is flat or nearly so, having merely the arris taken off. The gold-beater's hammer face is very different. The face and arris are formed to special and not chance curvatures. Some may be disposed to question the propriety of a com-parison, because the one is employed on heated metal and the other on cold. Those who thus think must remember that in each case an expan-sion of area is often the object of hammering. It must also be borne in mind that whilst the mole-cules of hot iron may be said to separate and re-weld, so also in the process of gold-beating there is much disintegration and re-welding of the gold leaf (for gold in the thin state welds when cold). Perhaps a thoughtful practical smith might get hints from a careful observation of the goldbeater's craft.

Great as is the contrast between the faces and weights of these two hammers it is still more ano-malous that to be struck by such a mass of metal the gold is placed in the thinnest and finest and lightest of animal skins.

For the first hammer 160 pieces of gold, each weighing 6 grains, are put into a "cutch" of [illegible] vellum and beaten for twenty minutes with a 17 lb. hammer, which falls about eighty times per minute. Each beaten leaf is divided into four, and put into a "shoder" made of skins worn out for the [illegible] process, and containing 700 leaves, and beaten for two hours with a 9 lb. hammer, falling (say) eighty times per minute. Each is again divided into four, and put between the leaves of a "mould" com-posed of 900 of the finest skins, each made double from the cæcum of oxen,* beaten for two hours with a 7 lb. hammer, falling nearly 100 times per minute. The gold is thus reduced to [illegible] of an inch, less than our instruments can measure, and the thinness is usually estimated by the [illegible]

* A large bundle of the cuttings of these skins were on the table; from such cuttings the pieces are made which are usually sold as goldbeaters' skin.

position of the light. The mountings between these sheets of plate glass illustrate various phases of the process, and if any one will examine them by transmitted light he will appreciate that mode of estimating thickness.

Such is a brief description of the mode of gold-beating. Now as to the hammering. The workman stands erect, and uses the hammer with equal facility in either right or left hand. The whole body from the loins upwards is in motion, and the ease with which the work seems to be done is apparently a practical contradiction to the laborious duty these heavy hammers might impose. An explanation must be sought for this. The books ("cutch," "shoder," and "mould") are placed on solid anvils; the blow falls truly upon them. These books are of elastic material, and formed of leaves, between which are not only pieces of gold to be expanded, but thin films of air.

Now air, as well as vellum or skin, is elastic. Hence the hammer falls upon what may be called a compound elastic body. Consequently there is a recoil, and I am informed that the effort of the workman in checking the height to which the recoil would raise the hammer, is more fatiguing than that required to impart the blow. From what was said in a former lecture this is a consequence of the muscular structures then explained. Hence it is clear that the blow of the hammer is resolved into two elemental parts; one the recoil, the other that portion of the blow which is actually retained (if the word may be used) by the book and utilised by the gold. Clearly this portion is distributed between the leaves of skin and the plates of gold, but the latter seem to possess themselves of the whole, for the little book of skins, measuring about five inches square, and about five-eighths of an inch thick, and worth about £10, will last nearly two years, and even then has a very fair pecuniary value to the beaters of what is popularly called gold-leaf, *i.e.*, Dutch gold.

If now we reflect upon the operation just witnessed, it consists in spreading and so enlarging the area of a flat surface. Now, suppose blows to be struck in succession upon the centre of the piece, then this extension of the metal would be resisted by the thick periphery.

It is evidently needful so to adjust the convexity of the hammer face as that the atoms of gold may be so pressed, and no more than to force themselves amongst the contiguous atoms, pushing these forward, and so on to the margin; these margins having been previously thinned for the purpose of receiving the superfluous gold from the middle. Thus much may suffice to satisfy you that the forms of the faces of a hammer are of as much, and indeed more, importance than those of either rifle or cannon balls. The latter have been studied, and the principles arrived at with respect to them might very fitly be applied to hammers.

The experiments with the croquet balls have their bearing upon gold-leaf making. Had the blows been struck with a light hammer, the effects of the successive blows would not have penetrated to the middle of the thickness of the "cutch," and although the workmen may have turned it over and over again, the gold in the middle would not expand. So accurately are the weights and faces of the hammers proportioned to the needs, that I am informed if the cutch is even one-sixteenth of an inch thicker in consequence of coarser skins, the beaten gold is not satisfactory.

In this penetrative power then, with these wonderfully light skins, and gold leaf so light that if the finger be drawn over a leaf it seems to vanish in the pores of the skin, and in the rivetting of iron plates in ship building and boiler making, the heavy hammer is a necessity not to be compensated for even by a lighter one producing the same units of work.

It cannot fail to interest you to witness another process, in which also a heavy hammer is the finishing tool. On this side of the room we have had the process of gold-beating; on the other side are those engaged in making springs for carriages. Contrast with this work of the gold-beater that of the spring-forger. Each artisan delivers the work finished from the hammer. In each case the hammers are heavy, *i.e.*, the gold-beater uses a short-handled, one-handed hammer, the spring-maker a longer-handled, two-handed hammer. The gold-beater stands upright, and his whole body moves; the spring-forger stoops; and his body is as rigidly fixed as possible. The gold-beater does not expend energy in driving the hammer downwards; the spring-forger expends much energy in accelerating the velocity of a falling hammer-head —the spring-forger puts his right hand above the handle, in order not only to add to the accelerating force of gravity, but to resist that recoil which the gold-beater accepts. Each has to expand the surface of metals. Now the element which enters, causing two such opposite modes of dealing with the same object, is heat. The spring smith, with a skilfully arranged hollow fire, heats the end of a parallel bar of steel, and it is essential that as much thinning and tapering of the bar should be had as possible from each heat; hence the blows must succeed each other with great rapidity, and he cannot afford to lose any portion of the energy of the blow during the conversion of it into recoil; and there is not in his case any reason to do so, because there is not to be any transference of energy through one bar of steel to another. The whole effect of his blow is required on the spot where it may fall.

To show the varieties that exist in the skilful application of hammers, let me take one more example. Here are two extreme hammers as used by the makers of files which are also entirely the production of hammers. Messrs. Stubbs, of Warrington, have sent them with two chisels and two files as examples of the largest and smallest files made with the chisels and hammers used. It will be observed that in the largest hammer the handle is very short, and inserted into the metal at a very acute angle. This hammer weighs 10 lbs. In the smallest hammer the handle is longer, but also inserted into the head at an acute angle: the head in this case weighs less than half an ounce. In both the centre of gravity is below the insertion of the handle into the head; the panes of these hammers are small, every provision being made to ensure the reaction of the blow being through the centre of percussion. The skill, rapidity, and uniformity with which these hammers are employed is really surprising. Let any one with even a magnifying glass examine the cuts upon this large 18 inch file, or upon this delicate needle-like small file, and he will be satisfied that in the use of these

hammers great care and skill are required. The rapidity with which the blows are given is very great, for the maker of this small file can make from 250 to 300 cuts per minute; the number and delicacy of these cuts may be inferred from the fact that in a fine half-round file of ten inches long there may be as many as 20,000 chisel cuts.

To the kindness of Major Maitland, of the Royal Gun Factories, Woolwich, we are indebted for some experiments and calculations with respect to hammers, which are likely to prove both valuable and interesting. They were made upon copper cylinders, of which examples are upon the table, and the mean, from three experiments, of the compression of each from one blow of the hammer described in the first and second columns is stated in the third. The other columns in the table explain themselves. The last column is an addition of my own, and although expressed in words open to adverse criticism, it is nevertheless useful as showing in a somewhat non-scientific form the work obtained from the hammers described in the first column.

FORCE OF HAMMERS.

A. Nature of Hammer.	B. Weight of hammer.	C. Compression of copper with one blow.	D. Mean compression.	E. Equivalent to 50lb. falling inches.	F. Blows per minute.	G. * Hours worked per day.	H. Total work done in one hour.	I. Total work per day.	K. Calculated velocity of hammer at impact.	L. The load in tons which, without impact, must have been placed on the [illegible]
	lb.	inches.	inches.				ft. pounds.	ft. pounds.	f. s.	
Hand	2	*a* ·145 *b* ·166 *c* ·159	·153	14	(say) 96	8	336,000	2,688,000	43·3	[illegible]
Light sledge (raised) ..	11	*d* ·331 *e* .329 *f* ·314	·325	59	48	4¼	708,000	3,009,000	37·9	[illegible]
Light sledge (swung) ..	11	*g* ·325 *h* ·333 *i* ·348	·335	65	48	4¼	780,000	3,315,000	39·8	[illegible]
Heavy sledge (raised) ..	26¼	*j* ·374 *k* ·376 *l* ·371	·374	98	36	3½	882,000	3,087,000	31·6	[illegible]
Heavy sledge (swung)..	26¼	*m* ·376 *n* ·374 *o* ·377	·376	100	36	3½	900,000	3,150,000	32·0	[illegible]

* Exclusive of rest and stoppages.

Reference was made to compound tools when speaking of the capabilities of the hand as a compound tool. This (Fig. 31) is one of the most compact of the class which has fallen under my notice. It is only six inches long, and yet comprises six tools, viz., a hammer, a claw for extracting nails, a [illegible]

FIG. 31.

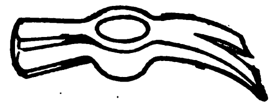
liers (the movable corrugated piece securing a irm hold of the pipe), a nut-wrench or spanner, screwdriver, and a bit-handle.

This lecture on hammers was closed by a decription of the purposes to which various hammers n the table were adapted. Many of the varieties esulted from the fancy of the artisans, others rom the necessities of the case.

This portion of the lecture cannot be reproduced n type. Messrs. Spon have supplied from the olume previously alluded to some illustrations of ammers which may supply the place of that which s lacking.

Fig. 32 is a ship carpenter's hammer-head with law. It differs from ordinary claw hammers (see Fig 35 and Fig. 36) in that the handle is not trapped. In English claw hammers the handle s strapped up the sides, as seen in the Figs. referred to; in many American claw hammers the strapping is carried up the back and the front of the hammer. Why this change has been made is

Fig. 32.



not very apparent, for by it one strap (that nearest the claw) is in tension, the other is in compression. In the English strapping both are in tension. Fig. 38 is another example of a non-strapped claw-hammer. In these cases, if much power is required when the claw is used, it should be applied by pressure on the face end of the hammer as well as upon the handle.

Fig. 33.

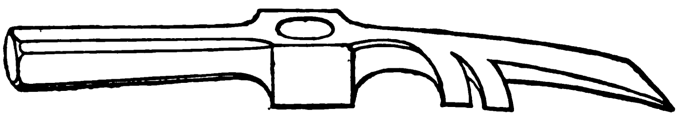


Fig. 33 is a coach-trimmer's hammer-head.

Fig. 34.

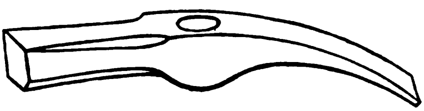


Fig. 34 is a hammer-head used by masons.

Fig. 35.

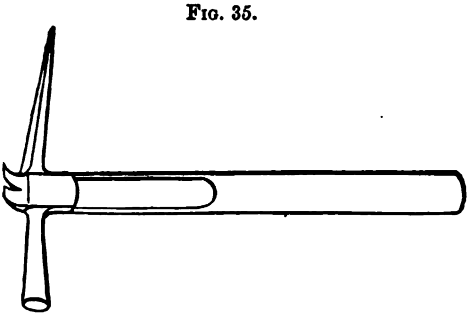


Fig. 35 is a slater's hammer, with pick and claw.

Fig. 36.

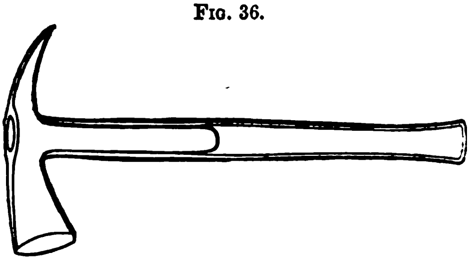


Fig. 36 is a fireman's hatchet or tomahawk hammer.

Fig. 37.

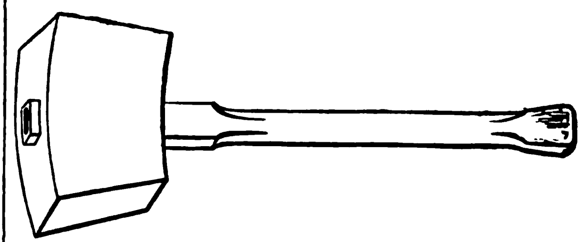


Fig. 37 is a carpenter's wooden mallet.

Fig. 38.

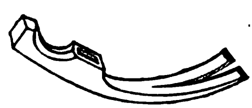


Fig. 38 is a cooper's claw hammer.

Fig. 39.

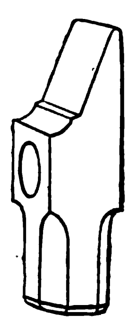


Fig. 40.

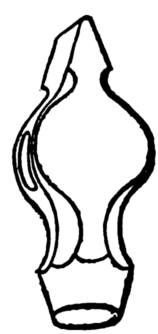


Fig. 41.

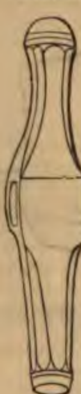
Fig. 42.

Fig. 43.

Figs. 39 to 43 are various forms of hammer-heads in general use amongst engineers and mechanics, differing, it will be observed, chiefly in the form and angle the pane makes with the handle.

Fig. 44.

Fig. 45.



Figs. 44 and 45 are boiler maker's hammers, and chiefly used in rivetting.

An improvement in safety lamps has been devised by M. A. B. Boullenot, of Paris. It consists in supplying safety lamps with air from outside the mine. Fixed pipes are carried down the mine, and branches are led into all the workings. Through these compressed air is forced from the surface by air-pumps, and lamps are screwed to the air-pipes. The cylinder which incloses the flame is protected by a cage, and the products of combustion pass off through two pieces of wire gauze. The match for lighting the lamp is inserted through a spring clip, ignited within the lamp, and cannot be withdrawn until extinguished.

A meeting has been held at Sydney, New South Wales, in favour of the annexation of New Guinea by the Imperial Government. A resolution was passed pointing out the importance of New Guinea as a field for colonisation, and affirming that it should be immediately colonised in the interests of humanity and commerce.

The summary of results of railroad operations in 1874, in the United States, shows that the gross earnings were 6,000,000 dols. less than in 1873, while in the operating expenses there was a reduction of 11,700,000 dols., and in the net earnings an increase of 8,700,000 dols.

MISCELLANEOUS.

GEOGRAPHICAL CONGRESS AND EXHI-BITION AT PARIS.

[From a Correspondent.]

The final meeting of the Congress, closing the scientific business proper of this international [illegible] took place on Wednesday, the 11th instant, in the [illegible] des Etats, at the Tuileries.

Admiral Baron La Roncière Le Noury presided at the concluding sitting, which was devoted to the announce-ment of the awards of the juries in the different [illegible] The Minister of Public Instruction, M. Wallon, [illegible] present on the platform, and made an excellent [illegible] of which one great merit was its brevity. The [illegible] President of the Republic, and the Premier, M. [illegible] with other State functionaries, were also present [illegible] the audience, in one of the tribunes, or galleries [illegible] apart for distinguished visitors, among whom, by the [illegible] it was anticipated that the Grand Duke [illegible] would have been found. Notwithstanding his [illegible] known tastes that way, it is presumable that the [illegible] visit of inspection made by him on Tuesday morning [illegible] renewed in the afternoon, had given his Imperial [illegible]ness a surfeit of savans and science, and as the [illegible] was merely formal he may be excused for not [illegible]

The letters of distinction awarded to the [illegible] Section comprised the following Government [illegible]ments:—The Admiralty Hydrographic-office [illegible] the Ordnance Survey Department of the [illegible] Southampton), and the Indian Topographical [illegible]nometrical Department (both in group 1); the [illegible] Survey of Great Britain, and the Meteorological [illegible] (group 3); likewise, in the same group, the [illegible]graphical Society; and the Palestine Exploration [illegible] and English Alpine Club, under group 1. The [illegible] Tunnel Company, similarly honoured, may be [illegible] as relating to both England and France.

Our country not being represented in groups [illegible] historic and didactic—no awards were made to it by [illegible] juries.

The only feature of the programme remaining [illegible] be executed was a visit of inspection to the [illegible] Paris, fixed for the following day, by such of the [illegible]bers as remained for that purpose, as also to attend [illegible] special reception held by the Marshal-President [illegible] Republic on Wednesday evening, which was a [illegible] affair. The Geographical Exhibition, supplementary [illegible] the Congress, will remain open till the end of [illegible] month.

While devoting themselves most zealously [illegible] business of the sections, during the ten days [illegible] scientific work, the members have had provided for [illegible] sundry excursions, or visits of inspection, of a [illegible] lighter character, combining amusement and [illegible] —after the manner of our own British Association [illegible] the Advancement of Science, Archæological Institute [illegible] *id genus omne*, for which, indeed, the leading English [illegible] paper has erewhile been so facetiously severe on the [illegible] —but which, nevertheless, the *Times* to the contrary [illegible]withstanding—are neither to be despised nor [illegible] as being needful relaxation from hard, intellectual, [illegible] routine work.

Thus on the "Ordre des Travaux du Congrès" [illegible] programme of labours, Thursday evening was [illegible] for a soirée at the Paris Observatory; Friday, for [illegible] excursion to Saint-Germain; Sunday, an [illegible] Compiègne; Monday, inspection of the Catacombs; [illegible] visit having some special object of curiosity and [illegible] in view, thus neither excluding all conviviality, [illegible] solely devoted thereto.

The inspection of the Observatory—now [illegible]

ider the charge of the celebrated French astronomer, verrier—was bereft of its principal object and in- rest by the unpropitious state of the weather, the rs being completely shrouded by heavy rainclouds, hich gave the geographers a liberal pluvious etting. Moreover, the new great equatorial telescope not yet ready for use. I need not, therefore, cupy your space with a long catalogue of astro- mical and philosophical instruments of precision, embling those of the Royal Observatory at Green- ich; nor yet enter at length into detail of the minute d tedious labours of observing, recording, and utilis- g, that are here continuously carried on. I merely te that the most recent proposal of its distinguished ad, is to initiate here the system long in operation in r own metropolis; and to establish electrical com- nication from the great timekeeper of the Observa- ry to the churches and public buildings of Paris. at important horological instrument is a masterpiece workmanship and precision, recording of course ris Mean Time: it is erected in the Catacombs, some or 60 feet below the level of the ground, so as to be tirely freed from all the disturbing influences of rface vibration and variations of temperature. The an thermometric reading at this subterranean level is to 10° Centigrade, corresponding to 50° Fahrenheit. This is a matter, however, that cannot be quietly lled between the Director of the Observatory, the nister of Public Works, and the Prefect of the Seine. fortunately, the Muncipal Council of Paris, at whose arge the cost of execution and maintenance of the neces- ry works must be defrayed, have a veto in the affair; as the recent comments in the press on the absence the Mayor of Paris, or more properly the President of the Municipal Council, from the International banquet the Guildhall, given by the Lord Mayor of London, made English readers familiar with the famous Floquet, and the body of which he is the n representative, your readers will understand that wreck is to be dreaded for the project, on the finan- question. The wires would communicate firstly h the clock at the Luxemburg, now the seat of the nicipality, since the destruction of the Hotel-de-Ville the Commune; and thence a network of telegraphic es would diverge to all the churches, mairies of arron- ements, and the like.

Friday was equally unpropitious to the excursionists, o went to the Musée of Saint-Germain through uring rain. The interest of this visit centred mainly the exhibition of the modern reproductions of ancient ensive and defensive weapons of warfare, and in the ctical and experimental demonstrations of their use d power, by actual example. The visitors were eived at the Gallo-Roman Museum by the director d sub-director, MM. Bertrand and De Mortillet, as by M. Abel Maître, engineer in chief of the work- ops attached to the institution, the skilful constructor these reproductions of ancient military appliances. ese latter were deemed necessary by the late Emperor, poleon III., for the work of preparing his "Life of sar"—rendered for the moment a familiar subject , by the trial of the action brought by the executors the publishers, MM. Plon et Cie, against his jesty's executors, to recover £6,000 damages for -completion of the work and non-fulfilment of con- ct, in which the Paris Tribunal has just nonsuited the intiffs—and in consequence the present collection made of the dimensions and materials as described Latin authors. A range had been prepared and rked out at 10-metre intervals (11 yards, or half a ain); and M. Maître exemplified by the exercises the and power of each weapon.

Commencing with the javelin, or dart, fitted with the pliance called the *amentum*, or loop, attached to the ntre of gravity, whereby the range is greatly increased, was shown that a distance of 60 yards was attained, against the wind; 72 yards having been attained under more favourable circumstances. The *pilum*, or Roman javelin came next; this consists of a pointed iron head let into a handle of wood, like a harpoon, and about 6½ feet long, and was the favourite weapon of the Roman soldier at about 20 yards distance, prior to an onslaught with the sword. This was followed by small iron-pointed darts, discharged with a sling to a great height, and falling point downwards some 70 or 80 yards off. As a variety of those hand-weapons, the use of the *assegai*, with the aid of the wooden *wummera*, was illustrated, ranging 70 or 80 yards, with surprising accuracy.

Subsequently the machines of the catapult class were set in action; firstly, the *onager*, consisting of a strong wooden lever affixed between two tightly twisted knots of cord, attached to a stout, heavy, wooden frame; the outer end of the lever is drawn back by means of a winch, and then made fast by a cord passing through a hook; a sling fastened to the free extremity of the lever contains the heavy missile, when, on the cord being slipped by a trigger, the tension of the cords forces the lever forwards with great force, projecting the heavy mass to a considerable distance, such as 140 to 180 yards. The *balista* is constructed on somewhat similar principles, the strain or torsion on twisted cords drives an arrow, dart, or other projectile, placed in a groove, in a straight line, and with a very flat trajectory, direct to the mark. Of this offensive machine three sizes were shown and operated, the smallest discharging a projectile weighing 85 grammes (about 3 oz.) to a distance of 176 yards, and the largest to 340 yards, the latter sending a missile of nearly 1¾ lbs. about 165 yards. This concluded a very interesting series of experimental trials with arms made on primitive models.

At Compiègne, on Sunday, the visitors inspected the curious and remarkable collection of Indo-Chinese antiquities, occupying the vast Salle des Gardes, on the ground-floor of the second pavilion, and called the Khmer Musée, the Khmers having been the aboriginal race that peopled Cambodia, Annam, and that region, long before the existing population. They left remains revealing an art grandiose and original, as well as a high state of civilisation. The first knowledge of them in more modern times was derived from the writings of a Chinese officer of the 12th century, published by Remusat. The first European traveller that visited those parts was a French naturalist, Henri Monhot, in 1861, and his discoveries almost rival the buried cities of Assyria. After him Commander Lagrée visited the monuments of Angkas, in 1865-7, and made the expedition of Me-kong, to the ruins of Siem-Reap-Melia, Priacan, Bachey, and Bassac-Pnom. The remains collected here were transported with great trouble to Saigon by Lieut. Delaporte, M. Faraut, Engineer Ponts-et-Chausées, and Dr. Thorel, for conveyance to France by sea.

The papers and discussions at the meetings of the sections, and the general sittings of the Congress, give many details and most interesting matter, which I cannot reproduce for want of space. The following brief summary will exemplify the important and debatable subjects dealt with. I may remark that, in theory, the conception that, after the day's work of the sections the results should be reported to, and discussed by, the general metings of the Congress, appears a valuable and excellent mode of summarising the work done; but in practice it is defective, and has led to a good deal of tedium and unpleasantness, not to say disagreement and scenes, owing to the prolixity and verbosity of the sectional presidents and secretaries who reported the proceedings. Indeed, it has proved a cumbrous and dilatory innovation on our own methods, and is rather to be avoided than copied. The programme of the proceedings is a very full one, and the results fail to correspond.

In the first, or mathematical section, after conferences with the 2nd and 6th groups, the adoption of the centesimal system of dividing the quadrant in lieu of

the sexagesimal, was recommended by a small majority; the hydrographers and navigators being generally in favour of the retention of the existing sexagesimal division. The subject of a general zero-point for all terrestial surface-levels was discussed, and the Mediterranean was decided to be preferable to the Atlantic Ocean as being most stable. A general system of levels was resolved to be desirable.

In the second, or hydrographic section, recommendations were similarly made in favour of the adoption of one common meridian by all nations, for maps, longitudes, &c., and the selection of such a meridian was referred to an International Commission; also for the unification of the system of conventional signs for meteorology, astronomy, hydrography, charts, maps, &c., of all kinds. After a long discussion, and important communications by MM. Prompt, Héraud, Bouquet de la Grye, Guyerne, and Rysselberghe, it was also resolved to recommend the establishment of maregraphs, or recording tide-gauges on all important points of sea-coasts. The influence of terrestial protuberances on meteorological phenomena was discussed, in special relation to the late inundations in the South of France, Bohemia, and elsewhere.

Group 3, the physical section, was decidedly overweighted with too ambitious a programme, including over 40 different questions and subjects, on geology, zoology, ichthyology, anthropology, extinct and living fauna, flora, &c. A distinct sub-section was therefore formed for anthropology, and, among other communications, heard a paper on the general subject, by Madame Clemence Royer. In the main body of the group, the subjects treated of included Col. Goulier's geoplastic theory of the causes to which the external configuration of the earth are attributable; M. Perrier's theory on the lithology of the beds of seas; recent modifications in the earth's surface, due to the defective homogeneity of the strata forming the terrestrial crust, causing alterations in level, and inconstancy in the latitudes of some observatories; recent volcanic formations in the Hawaii islands; alluvial deposits on the coast of Sicily, and variations in its level, a subsidence of six or seven feet having taken place since the Punic wars, and being now replaced by a gradual elevation. A Belgian naturalist read an important paper on the migrations of whales, maintaining that those species have separate summer and winter quarters which they frequent. Mr. Milne-Edwards had two papers, one on Japanese ichthyology, and the other on the theory of the distribution of zoological species over the surface of the earth, to the effect that each sprang and extended from a single point, exercising antagonistic influences at points of contact with modifying results. And this may be compared with similar essays as to the distribution of man and the relations between and growth of populous centres, given before the 1st and 3rd sections, by MM. Lalaune, de Chancourtois, and Silberman, on the equilateral and pentagonal theories; families being taken as centres or radiating points, and conterminous boundaries assuming fixed mathematical figures, by the very nature of things as a fundamental principle, only deranged by war. Thus M. Lalaune finds a network of equilateral triangles to prevail in France between the various points, such as communes, and chief towns of cantons, arrondissements, and departments, the sides increasing in length respectively as 1, 4, 12, and 24; and he gives the accumulated measures of these networks (*reseaux*) as follows:—Triangles of prefectures, 20,353 kilometres; of arrondissements, 44,418; cantons, 125,600; and communes, 453,450 kilometres.

In group 4, the historic section, M. Waldemar Schmidt, the founder of geology in Hungary, treated of the prehistoric origin of the European nations, and assigned the age of man as a race at 20 to 30,000 years. M. Henri Martin assigned reasons for the use of the word "protohistoric" instead of "prehistoric," and the geography of the Augustan and Diocletian times was developed by M. Desjardins, that of Mercator by M. Vivien Saint Martin, while M. Bertrand advanced the theory that the west and centre of France were Celtic, the Gauls having their centre on the Danube, whence they spread invading Asia eastwards, Italy southwards, and France westwards, those views being stoutly combated by M. Deloche, the latter accepting Livy as correct, the former, Polybius.

The economic section, 5, have dealt with some important points, chief among which was the cutting of the Isthmus of Darien by a canal. These schemes, for connecting the Pacific and Atlantic Oceans, gave rise to much discussion without attaining any definite end; MM. de Gogorza, de Puydt, and Thomé de Gamond were among the prominent speakers, with Captain Selfridge, of the U.S.A. Navy, but the results have not removed all doubts, it being considered that our knowledge of the country is incomplete, more particularly of the courses of the Thuyra and Atrato, and the passes of the Cordilleras. Another important transcontinental route was also treated of, viz., the Pacific line to connect Europe with Asia and the far Orient, through countries as difficult and little known, by railway from Petersburg to Pekin and Bombay. Colonel Bogdanovitch, who has studied the localities for 10 years, proposed a scheme as follows: from Nijni Novgorod by Kazan to Ekaterinenburg, and thence by Tioumen, Omsk, Tomsk, Krasnoiarsk, Irkoutsk, Tchita, Doulou Nor, to Pekin, with a branch southwards from Ekaterinenburg, by Troitsk, Sari-Soul, Taschkend, &c. From Nijni Novgorod to Tioumen is 1,500 kilometres, and the proposed line would follow the present route to Irkoutsk 3,250 kilom. This project is advanced in preference to the Saratow or Orenburg lines, and the proposers of the latter, M. de Lesseps and Collard, the engineer, commended the new route. However, if it is "a far cry to Loch Awe," it is unquestionably a long stretch to Pekin, and the Geographical Congress will not lack subject-matter in this respect for many years to come.

The didactic, or 6th section has established two important principles; that history and geography should be taught by different professors, and by parallel programmes, and that geography in primary schools should be taught on the topographical method, with the aid, in some details, of the cosmographical method.

Of all the groups, the 7th has been the most attractive and the best attended, and the accounts given by well-known travellers and explorers, of the regions with which their names are associated, have been listened to with interest; in many cases the same accounts have been repeated before the general meetings of the Congress; Dr. Nachtigall's journey from Tripoli to Khartoum and Lake Tchad, by Fezzan Bornou, Baghirmi, and by Soudan, Wadaï, and Darfoor, to the Nile and Egypt; Rohlf's African journeys in the Cyrenean district; Camperio's account of Mianni's explorations in the regions of the sources of the Nile; Capt. Roudaire on the Algerian Chotts; Soleillet's visit to the little-known Oasis of In Calah; Dr. Meyer's travels in Papua; the account given by Lieutenant Delaporte of the discoveries in Cambodia, Annam, and Indo-China, and of the Khmer cities and remains; M. Baranti's description of the routes and lines of communication in Central Asia; M. de Cessac's account of the Cape Verd Islands; with the comments of Raffrey, Dweyrier, Schweinfurth, &c., constitute the principal items.

Under the head of general proceedings I may further note that the members were received, on Wednesday evening last, at the rooms of the Geographical Society of Paris, and there heard a paper by M. Janssen on the recent French expeditions to observe the transit of Venus, which might, it seems to me, have constituted a very interesting and appropriate communication to the Congress itself. Furthermore, the resolutions and recommendations of the groups, previously adverted to, have been adopted, including also the institution of an International Geodesic Association; the establishment of observations to deter-

mine the moon's influence on atmospheric movements; and the collection of information, facts, and records, on the movement of ice; and also on the influence of the surface projection of the earth on meteorological phenomena. Mohammed Bey announced the establishment of a meteorological station at Darfoor.

COOKING IN ELEMENTARY SCHOOLS.

It may be hoped that the time will come when cookery of a simple and suitable kind will be taught in every elementary school in the kingdom. But more is wanted than this. Cookery among the middle classes is oftentimes very bad and wasteful. At the present time every one at the sea-side feels how bad cookery is among lodging-house keepers.

An account of the working of the village school kitchen at Watford Heath, which claims to be the first erected in England, has been recently sent to the *Times* and other papers, which may be found useful to other places. The correspondent, the Rev. N. Price, thus gives it:—

"The building, which is in the playground, a few yards from the school, was opened with a demonstration by Mr. Buckmaster early in the present year. It is plainly but thoroughly furnished. There are ten girls in training (average age eleven), six of whom we will call cooks, and four assistants. A dinner is prepared twice a week. Three of the cooks are engaged during the morning in preparing the dinner, and two of the assistants during the afternoon in cléaring away. Thus each girl in training has a turn in the kitchen once a week, without being absent from school duties for more than two hours. The Education Department, I may add, does its best to hinder us from giving more than twenty of these lessons in the year to each girl. The dinner prepared is for eight persons—the teacher, the three cooks for the day, and four other children, preference being given to those whose homes are distant from the school. Each child pays twopence for the dinner. With this tariff we find ready customers, and dispose of the cooked food without great loss.

"In the 'Kitchen Journal,' of which I enclose a specimen sheet, are entered the particulars of each dinner. The blank side is used for recipes approved after repeated trial. Among the dishes thus honourably mentioned are, haricot beans and bacon, with red pepper (Spanish); poor man's goose; sheep's head with rice; alamode beef; Irish stew; and some farinaceous puddings, for the dinner is generally of two courses.

"Now as to cost. From March 16 to July 21 we have had 32 meals distributed among 258 persons. The total cost of the food is £4 1s., or 3¾d.—a loss of 1¼d. a-head; or 10d. on each meal. Everything except fuel is charged—a price is put even on gifts.

"The cooking is taught by the mistress and pupil teachers. The senior pupil teacher has been trained in the artisan class of the National School of Cookery, and has passed the examination at South Kensington. In return for a yearly subscription we have the right of sending up one person annually to the training school. Our scheme will not cost more than £15 a year. For this small outlay we hope, year by year, to train a number of girls for the duties of domestic life, to supply good dinners to growing children, and by increasing the supply of teachers, to aid the best temperance movement of the day."

The first thing to get good cookery made general is to get good teachers. The necessary training for cookery for all classes is thoroughly given at the National Training School for Cookery, South Kensington. The fee for a course of twelve weeks' training is ten guineas, and a trained teacher, when certificated, has a fair chance of earning a hundred pounds a year.

THE MINT REPORT FOR 1874.

In a recent article on the subject of medals, allusion was made to the account of the work in the department of the Mint devoted to their manufacture, given by the Deputy-Master, Mr. Fremantle, in his annual report recently issued. The same document also deals with a variety of other matters connected with the coinage, many of which are of sufficient interest to make but little excuse necessary for recurring to it again, in order to bring before readers of the *Journal* information which would probably be unnoticed while it remained in the pages of a Blue-book.

A considerable portion of the report is of necessity devoted to statistics. To many it will appear a somewhat startling fact that coins to the value of nearly two and a half million pounds were required to be struck in the year, and that it is only from the large coinages of 1872 and 1871, coupled with the large import of Australian sovereigns and half-sovereigns, that so small an amount as a million and a half (value) of gold coins were sufficient, instead of the average £5,000,000. Of the Australian coins nearly two millions in value were imported. The demand for silver coin in 1874 was less by a fourth than in the year previous. A noticeable fact is the largely increased demand for threepences, 4,122,090 pieces, worth £51,525, having been issued. This is an increase of 15 per cent. over 1874, and no less than 339 per cent. over 1870. Most of these were required by the colonies. The re-issue of half-crowns commenced in May, 1874, and the amount coined in the year was £273,000, of which nearly £200,000 was issued. The process of renewing the silver coinage of the colonies is going on rapidly, £24,000 of coin having been withdrawn and melted down, while £188,000 of new coin was issued.

The fact that a considerable amount of bronze money had to be coined by contract leads Mr. Fremantle to repeat a somewhat urgent appeal for extended accommodation. The machinery is now the same as that erected in 1810, when the Mint was moved from the Tower to its present site on Tower-hill. Considering the fact that our coinage is admitted to be at least equal to that of any country in the world, it is difficult to believe that the work is done by "machinery more obsolete and inefficient than that of any mint in Europe, not excepting that at Constantinople." Such, however, is the case. The great difficulty at the Mint appears to be that there is only just sufficient room to carry on the work in hand, consequently any extensive repairs necessitate the entire stoppage of work. To effect the alterations absolutely necessary, at least a year would be required, and such a break in the continuity of the ordinary arrangements would be obviously impossible. As it is, scarcely any of the special colonial coinages are executed at the Mint, this, as well as a large quantity of bronze coinage for home use in 1874, having been contracted for by private firms.

The portion of the report dealing with the Mint records, now under examination by the authorities of the Rolls-office, may be passed over here, interesting though it is from an antiquarian point of view. The notes on medals have been fully dealt with in Mr. Simmonds' article above referred to. The portions of the report dealing with the chemical work done deserve more extended notice. The most important investigations, in a scientific point of view, that have been carried on during the year at the Mint are certainly those connected with spectroscopic assaying. It will be remembered that Mr. Norman Lockyer, in a course of Cantor Lectures in 1873,* gave an account of what was then being attempted in this direction, having previously communicated the results of his experiments to the Royal Society.† In the report by Mr. Roberts, the chemist of the Mint, a diagram is given showing the comparative results of spectro-

* *Journal*, vol. xx, pp. 440 and 793.

† Lockyer, Proc. Roy. Soc., vol. xxi., p. 85; Lockyer and Roberts, Phil. Trans., vol. clxv., pt. 2, p. 495.

scopic assaying and the ordinary parting assay. This diagram consists of a curve, the co-ordinates of which are furnished by the indications of the micrometer in the eye-piece of the spectroscope, together with the known composition of the several alloys. The chief point noted with regard to this curve is that there is a much greater change in the micrometer readings for a corresponding change of composition in the alloy in the less pure than in the finer alloys. Thus the difference between an alloy containing 916·7 parts gold in the 1,000, and that containing 916·6, is shown by (roughly speaking from an inspection of the drawing) 30 divisions of the micrometer scale, whereas the difference between 916·3 and 916·2 is shown by about 200 divisions. This latter fact may serve to show how infinitely more susceptible the spectroscopic method is than that in common use, when $\frac{1}{10000}$th part of alloy is marked by so very considerable a change in the scale. It does not, however, appear that any great practical advance has been made in this novel application of the spectroscope, although on one occasion this instrument was used in testing the recently-made trial plate of pure gold. It was found that its spectrum, when compared with the solar spectrum, showed absolutely no lines, except those due to gold. The result of Mr. Roberts' long labours were thus approved by the most delicate of all possible tests. How long these labours were may be seen by a reference to the report of the preceding year, in which it is stated that over 1,000 assays were made in the preparation of the two gold plates, the standard (22-carat or 916·66 parts in the 1,000) and that absolutely pure. The necessity for these plates arises from the impossibility of obtaining absolutely accurate results from the usual process of chemical analysis. It has, therefore, long been the practice in the annual testing of the coinage to check the result by assaying, side by side with the alloy under examination, pieces of metal of known fineness. The test-plates in use since 1829 were found not to be of their reputed standard, that for gold being actually 915·3, instead of 916·6. It was, therefore, determined to prepare new plates, and this was done, with minute and elaborate care, as detailed in the report for 1873. To still further check the accuracy of the result, plates of absolutely pure gold and silver were also prepared, and it was this new pure gold that was examined by the spectroscope. These plates having been formally tested and approved in 1873, the annual trial of the gold and silver coinage was effected by their aid in 1874. The natural result of this elevation of the standard was that the "Trial of the Pyx" showed an apparent falling off in the fineness of the coins. However, the greatest variation from standard was only four ten-thousandth parts (·0004) or one-fifth of the legal "remedy" of two thousandths (·002) allowed as a limit for variation.

A new method of reducing the weight of heavy "blanks" by electro-chemical action, suggested a short time back by Mr. Roberts, has been adopted at the Bombay Mint. The superintendent there has even been successful in removing the metal from a rouleau of heavy blanks, and depositing it on a similar rouleau of blanks under weight, thus obviating the necessity for re-melting. In our own mint, this method is inapplicable, as only the finished coin is weighed.

It is being found, says *Iron*, that De la Bastie's glass, which is undoubtedly hardened by tempering, loses its molecular cohesion under a repetition of blows, and then fractures like ordinary glass. Tempered glass, submitted to hammering, presented an appearance on fracture similar to that of *fatigué* steel, a molecular disintegration having taken place. It is feared that this alteration of structure and loss of temper may not only follow from shock, but may happen spontaneously from interior change in the lapse of time.

BRITISH ASSOCIATION.

The following are the officers at the forty-fifth meeting of the British Association, to be held at Bristol on the 25th inst.:—President Elect—Sir John Hawkshaw, F.R.S. Vice-Presidents Elect—The Right Hon. the Earl of Ducie, F.R.S.; the Right Hon. Sir Stafford Northcote, Bart., F.R.S.; the Mayor of Bristol; Major-General Sir Henry C. Rawlinson, F.R.S.; Dr. W. B. Carpenter, F.R.S.; W. Sanders, F.R.S. General Secretaries—Capt. Douglas Galton, F.R.S.; Dr. Michael Foster, F.R.S. Assistant General Secretary—George Griffith, F.C.S. General Treasurer—Prof. A. W. Williamson, F.R.S. Local Secretaries — W. Lant Carpenter, F.C.S.; John H. Clarke. Local Treasurer—Proctor Baker.

The following are the presidents and secretaries of the sections:—

A. Mathematical and Physical Science.—President—Prof. Balfour Stewart, F.R.S. Secretaries—J. W. Glaisher, C. T. Hudson, J. Perry, G. F. Rodwell.

B. Chemical Science.—President—Prof. A. G. Vernon Harcourt, F.R.S. Secretaries—Dr. H. E. Armstrong, W. Chandler Roberts, F.R.S., W. A. Tilden.

C. Geology.—President—Dr. T. Wright, F.R.S.E., F.G.S. Secretaries—L. C. Miall, E. B. Tawney, W. Topley.

D. Biology.—President—P. L. Sclater, F.R.S. Secretaries—E. R. Alston, Prof. W. R. M'Nab, F. W. Rudler, Dr. P. H. Pye Smith, Dr. W. Spencer.

E. Geography.—President—Major-General Strachey, F.R.S. Secretaries—H. W. Bates, E. C. Rye, F. F. Tuckett.

F. Economic Science and Statistics.—President—James Heywood, F.R.S. Secretaries—F. P. Fellowes, T. G. P. Hallett, E. Macrory.

G. Mechanical Science.—President—William Froude, F.R.S. Secretaries—W. R. Browne, H. M. Brunel, J. G. Gamble, J. N. Shoolbred.

The President's Address will be delivered on Wednesday, August 25, at 8 p.m. On Thursday evening there will be a *soirée*. On Friday evening, at half-past 8, Mr. Spottiswoode will discourse on "The Colours of Polarised Light." On Saturday evening Dr. Carpenter will lecture to working men on "A Piece of Limestone." On Monday evening, the 30th inst., Mr. Bramwell will lecture on "Railway Safety Appliances." On Tuesday evening a second *soirée* will be held, and on Wednesday, September 1st, the concluding General Meeting will be held.

THE LIBRARY.

The following works have been presented to the Library:—

Minutes of the Proceedings of the Institution of Civil Engineers. Vol. 40. Presented by the Institution.

Map of the Colony of New South Wales. Presented by the proprietors of the *Sydney Mail*.

Twenty-second Report of the Science and Art Department. (Two copies.) Presented by the Department.

State Savings; a scheme of universal competency. By R. Moore James. Presented by the author.

Key to the Life and Salvage Chart of the Cornish Coast. Arranged and compiled by Samuel Higgs, F.G.S.

Statistical Register of the Colony of Victoria for 1874. Parts 1 to 3.

Report of the Conference of Government Statists, held in Tasmania, January, 1875.

Seventh and Eighth Report of the Royal Commission on Scientific Instruction and the Advancement of Science.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fifth lecture of the course of Cantor Lectures on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft," by the Rev. Arthur Rigg, M.A., was delivered on March 8th, 1875, as follows:—

Lecture V.

On Tools with Cutting Edges.

Tools with cutting edges are not only numerous and varied in form, but they are also varied in the purposes for which they are formed, and in the mode of using. Hence no very precise statement of what is generally meant by a "cutting edge" can well be given. Three classes, however, of such tools may be marked out, and into one or other of these it is probable all those tools which can properly be defined as tools with cutting edges may be arranged.

A first class will comprehend tools which meeting the work at a particular angle continue the path of each portion of the edge in the same straight line. Axes, adzes, gouges, chisels, and planes (as ordinarily used by carpenters) belong to this class. Such tools are brought into action either by impact or by direct thrust. The adaptation of machinery to tools in this class is easy, because the cutting edge has to describe only a straight line, and this done once, if the place of application be removed, a repetition of impact or thrust in the same direction will suffice.

A second class will comprehend tools which, whilst as a rule retaining the angle at which they are applied to the work, the path of any portion of the tool is not a straight but a curved line. Tools of class 2 are seldom acted upon by direct impact, or simple thrust. To adapt them to machine work requires either a compound motion in the tool, or a motion compounded of the tool and work. When used as handicraft tools, this compound motion is derived from the muscular actions of the body of the workman, or the mechanical contrivances of construction in the tool. Knives, shears, razors, and saws belong to this class. And to this class belong those tools in which what are mechanical contrivances for causing a "draw cut" is introduced, *e.g.*, certain garden and pruning shears, also, hay and bread-cutting knives. There is a motion in the human jaws which gives to the cutting teeth this "draw cut," and so they separate what is between them as draw cut scissors might do. Indeed, all tools in this class operate most efficiently when acting upon the "draw-cut" system.

Hence, whilst certain of the human teeth belong to class 1, others belong to class 2. The contrivance in the jointing of the lower jaw to the upper in man is a compound one, adapting itself to three motions, one or other of which is found in many tools. There is up and down motion, enabling certain of the teeth to cut meat as nippers do. There is also a backward and forward motion, producing a saw or file-like operation, and there is a lateral or side motion, producing such a result as that of grinding. It is probable that from observation on the action of the teeth, the "draw cut," so essential to the perfection of tools that really *cut*, has been suggested.

Class 3 will comprehend those tools in which rotation is more usual than rectilineal motion. The tools in this class are constructed on principles allied to those in the two former classes. All drilling and boring tools belong to this class.

The action of tools with cutting edges in class 1, being the most simple, had better be first considered. As axes and adzes belong to this class, and as the structure of habitations probably led our ancestors to the formation of tools, doubtless that form of cutting instrument which most commended itself to these primitive artificers would be the first to be constructed. Passing by the very early form, we may commence with a consideration of the edge of the axe or adze, when that edge became part of a constructed implement and not a mere piece of sharp edged flint. The construction essential to the tool is a handle, or, as it is called a "helve." The shape of this helve, and the mode in which the head or metal of the axe is attached to it, are well worthy of some preliminary attention.

Perhaps here may be drawn the distinction between narrow and broad axes and hatchets. Axes are tools to be used with both hands; they have long handles, and may be swung as sledge hammers. Hatchets are to be used with one hand, have short handles, they are much lighter and thinner than axes, and are employed more in the trimming than in the hewing of timber. Both narrow and broad axes are employed in forestry, the woodman's choice being affected by the size of the timber and the character of the fibre. A hatchet is handled with the centre of gravity nearer the cutting edge than the line of the handle; an axe with the centre of gravity in the line of handle produced. Of this, however, more hereafter.

The mode of attaching a handle to anaxe in the bronze age is very instructive to us. The illustrations in the room are suggestive enough, and need only a passing remark. It will be observed that for the purpose of handling, some of these axes are socketed, others wedge-pointed. The socketed ones were evidently handled as we handle socketed chisels. There is, however, one peculiarity, and that worthy of consideration. These bronze hatchets have in many instances a semi-

circular, ring-like projection, see Figs. 47 and 48, the object of which was for a long time a puzzle, but the suggested mode of handling the implements, if correct as seen in the diagram, points to a knowledge of directions of tension and of pressure, which engineers at the present day cannot but admire. If any one has ever struck a common hatchet to any great depth into timber, and carelessly endeavoured to loosen it by raising the extremity of the handle, he may have found the handle separate from the metal near the junction of the two. Now the withy, or lashing shown in this bronze instrument, has been put as we should put it at the present day, in order to strengthen the connection at this, the weakest part.

Figs. 46, 47, 48, are examples of the modes of handling these ancient bronze hatchets. Fig. 46 is the most primitive. Fig. 47 and Fig. 48 illus-

Fig. 46.

Fig. 47.

Fig. 48.

trate the mode adopted to strengthen by tension cords the weakest part of the handle. A remnant of this tension cord is probably seen in the increased depth now given to the handle, where it enters the eye. It will be noticed that Fig. 48 is socketed as a carpenter's heavy mortising chisel. The commendable pride of these pre-historic workmen in the beauty of their tools may be inferred from the ornamentation of these bronze axe blades.

When we pass from the tool and its contrived handle to the mode of using, and the purpose for which it has been constructed, we find, as a rule, a cutting edge formed by two inclined surfaces meeting at an angle, the bisecting line of which passes through the middle of the metal. It is very apparent that the more acute this angle is, the greater, under the same impact, will be the penetrative power of the axe into the material against which it is driven. This supposition very soon needs to be qualified, for suppose the material offers a great resistance to the entrance of the edge, then the effect of the blow, upon the principle that action and re-action are equal, will re-act upon the edge, and the weakest, either edge of axe or object struck, must yield. Here then primitive experience would be obliged to qualify the simple tool in which the edge was keen and acute, and would naturally sacrifice the keenness and acuteness to strength.

When early uses of the axe are considered, it will be noticed that even in fashioning with an axe or adze the same piece of wood, different conditions of edge are requisite. If the blow be given in the direction of the fibre, resistance to entrance of the edge is much less than in the blow across the fibre. So great, indeed, may this difference become, that whilst the axe in class 1 seems in all respects a suitable tool, yet as the attention of the workman passes to directions inclined to the fibre at an angle of more than 45°, he will be induced to lay aside the tools in class 1, and try those in class 2; for he will have found that while in the one direction of the wood the edge of his axe continues sound and efficient, yet a few blows on the same timber at right angles to this direction has seriously damaged the perfection of the edge, whatever may be the angle at which the faces meet which constituted the edge.

These remarks apply only to tools used in dividing materials, and not to tools used in preparation of surfaces of materials. This preliminary consideration prepares us for the different circumstances under which these two classes of tools may be respectively used. And as the contrast of the effect of the same tool under different circumstances in the same substance is considerably great, also, is likely to be the contrast between the edges of the tools and the manner of using them, *e.g.*, the axe, which is the proper tool in the direction of the fibre, is operated upon by impact, whilst a saw, which is the proper tool across the fibre, is operated upon by tension or thrust, but never by impact.

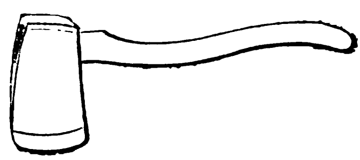
The mode in which the axe is used will explain why it is unsuited for work across the fibre. The axe is simply a wedge, and therefore arranged to cleave, rather than to cut, the wood. Now a calculation of the pressure necessary to thrust forward a wedge, and the impact necessary to cause the same wedge to enter the same depth, would explain (as in the lecture on Hammers) why (regarded as a wedge only) the handle proves an important adjunct to the arm of the workman. Anyone may test this by using an ordinary-handled hatchet on a soft straight-grained wood, or he may take a small axe with a straight and not a curved edge; let it rest upon a lump of moderately soft clay. Add weights until it has sunk to any decided depth, then take the axe by the head, and by pressure force the edge to the same depth. Next hold the axe by the handle, first at, say, a foot from the head, then at two feet, then, perhaps, at three feet, and give blows which seem of equal intensity, and mark the depth. Thus practical testimony to the value of a handle will be borne by the respective depths.

A few words about the motion of the hands and the handle they grasp; and then a consideration of the curves given to the cutting edges of axes, adzes, &c.; also to the wedge-like sections of the edges. These will be all that can now be considered.

The motions of the hands on the handle of an axe are similar to those of a workman on that of the sledge hammer. The handle of a properly handled axe is curved, that of a sledge hammer is straight. For present consideration this curvature may be overlooked, although it plays an important part in the using of an axe with success and ease. If the almost unconscious motions of a workman skilled in the use of an axe be observed, it will be noticed that whilst the hand furthest from the axe-head grasps the handle at the same or nearly the same part, the other hand, or the one nearest to the head, frequently moves. Let us follow these motions and consider the effect of them. The axe has just been brought down with a blow and entered between the fibres of the wood. In this position it may be regarded as wedged in the wood, held in fact by the pressure of the fibres against the sides of the axe. From this fixity it must be released, and this is usually done by action on or near the head. For this purpose the workman slides his hand along the handle, and availing himself (if need be) of the oval form of the handle after it has passed through the eye of the metal, he releases the head. The instrument has now to be raised to an elevation; for this purpose his hand remains near to the head, so causing the length of the path of his hand and that of the axe-head to be nearly the same. The effect of this is to require but a minimum of power to be exerted by the muscles in raising the axe; whereas if the hand had remained near the end of the handle most distant from the head, then the raising of the axe-head would have been done at what is called a mechanical disadvantage. Indeed, if a workman will notice the position of the hand (which does not slide along the handle) before and after the blow has been given, he will find that its travel has been very small indeed. Remembering that the power exerted to raise a body is in the inverse ratio of the spaces passed through by the body, and the point of application of the power, it may thus be obvious how great a strain will be on the muscles if the axe-head be raised by the hands at the opposite extremity of the handle. Reverse the problem. Take the axe-head as raised to such an elevation as to cause the handle to be vertical (we are dealing with ordinary axes, the handles being in the plane of the axe blade). Now the left hand is at the extremity of the handle, the right hand is very near to the axe-head—the blow is about to be given. The requirement in this case is that there should be concentrated at the axe-head all the force or power possible; hence to ease the descent would be as injudicious as to intensify the weight of the lift. Consequently, whilst with the hand nearest to the head (as it is when the axe reaches its highest elevation) the workman momentarily forces forward the axe, availing himself of the leverage now formed by regarding the left hand as the fulcrum of motion, he gives an impulse, and this impelling force is continued until an involuntary consciousness assures him that the descending speed of the axe is in excess of any velocity that muscular efforts can maintain. To permit gravity to have free play, the workman withdraws the hand nearest to the head, and sliding it along the handle, brings it close to the left hand, which is at the extremity of the handle; thus the head comes down upon the work with all the energy which a combination of muscular action and gravity can effect. The process is repeated by the right hand sliding along the handle, and releasing as well as raising the head.

The form of the axe handle deserves notice, differing as it does from that of the sledge hammer. In the latter it is round or nearly so, in the axe it is oval, the narrow end of the oval being on the side towards the edge of the axe, and more than this the longer axis of the oval increases as the handle approaches the head, till at its entrance into the head it may be double what it is at the other extremity. It often has also a projection at the extremity of the handle. The increasing thickness near the head not only gives strength where needed, as the axe is being driven in, but it also supplies that for which our ancestors employed the thongs as illustrated in Figs. 47 and 48. There is, too, this further difference —in a sledge hammer more or less recoil has to be provided for, and the handle does this; in the axe no recoil ought to take place. The entrance of the axe edge is, or ought to be, sufficient to retain it, and the whole of the energy resulting from muscular action and gravity should be utilised.

Fig. 49.



The curvature, too, of the handle is in marked contrast with the straight line of the sledge hammer handle. The object of this curvature is worthy of note. In my hand is an American forester's axe. The handle is very long and curved. If laying the axe handle across my finger where the head and handle balance, I place the blade of the axe horizontal, you may notice that the edge does not turn downwards, in fact the centre of gravity of the axe-head is in the horizontal straight line prolongation of the handle through the place where my finger is. Now in sledge hammer work the face is to be brought down flat, *i.e.*, as a rule, in a horizontal plane. Not so with the forester's axe, it has to be brought down at varying obliquities. If now the hewer's hand had to be counteracting the influence of gravity, there would be added to him very needless labour, hence the care of a skilled forester in the balance of the axe-head and the curvature of the handle.

We must now consider the form of the cutting edge as seen in the side of the axe. It is often convex. The line across the face in Fig. 50 indicates the extent of the steel, and the corresponding line in Fig. 51 the bevel of the cleaving edge. It will be noticed that the cutting edge in each case is curved. The object of this is to prevent not only the jar and damage which might be done by the too sudden stoppage of the rapid motion of the

heavy head in separating a group of fibres, but also to facilitate that separation by attacking these fibres in succession. For, assuming the axe falls

Fig. 50.

Fig. 51.

square on its work in the direction of the fibres, a convex edge will first separate two fibres, and in so doing will have released a portion of the bond which held adjoining fibres. An edge thus convex, progressing at each side of the convexity which first strikes the wood facilitates the entrance of successive portions from the middle outwards. If the edge had been straight and fallen parallel to itself upon the end of the wood, none of this preliminary preparation would have taken place; on the contrary, in all probability there would have been in some parts a progressive condensation of fibres, and to that extent an increase in the difficulty of the work.

The equally inclined sides of the wedge-form of edge hitherto alone described as belonging to axes, and the equal pressure this form necessarily exerts upon each side if a blow is given in the plane of the axe, suggest what will be the action of an axe if the angle of the wedge is not bisected by the middle line of the metal. Assume that one face only is inclined, and that the plane of the other is continuous to the edge, then let the blow be struck as before. It will be obvious that the plane in the line of the fibres cannot cause any separation of these fibres, but the slope entering the wood will separate the fibres on its own side. Supposing a hatchet sharpened as previously described, and one as now described, are to be applied to the same work —viz., the cutting from a solid block the outside irregularities—say to chop the projecting edges from a square log and to prepare it for the lathe. It may be briefly stated that the hatchet described in the second case would do the work with greater ease to the workman, and with a higher finish than the ordinary equally inclined sides of the edge of the common hatchet. Coachmakers have

Fig. 52.

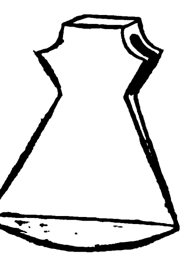
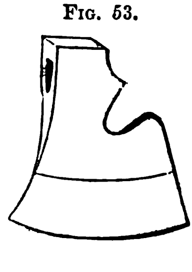


Fig. 53.



much of this class of hatchet-paring work to do, and the tool they use is shaped as in Fig. 53. The edge is bevelled on one side only, and under

Fig. 54.

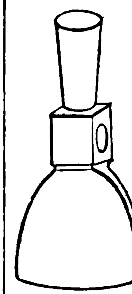
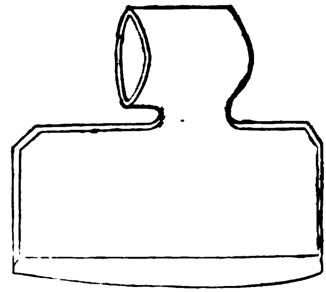


Fig. 55.



where the handle enters the eye, may be noticed a piece rising towards the handle; on this the finger of the workman rests in order to steady the blade in its entrance into the timber in the plane of the straight part of the blade, and to counteract the tendency of the wedge side pressing the hatchet out of its true plane.

On Adzes.

Those whose business requires the forming of lengths of wood into curved shapes, and who rely upon the adze for the preliminary operation, use an Indian form of adze. In India it is held so near the metal that the workman's hand touches the metal. He accomplishes blows chiefly by acting from the elbow. This very general mode of holding gives a pretty uniform length to the radius of the swing, hence the form of the adze in the plane of the swing is nearly that of the circle described. The diagrams on the wall plainly shew the tool and the posture of the workman. The angle of the handle and the adze is very much the same as that of the handle of the file-maker's hammer and the head.

The Two-handed Adze.

When we look at the adze as used by English wheelwrights or shipwrights, we may well shudder to see how it is handled, especially when the cutting edge is taken into account. The operation, briefly described, is the following:—The workman stands with one foot upon the wood, this foot being in the line of the fibre. He thus assists in steadying (say) the felloe of a wheel. From this felloe much of the wood on which the sole of his shoe rests has to be removed. It will be noticed that the long handle of the adze is curved—the object of this is to permit an efficient blow to be given, and the instrument brought to a stop before the handle strikes any part of the workman's body; in fact, caused to stop by the exhaustion of its impact energy in and amongst the fibres of wood to be separated. The edge is often so keen as to cut through a horse-hair held at one end and pressed against it.

This instrument is raised by both hands until nearly in a horizontal position, and then not simply allowed to fall, but steadily driven downwards until the curved metal, with its broad and sharp edge, enters near to, if not below the sole of

the workman's shoe, separating a large flake of wood from the mass; the handle is rapidly raised, and the blows repeated. This is done with frequency, the workman gradually receding his foot until the end flakes of wood are separated. It is fearful to contemplate an error of judgment or an unsteady blow. William Tell and the apple on his son's head are, in another form, here repeated.

So skilled do men become in thus using the adze, that some will undertake, with any pre-determined stroke in a series, to split their shoe sole in two.

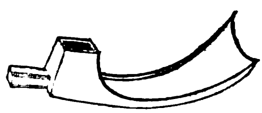
Curvature of Adze.

Clearly the adze must be sharpened from the inside, and when the action of it is considered, it is also clear that the curvature of the adze-iron must be circular, or nearly so.

The true curvature of the metal may be approximately deduced from considering the radius of the circle described by the workman's arms, and the handle of the adze.

Fig. 56.

Fig. 57.



The edge of the adze is convex (Fig. 56), the projection in the middle being so formed for the same reasons as influenced the curvature of the edge of the axe already alluded to.

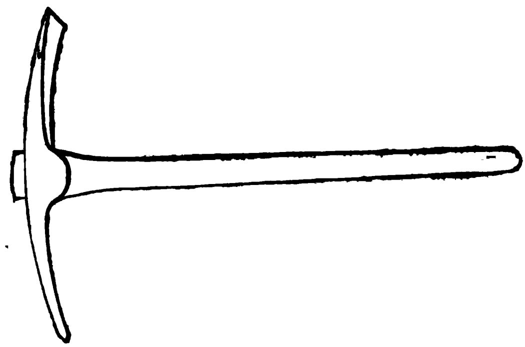
The curvature in the blade also serves (though partially) as a fulcrum, for, by slightly thrusting the handle from him, the workman may release such flakes of timber as are over the adze, and yet so slighly adherent as not to require another blow. Thus the adze when applied lever-fashion discharges its duty as the curvature in the claw of a hammer does. Fig. 57 is a gouge formed adze; a modification of this is used in making wooden spouts, and similar hollow work.

Many of the remarks applied to axes and adzes, also apply to pick-axes. It may suffice to refer to two forms of this tool; they differ not so much in the operative points, as in the size and distribution of the material.

The one used by paviours is long and light, and of large curvature; the other, used by stone-masons and quarrymen, is short-handled and heavy, much material being concentrated in the head. There is also another form of this instrument used on kegs, for the purpose of driving home the wooden wedges; in this form there is no point, the tool is rather that of an elongated hammer, the ends being provided with "panes" of different forms, set off at different angles. Such tools may properly be consigned to the class of hammers.

The paviour's, the mason's, and the quarryman's picks are the three to be very briefly considered. The first is properly a lever, and no more; its pointed end is for entrance between stones, and then the wooden handle, and the unemployed elevated arm of the pick, are used as two lever

Fig. 58.



arms at right angles to each other, thus motion can be had in two planes for the varying character of the paviour's work.

Such an employment is never allotted to the stone-mason's pick. The object of this is to remove chippings from stone much as the single angled edge of an axe or an adze would do with chips from timber. It is, however, pointed and not edged, because stones are not fibrous. The weight of the iron head corresponds exactly with that of a heavy hammer, and so far as this particular feature is concerned, the considerations in relation to hammers apply.

There are peculiarities in reference to the points of these tools. The whole of the energy of the workmen is expended upon one point (in the carpenter's axe or the wheelwright's adze this energy is distributed over an edge from four to eight inches in length), hence the rapid wear of this point, and the necessity not of frequent grinding, but of frequent re-forging and re-tempering. Any attempt at grinding up these points would be practically unsuccessful, made as these picks usually are, because of the mass of metal required to give that penetration resulting from the sudden stoppage of heavy weights. The ordinary picks are therefore sent to the smith's to be sharpened. For this purpose they must be removed from the handle; and this has suggested forms of eye and handle which might with advantage be used with some other tools.

The axes and adzes hitherto considered have been chiefly regarded as tools for the greatest amount of heavy work to be accomplished by a workman. They are at one extreme of the scale, the other extreme being the removal of such small flakes as to become shavings of varying thickness. In progressing from great to small the order would be from the axe or adze, with its weighted head, to a separation of the cutting edge and its necessary metal, and the weight which must give the blow. Hence, in this descending scale, we reach the chisel, struck by a mallet.

The chisel in its most simple form is as a slice of an axe, but as the impact is not from the motion of the chisel, but from that of a swung mallet or hammer, the eye of the axe must give way to the contrivance for receiving the blow. When the element of thrust enters then the chisel is passing

into the "plane iron." Beside the mushroom form of head made in the metal of the stonemason's chisel, two contrivances are in general use in England. One is to put a tang on the metal of the chisel, and to let this be driven into a handle so shaped at the extremity as to receive the blow of a mallet. A very few blows would soon drive the handle forward, and so the tang end would soon project through the handle and receive the blows. To avert this a shoulder is forged, where the tang is supposed to end, and the chisel proper to begin. When the blows have been repeated, so that the handle rests upon the tang shoulder, then the handle is "home," and the tool completed. In the turner's chisels, where mallets are not used, the shouldered tang is not required. The plan thus described is not, however, the way in which handles are put on tang-ended chisels.

Assume that a suitable handle has been formed—and what constitutes a suitable handle is worthy of consideration—assume too that a ferrule has been suitably placed on the handle, not, however, driven on, but left somewhat loosely—assume, too, that a hole has been bored down the handle and a little shallower than the length of the tang—assume, too, that the hole has been widened at its mouth so as to show a square, the sides of which are just shorter than those of the tang under the ferrule—now, enter the chisel-tang, and let it be pressed in by the hand until it is so retained by friction, that by pointing the chisel edge downwards, the metal does not fall out. The operation of fixing the handle may now be said to commence. The line of the handle and blade is then inclined at about an angle of 45° to the horizon. A blow with a mallet is struck at the end of the handle: the inclination remaining the same, the tool is turned round its longitudinal axis, say, one-fourth of a rotation, another blow given; the operation of turning and striking being continued until the ferruled end of the handle and tang meet.

As to the effects of a blow upon the end of a handle, there being no apparent resistance. This takes place: The velocity of impact is communicated to the handle and chisel. Now, as may be noticed in the case of a horse commencing to draw a carriage, the greatest effort is required to cause the first motion, so here a high velocity in the mallet has to be divided between a supported tool and itself. What is sometimes called "inertia" has to be overcome in the act of this transference of velocity through the length of the handle and chisel; that portion which offers the least resistance will be the first to move. As with a cord, no strength can stretch it into a straight line, so with this so-called "inertia," no velocity can be communicated to a body at rest without what is usually called resistance. The friction between the tang and the handle is so adjusted by the preliminary formation of the hole, that the resistance from the friction is less than the resistance from inertia; hence the gradual approach of the ferrule and the flange.

Now as to the turning in the hand about the axial line. The wooden handle is held in the left hand, therefore the effect of gravity upon it is neutralised. Not so with the chisel; gravity produces its full effect upon this. What is the consequence? Some part or other of the hole becomes a fulcrum, the cutting end of the chisel is drawn downwards by gravity, and therefore the tang end is pointed upwards. Continued impact in this position would place the chisel oblique to the axis of the handle; the turning is to avert this. Again, it was said that the depth of the hole should be less than the length of the tang. The reason is this: the end of the hole is of greater diameter than the end of the the tang; if, therefore, the tang does

Fig. 59.

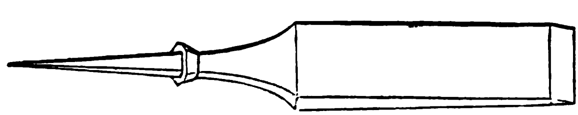
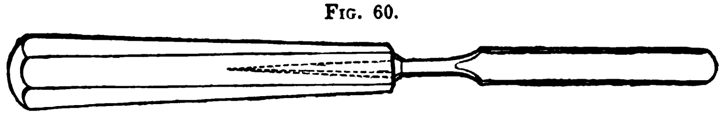


Fig. 60.



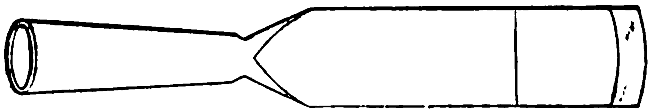
not enter and fix itself in the wood, there may be unsteadiness in the chisel.

Again assume the instrument to be under the operation of repeated blows, the effect of these will be first expended upon the end of the wooden handle, and then transmitted to the cutting edge. Unless provision be made, the destruction of the end of the wooden handle will be assured. To diminish as much as possible liabilities to such a result, the end of the handle is formed as a portion of a sphere, Fig. 60. Further, the impact blow is modified in the mallet, which is of wood, with a curvilinear face; thus these two wooden surfaces act and re-act upon each other. The yielding elasticity of the wood also gives to the blow and so transmits to the work a different effect to that which would take place if the handle and chisel were of iron, as is the case with those used by workers in the metals. In these the blows being struck by a metal hammer the chisel heads are neither wooden, as with the carpenter, nor mushroom shaped, as with the stonemason.

There is another mode of attaching the handle to the metal, viz., the forging on the chisel of a coned socket, into which the wooden handle is inserted, Fig. 61. This is the best plan when the instrument is to be subjected to heavy blows, because the wooden handle is blow by blow more solidified, and to some extent the fibres of the wood are condensed into this cone, and remain available

uch longer than upon the tang scheme. The tter, however, adds to the lightness and economy f the tool, and may be considered as most suitable for chisels when used in a way furthest removed from the usages of hatchets. This way will be when the work is so light that impact gives

Fig. 61.



lace to a thrust. Cutting edges, however, are ometimes doubled, and then the chisel form passes to the group of tools in class 2. The most common of these is the ordinary household scissors opened and closed by hand; when required for heavier work, then one handle is fixed in a vice, and both hands

Fig. 62.

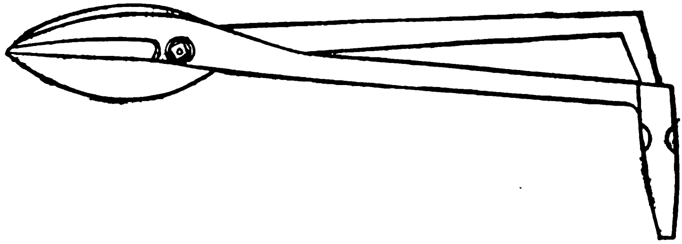
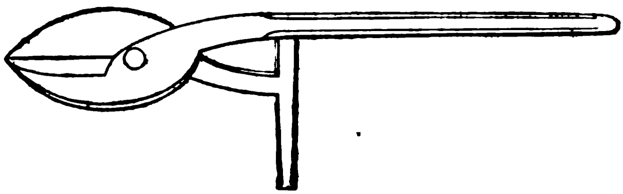
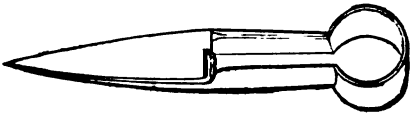


Fig. 63.



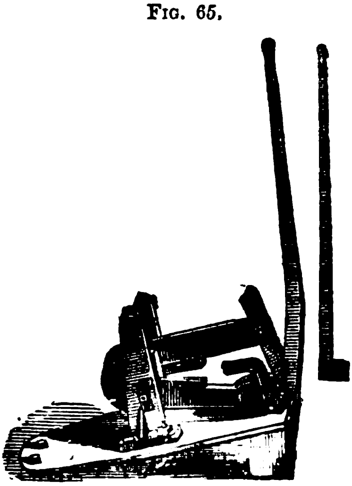
n be employed upon the other lengthened arm, see ig. 62 and Fig. 63. At other times this double

Fig. 64.



hisel opens with a spring, and then the workmen ly employs himself in closing such upon their

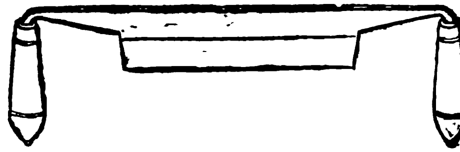
Fig. 65.



work, Fig. 64. Compound lever power is sometimes introduced, and as an example of this, here is a pair of very light shears called the "little giant," the mechanical contrivances in which are so adjusted that we can, smoothly and without jar, cut an iron rod 1-inch wide by ¼-inch thick. The lightness of the tool and the ease in cutting are very noticeable. It is an American contrivance, and the bar of iron is cut with the same ease as though it were of lead. This results to some extent from both jaws approaching each other. The arrangement of levers, cams, and stays is worthy of examination after the lecture.

The use of the chisel, however skilfully handled, is not satisfactory over a surface wider than itself, although widened and made two-handed, as Fig. 66,

Fig. 66.



and although the gouge has succeeded, or rather been planned to precede it, there is still a tendency almost unconquerable for the tool to follow the leadings of the fibres rather than cut through them at a very slight obliquity.

The only guidance either the axe, the adze, the pick, the gouge, or the chisel receive, is from the skill of the workman. Hence these tools produce such different work in different hands. However much it may be desirable to encourage skill in the

workman, it is quite as desirable to furnish him with implements which shall make the least demand upon the exercise of this skill, which shall, in fact, so assist the skill in one or more directions as to permit all its care in some other direction. The assistance which the chisel needs is such as shall not only prevent it running deeper into the timber than is desired, but shall enable it to be used with equal facility upon a broad as upon a narrow surface.

Given a rough piece of timber, 9 in. wide and 5ft. long, to be smoothed by tools guided only by the handicraft skill of the workman, setting aside the adze as dangerous and unsuitable, the probability is that the tools selected would be gouges and chisels of various breadths and curvatures. The order of use would probably be, first, the narrow and deeply-curved gouges, ⌣, these to be followed by the shallower A ⌣ B and broader, these again to be followed by the chisels, using in the first place a chisel wider than A B.

Let us consider what these tools would respectively accomplish. The timber is rough, as from the axe or pit-saw. The small gouge would corrugate the surface ⌣⌣⌣⌣, the second gouge would enlarge the corrugation to this ⌣⌣⌣⌣, and the chisel might render these more irregular. Such considerations as these, combined, doubtless, with others, led to the designing of what may be generally called the "guide principle," and this has been extended to various branches of artisan labour. At present we are only concerned with the application of this principle to gouges and chisels. This guide principle may consist of a guide as to the depth of cut, or as to the form of the surface, or as to the direction of travel, or as to the correction of cross or longitudinal irregularities of surface.

The depth of cut is that which probably first presented itself as an important appendage to a chisel, and it has led to a form of tool of a very useful construction, although of limited range. The instrument is called a "spoke-shave." In this case the tool is that in Fig. 66 with the guide principle introduced, the depth of cut being determined by the nearness of the edge to a parallel wooden handle.

This tool, owing to the position of the application of the power, viz., the hands, and the tendency of resistance by the work to turn the whole tool in the hand, is not of general use; where, however, the curvature of surface varies, the parings to be removed are light, and the workman can have convenient access, the tool is one capable of doing good work, and, in some respects, possesses advantages over the plane, to which it probably formed an introduction.

The plane, in its most simple form, consists of a chisel inserted at an angle into a box, generally of wood, and with the cutting edge of the chisel projecting through the bottom of the box. If the actions of a workman be noted as he is smoothing wood with a chisel alone, it will be seen that he holds the bevel edge on the wood, and so elevates or lowers the handle as to secure a proper and efficient cut. Then he advances the tool in a line at right angles to its cross section. If, now, instead of thus continuing to hold the tool, the chisel was so fixed in a moveable piece of wood as to be at the same angle as the workman required, then, if the mouth were broad enough, and the instrument were propelled along the wood, a shaving would be removed very nearly the same as that obtained from the chisel alone.

In the arrangement thus sketched the workman would be relieved from the care needed to keep the tool at a constant angle with the surface of the timber. There is, however, a fixity of tool lost, and consequently an optional or needful adjustment called for by any varying condition of the problem cannot be had. When operated upon by hand alone, if an obstacle to the progress of the tool is presented, as, for instance, a twist or curl in the fibre or grain of the plank—the presence of a knot—then the workman by hand can adjust the handle, and so vary the inclination of the cutting edge as the circumstances of the case require. Not so if the tool is securely fixed in a box as described.

Whilst therefore one gain has been had, one loss has been encountered. Can the gain be made to more than counterbalance the loss? This can only be answered by observing the defects of the primary plane, as hitherto described, and noting what hopeful elements it contains.

1st. The front of the sole of the box will clearly prevent the penetration of the encased chisel into the wood, because it cannot now be drawn to follow the fibre should it lead inwards. Suppose, however, that in the progress of the work such a place has been reached as would have so drawn the chisel inwards. What will happen? Either the strength of the indrawing fibre will be so great that the workman will be unable to propel the tool, or 2nd, if not thus impeded, he must by extra effort separate the fibre and so release the tool. This separation, however, will not be by the process of cutting, but by that of tearing, and shavings so torn off will have left their marks in the roughnesses which attend the tearing asunder of fibrous woods. Thus the tool will defeat the very purpose for which it was designed.

To obviate the difficulty described has exercised much ingenuity, and led to more than one contrivance in planes as generally used.

Now what is it which so forcibly draws, or tends to draw, the tool downwards below the surface of the timber? The forces in operation are the hand of the workman and the tenacity of the fibre. If the tenacity is greater than the power, the workman must stop. That the tool cannot follow the direction of the fibre is clear, because the front part of the wooden sole forbids the penetration; but that it may be brought to a standstill, or must tear off the fibre, is also very clear. The mechanician has therefore to consider how to defeat the tendencies which, as now sketched, result from collision between the indrawing strength of the fibre and the power of the man to cross cut the fibre by the tool, or else to tear it asunder and leave the surface rough.

It will be seen, when we come to treat of the tools in class 2 (saws, &c.), that the chisel either in its unframed or framed state is not adapted to the cross cutting of fibres. Let us, therefore, for the present, assume that this is the case returning to it hereafter.

Since the tool, as now contrived, cannot efficiently cross cut the resisting fibre, and since the fibre has to be removed, the object must be either

to prevent such an accumulation of fibres as will stop the progress of the tool, or to destroy the fibre piece-meal as it is operative for hindrance. Both plans have been adopted. A consideration of the former may prove introductory to the latter which appears in almost all attempts to perfect this tool and its appended contrivance.

As the tool progresses, and the fibres become more and more impeding, it will be clear that a portion of this impediment results from a condensation of the fibre in the mouth of the wooden box. The more numerous the fibres admitted here, the greater will be the condensation. This state of affairs can be partially obviated by a narrowing of the mouth of the plane; such an act of course requires that the introduced chisel should enter less deeply into the timber being operated upon. Although thus abated the cause is not removed, and even if so far abated as to prove no real impediment to the workman, yet the quantity of material removed on each occasion will be so small that the tool becomes one for finishing work only, and not for those various operations to which its present powers enable artisans to apply it.

To be the useful tool it is, the mouth must not be so narrowed, nor the inserted chisel so withdrawn that the shaving is thus the thinnest possible. This led to a contrivance now almost universal, that of breaking the fibre so soon as it is separated from the piece of timber. The designer seems to have considered that as soon as a short length of shaving had been removed, it would be well to destroy the continuity of the fibre, and so prevent an accumulative resistance from this cause. Hence instead of allowing the cut-off fibres to slide up the inserted chisel, he bent them forward, in fact, cracked them, and so broke the cumulative indrawing force of them. This he accomplished by the use of what is now called the back iron, and from henceforth the boxed-in chisel loses its identity, and must be regarded as part of an independent tool.

The tool thus built up is called a plane, and from its general utility and capability of adaptation to various forms and conditions, it is well deserving of the high opinions entertained of its powers. Three forms of this tool are in general use in English worshops, called the "jack," the "trying," and the "smoothing" planes. These are on the bench of all workers in smooth straight surface wood. Although externally alike except in size, they are yet used for different purposes, and each has a speciality met with in its construction. These specialities may now be considered.

After the wood has passed from the sawyer into the hands of the carpenter, the surface undergoes those operations which render it true and smooth. These three planes do this work. The "jack," usually about fifteen inches long, and the "trying" plane, ranging from eighteen inches to twenty-four inches long but, in exceptional cases, far exceeding these dimensions, are to external appearances alike; indeed, some regard the different handles as the only distinctions between them, and that these handles show which must be used for rough work and which for smooth (see Fig. 69 as an example of the handle of a "jack plane," and Fig. 70 as an example of a "trying plane handle." This is an error. There are other differences, but the main and leading one is the different form given to the edge of the cutting iron.

If the iron of the "jack" plane be looked at from the front end of the plane, the form of the edge will be curved, as in Fig. 67; but the iron of the "trying" plane is straight, as in Fig 68. Upon the curvature of the edge depends the efficient action of the "jack."

Fig. 67.

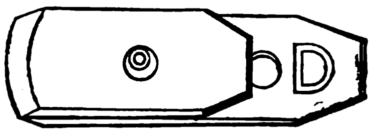


Fig. 68.

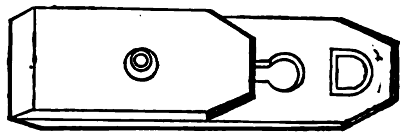
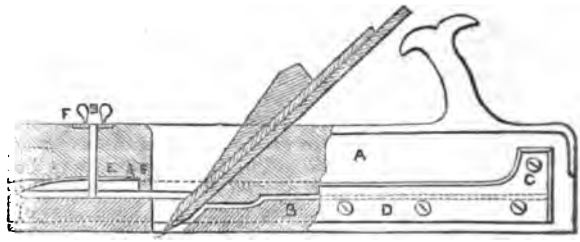


Fig. 69.



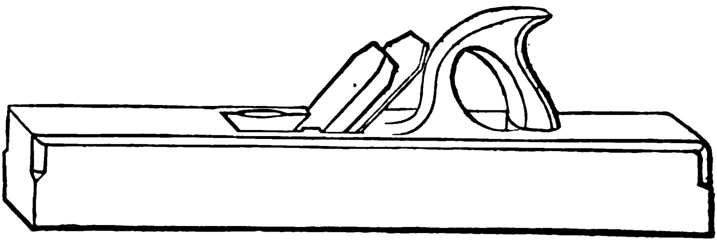
Sufficient has been said of the tendency of the fibre to draw the tool downwards; but it must not be forgotten that the same adhesion of fibre to fibre, takes place between the surface fibres as amongst those below the surface. If tools excluded from this course of lectures had entered, we should have found that these connecting surface fibres are separated by the addition of certain supplementary appendages to the tools. The depth to which the plane penetrates, has led to the combination in one edge of such supplementary parts.

For the purpose of separating the surface connected fibres, the jack iron is convex. Note now its action. The convex sharp edge is pushed along a horizontal plank, penetrating to a depth determined by the projection of each vertical section below the sole of the plane. The ends of this convex edge are actually within the box of the plane, consequently (sideways) all the fibres are separated by cutting, and are therefore smooth and not torn. The effect of this upon the entire surface is to change the surface from the original section to a section irregularly corrugated. The surface after using the "jack" is ploughed, as it were, with a series of valleys and separating hillocks, the valleys being arcs from the convexity of the tool and the separating hillocks being the intersection of these arcs. All traces of the tearing action of the saw have been removed, and from a roughened but level surface a change has been

made to a smooth but in cross-section an undulating one.

The mechanician's next object is to remove these lines of separation between the valleys. For this the trying-plane is required. The trying-plane is longer than the jack, because the sole of the plane which is level is, so far as its size goes, the counterpart of that which the surface of the wood is to be; further, the trying-plane should be broader than the jack, because its object is to remove the valleys and not to interfere with the wood below the bottoms of the valleys. If its action passes below the bottoms of the furrows, then occasion arises for cutting the side connection of the fibres, and however a workman may sharpen the edge of his trying-plane for this purpose, he in one respect has destroyed one object of the plane, because, so soon as the iron penetrates below the surface, so soon

FIG. 70.

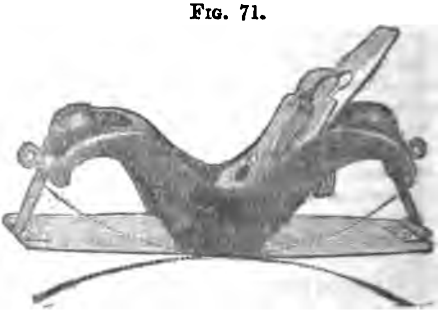


does the effect of the jack action begin to re-appear, and the cutting edge should pass from the shape shown in Fig. 68 to the shape in Fig. 67. The result of the trying-plane following the jack is to remove all the elevations of wood above the valleys the jack left; and secondly, to compensate by its great length for any want of lineal truth consequent upon the depth of bite of the jack. Again, the mouth of the trying-plane is much narrower than that of the jack; hence the shavings removed are finer, therefore the slope of of the iron, or its inclination to the wood may be less than is the iron of the "jack"—hence the line of cut is more nearly accordant with that of the fibre, and by so much the surface is left more smooth from the trying-plane than from the jack, as there is more cutting and less tearing action than in the jack. The reasoning hitherto pursued in reference to the purpose of this sequence of a jack and trying-plane might and does legitimately produce the conclusion that, after the trying-plane has done its duty, the work is as perfectly finished as it can be. Custom, and perhaps other considerations, have established that after the long trying-plane must follow the short and almost single-handed smoothing-plane. So far as the form of the iron of the smoothing-plane is concerned, there is no difference between it and the one used in the trying-plane; each (as across the plane) is straight, the corners being very slightly curved, but only so much as to ensure that they do not project below the line of the cutting edge.

The facet edge and inclination of the cutter to the work, and the position of the back iron are not now under consideration.

It would seem that, whilst the trying-plane levelled down all the elevations left by the jack, and brought the surface of the wood as a counterpart of that of the plane, there might be in the fibre, or grain of the wood, twists, curls, and other irregularities which, whilst levelled, were yet left rough in consequence of the direction in which the cutting edge came upon them. Indeed, this cutting edge, in a long plane, which must advance in the direction of its length, must at times come across a large number of surfaces where the fibre is in opposite directions. The consequence is that there will be various degrees of smoothness; for good work these must be brought to uniformity. This is effected by passing a short-soled plane over the respective parts of the surface in such directions as observation may suggest. Hence the smoothing plane is of use chiefly to compensate for such changes in the direction of the fibres of the wood as the longer length of the trying plane could not conveniently deal with. Hitherto we have regarded the plane as arranged with a "guide principle" which shall always repeat a straight level surface. The guide may however be the counterpart of any required surface. The plane made of iron, now in my hand, has an elastic steel sole which, by means of adjusting screws, enables a workman readily to convert a straight faced sole into one either concave or convex. This is an American production, see Fig. 71.

FIG. 71.



There is also in this and other planes a mode of fixing the iron which deserves more general adoption than it receives, viz., by a cam action. It will often be noticed that where the holding wedge binds on the box of the plane in our ordinary planes, the wood has split. This arises from a commendable, but, in this case, too strict a care for a good fit, hence the wedge is made tight where it should be slack.

On the table were many Austrian, French, and other planes, and the portion of the Lecture respecting these cannot be reproduced.

MISCELLANEOUS.

BRITISH ASSOCIATION.

The forty-fifth annual meeting began on Wednesday [cut off]t, August 25th, at Bristol, by the usual address from [cut off]e President, Sir John Hawkshaw, C.E., F.R.S.

Sir John Hawkshaw, in commencement, alluded to [cut off]e variety of topics which had formed the theme of [cut off]rmer addresses, and to the difficulty which there was [cut off] finding a subject at once suitable and new. After re[cut off]rring to the fact that the progress of each branch of [cut off]ience was sufficiently illustrated in the addresses of [cut off]e presidents of sections, he went on to say that he had [cut off]lected for himself the history of that pursuit with [cut off]hich he was principally connected—civil engineering. [cut off]he history of construction in its widest sense was then [cut off]ssed in review. In the earliest civilisations, those of [cut off]gypt and Assyria, there was much that showed a con[cut off]derable advance in the arts, indeed many inventions of [cut off]mparatively recent birth, were but re-discoveries of [cut off]ts known ages back. Some ancient knowledge yet re[cut off]ained to be re-discovered. The Egyptian knowledge [cut off] metallurgy, their power of raising and transferring [cut off]t weights were instanced, among other points, [cut off] examples. After a glance at the probable me[cut off]anical knowledge of the peoples of the East, as [cut off]own by their yet remaining works, the speaker passed [cut off] to classical times and history. Not much attention [cut off]s devoted to the engineering works of the Greeks, but [cut off] executed by the Romans were remarked on at [cut off]e length. Their roads, their aqueducts, bridges, [cut off]ths, &c., were specially alluded to. From this part of [cut off] subject, Sir John Hawkshaw proceeded rapidly on [cut off]rough mediæval times, noting the great engineering [cut off]rks of Holland in passing, to the period marked by [cut off] invention of the steam-engine. Here was the birth [cut off] the new era.

"Water-mills, wind-mills, and horse-machines were in [cut off]st cases superseded. Deep mines, before only acces[cut off]le by adits and water levels, could at once be reached [cut off]ith ease and economy. Lakes and fens which, but for [cut off] steam-engine, would have been left untouched, were [cut off]ined and cultivated.

"The slow and laborious toil of hands and fingers, [cut off] and sinew, was turned to other employments, [cut off]ere, aided by ingenious mechanical contrivances, the [cut off]duce of one pair of hands was multiplied a thousand[cut off]d, and their cunning extended until results mar[cut off]lous, if you consider them, were attained. Since the [cut off]e of Watt the steam-engine has exerted a power, [cut off]de conquests, and increased and multiplied the [cut off]terial interests of this globe to an extent which it is [cut off]rcely possible to realise.

"But while Watt has gained a world-wide, well[cut off]ned fame, the names of those men who have pro[cut off]ed the machines to utilise the energies of the steam[cut off]gine are too often forgotten. Of their inventions the [cut off]jority of mankind know little. They worked silently [cut off]home, in the mill, or in the factory, observed by few. [cut off]eed, in most cases these silent workers had no wish [cut off] expose their work to public gaze. Were it not so, the [cut off]tory and the mill are not places where people go to [cut off] the air. How long in the silent night the inven[cut off] of these machines sat and pondered; how often they [cut off] to cast aside some long-sought mechanical move[cut off]nt and seek another and a better arrangement of [cut off]ts, none but themselves could ever know. They were [cut off]en workers, who succeeded by rare genius, long [cut off]ience, and indomitable perseverance.

* * * *

"For complex ingenuity few machines will compare [cut off]h those used in the manufacture of lace and bobbin net. Hammond, in 1768, attempted to adapt the stocking frame to this manufacture, which had hitherto been conducted by hand. It remained for John Heathcoat to complete the adaptation in 1802, and to revolutionise this branch of industry, reducing the cost of its produce to one-fortieth of what the cost had been before Heathcoat's improvements were effected.

"Most of the ingenious machines were in use before Watt's genius gave the world a new motive power in the steam-engine; and, had the steam-engine never been perfected, they would still have enormously increased the productive power of mankind. Water power was applied to many of them; in the first silk-thread mill erected at Derby in 1738, 318 million yards of silk thread were spun daily with one water-wheel.

"These are happier times for inventors: keen competition among manufacturers does not let a good invention lie idle now. That which was rejected by old machines as waste is now worked up into useful fabrics by new ones. From all parts of the world new products come—jute from India, flax from New Zealand, and many others which demand new adaptations of old machines or new and untried mechanical arrangements to utilise them. Time would fail me if I were to attempt to enumerate one tithe of these rare combinations of mechanical skill; and, indeed, no one will ever appreciate the labour and supreme mental effort required for their construction who has not himself seen them and their wondrous achievements.

"Steamboats, the electric telegraph, and railways, are more within the cognisance of the world at large, and the progress that has been made in them in little more than one generation is better known and appreciated."

The next point treated was that of steam navigation. After alluding to the early inventors, Patrick Miller, Symington, and others, Sir John Hawkshaw went on to say:—

"As the number of steamboats has largely increased, so also gradually has their size increased until it culminated in the hands of Brunel in the *Great Eastern*.

"A triumph of engineering skill in ship-building, the *Great Eastern* has not been commercially so successful. In this, as in many other engineering problems, the question is not how large a thing can be made, but how large, having regard to other circumstances, it is proper at the time to make it.

"If, as regards the dimensions of steamboats, we have at present somewhat overstepped the limits in the *Great Eastern*, much still remains to be done in perfecting the form of vessels, whether propelled by steam or driven by the force of the wind. A distinguished member of this Association, Mr. Froude, has now for some years devoted himself to investigations carried on with a view to ascertain the form of vessel which will offer the least resistance to the water through which it must pass. So many of us in these days are called upon to make journeys by sea as well as by land, that we can well appreciate the value of Mr. Froude's labours, so far as they tend to curtail the time which we must spend on our ocean journeys; and we should all feel grateful to him if from another branch of his investigations, which relates to the rolling of ships, it should result that the movement in passenger vessels could be reduced. A gallant attempt in this direction has lately been made by Mr. Bessemer; whether a successful one yet remains to be proved. In any event, he and those who have acted with him deserve our praise for an experiment which must add to our knowledge.

"It is a question of vital importance to the steamboat that the consumption of fuel should be reduced to the smallest possible amount, inasmuch as each ton of fuel excludes a ton of cargo.

"As improvements in the form of the hull are effected, less power—that is, less fuel—will be required to propel the vessel through the water for a given distance. Great as have been the improvements effected in marine

engines to this end, much still remains to be done. Wolf's compound engine, so long overlooked, is, with some improvement, being at last applied. Whereas the consumption of fuel in such vessels as the *Himalaya* used to be from 5 to 6 lbs. of fuel per effective horse-power, it has been reduced, by working steam more expansively in vessels of a later date, to 2 lbs. Yet, comparing this with the total amount of energy of 2 lbs. of coal, it will be found that not a tenth part of the power is obtained which that amount of coal would theoretically call into action." *

The progress of the telegraph was then noted, and the principal inventors mentioned whose names are associated therewith:—Wheatstone, Alexander, Steinheil, Morse, Bain, Siemens.

"By the application of these automatic systems to telegraphy, the speed of transmission has been wonderfully accelerated, being equal to 200 words a minute, that is, faster than a shorthand writer can transcribe; and, in fact, words can now be passed along the wires of land lines with velocity greater than can be dealt with by the human agency at either end.

"Owing partly to the retarding effects of induction and other causes, the speed of transmission by long submarine cables is much smaller. With the cable of 1858 only 2½ words per minute were got through. The average with the Atlantic cable, Dr. C. W. Siemens informs me, is now 17 words, but 24 words per minute can be read.

"One of the most striking phenomena in telegraphy is that known as the duplex system, which enables messages to be sent from each end of the same wire at the same time. This simultaneous transmission from both ends of a wire was proposed in the early days of telegraphy, but, owing to imperfect insulation, was not then found to be practicable; but since then telegraphic wires have been better insulated, and the system is now becoming of great utility, as it nearly doubles the capacity for work of every wire.

"And yet within how short a period of time has all the wonderful progress in telegraphy been achieved! How incredulous the world a few years ago would have been if then told of the marvels which in so short a space of time were to be accomplished by its agency!

"It is not long ago—1823—that Mr., now Sir Francis Ronald, one of the early pioneers in this field of science, published a description of an electric telegraph. He communicated his views to Lord Melville, and that nobleman was obliging enough to reply that the subject should be inquired into; but before the nature of Sir Francis Ronald's suggestions could be known, except to a few, that gentleman received a reply from Mr. Barrow, 'that telegraphs of any kind were then wholly unnecessary, and that no other than the one then in use would be adopted;' the one then in use being the old semaphore, which, crowning the tops of hills between London and Portsmouth, seemed perfection to the Admiralty of that day.

* Theoretical energy of 1 lb. of Coal:—The proportions of heat expended in generating saturated steam at 212° Fahr., and at 14·7 lbs. pressure per square inch, from water at 212° are:—

	Units of heat.		Mechanical equivalent in foot lbs.
1. In the formation of steam	892·8	...	689,242
2. In resisting the incumbent pressure of 14·7 lbs. per square inch	72·3	...	55,815
	965·1		745,057

One pound of Welsh coal will theoretically evaporate 15 lbs. of water at 212° to steam at 212°. Therefore, the full theoretical value of the combustion of 2 lbs. of Welsh coal is

$2 \times 15 \times 745{,}057$ foot pounds, or

$$\frac{2 \times 15 \times 745{,}057}{60 \times 33{,}000} \text{ horse-power, if consumed in 1 hour.}$$

$= 11{\cdot}2$ horse-power.

As the consumption of coal per effective horse-power in a marine engine is 2lbs., the power obtained is to the whole theoretical power as 1 is to 11.

"I am acquainted with some who, when the first Transatlantic cable was proposed, contributed towards that undertaking with the consciousness that it was only an experiment, and that subscribing to it was much the same thing as throwing their money into the sea. Much of this cable was lost in the first attempt to lay it; but its promoters, nothing daunted, made 900 miles more cable; and finally laid it successfully in the following year, 1858.

"The telegraphic system of the world comprises almost a complete girdle round the earth; and it is probable that the missing link will be supplied by a cable between San Francisco in California and Yokohama in Japan.

"How resolute and courageous those who engaged in submarine telegraphy have been will appear from the fact that, though we have now 50,000 miles of cable in use, to get at this result nearly 70,000 miles were constructed and laid. This large percentage of failure, in the opinion of Dr. C. W. Siemens (to whom I am much indebted for information on this subject), was partly due to the late introduction of testing a cable under water before it is laid, and to the use of too light iron sheathing.

"Of immense importance in connection with the subsequent extension of submarine cables have been the discoveries of Ohm and Sir William Thomson, and the knowledge obtained that the resistance in wire of homogeneous metal is directly proportional to the length, so that the place of a fault in a cable of many thousand miles in length can be ascertained with so much precision as to enable you to go at once to repair it, although the damaged cable may lie in some thousands of fathoms of water."

The subject of railways was treated at some length:—

"Of railways the progress has been enormous; but I do not know that, in a scientific point of view, a railway is so marvellous in its character as the electric telegraph. The results, however, of the construction and use of railways are more extensive and widespread, and their utility and convenience brought home to a larger portion of mankind. It has come to pass, therefore, that the name of George Stephenson has been placed second to that of James Watt; and as men are and will be estimated by the advantages which their labours confer on mankind, he will remain in that niche, unless, indeed, some greater luminary should arise to outshine him. The merit of George Stephenson consisted, among other things, in this—that he saw more clearly than any other engineer of his time the sort of thing the world wanted, and that he persevered, in spite of learned objectors, with the firm conviction that he was right and they were wrong, and that there was within himself the power to demonstrate the accuracy of his convictions.

"Railways are a subject on which I may (I hope without tiring you) speak somewhat more at length. The British Association is peripatetic, and without railways its meetings, if held at all, would, I fear, be greatly reduced in numbers. Moreover, you have all an interest in them; you all demand to be caried safely, and you insist on being carried fast. Besides, everybody understands, or thinks he understands, a railway, and therefore I shall be speaking on a subject common to all of us, and shall possibly only put before you ideas which others as well as myself have already entertained.

* * * *

"Railways add enormously to the national wealth. More than 25 years ago it was proved to the satisfaction of a committee of the House of Commons, from facts and figures which I then adduced, that the Lancashire and Yorkshire Railway, of which I was the engineer, and which then formed the principal railway connection between the populous towns of Lancashire and Yorkshire, effected a saving to the public using the railway of

more than the whole amount of the dividend which was received by the proprietors. These calculations were based solely on the amount of traffic carried by the railway, and on the difference between the railway rate of charge and the charges by the modes of conveyance anterior to railways. No credit whatever was taken for the saving of time, though in England pre-eminently time is money.

"Considering that railway charges on many items have been considerably reduced since that day, it may be safely assumed that the railways in the British Islands now produce, or rather save to the nation, a much larger sum annually than the gross amount of all the dividends payable to the proprietors, without taking into account the benefit arising from the saving in time. The benefits under that head defy calculation, and cannot with any accuracy be put into money; but it would not be at all over-estimating this question to say that in time and money the nation gains at least what is equivalent to 10 per cent. on all the capital expended on railways. I do not urge this on the part of railway proprietors, for they did not embark in these undertakings with a view to the national gain, but for the expected profit to themselves. Yet it is as well it should be noted, for railway proprietors appear sometimes by some people to be regarded in the light of public enemies.

"It follows from these facts that whenever a railway can be made at a cost to yield the ordinary interest of money, it is in the national interest that it should be made. Further, that though its cost might be such as to leave a smaller dividend than that to its proprietors, the loss of wealth to so small a section of the community will be more than supplemented by the national gain, and therefore there may be cases where a Government may wisely contribute in some form to undertakings which, without such aid, would fail to obtain the necessary support.

"And so some countries, Russia for instance, to which improved means of transport are of vital importance, have wisely, in my opinion, caused lines to be made which, having regard to their own expenditure and receipts, would be unprofitable works, but in a national point of view are or speedily will be highly advantageous.

"The empire of Brazil also, which I have lately visited, is arriving at the conclusion, which I think not an unwise one, that the State can afford and will be benefited in the end by guaranteeing 7 per cent. upon any railway that can of itself be shown to produce a net income of 4 per cent., on the assumption that the nation will be benefited at least to the extent of the difference.

"A question more important probably in the eyes of many—safety of railway travelling—may not be inappropriate. At all events, it is well that the elements on which it depends should be clearly understood. It will be thought that longer experience in the management of railways should go to ensure greater safety, but there are other elements of the question which go to counteract this in some degree.

"The safety of railway travelling depends on the perfection of the machine in all its parts, including the whole railway, with its moveable plant, in that term; it depends also on the nature and quantity of traffic, and lastly, on human care and attention.

"With regard to what is human, it may be said that so many of these accidents as arise from the fallibility of men will never be eliminated until the race be improved.

"The liability to accident will also increase with the speed, and might be reduced by slackening that speed. It increases with the extent and variety of the traffic on the same line. The public, I fear, will rather run the risk than consent to be carried at a slower rate. The increase in extent and variety of traffic is not likely to receive any diminution; on the contrary, it is certain to augment.

"I should be sorry to say that human care may not do something, and I am not among those who object to appeals through the press, and otherwise to railway companies, though sometimes perhaps they may appear in an unreasonable form. I see no harm in men being urged in every way to do their utmost in a matter so vital to many.

"A question may arise whether, if the railways were in the hands of the Government, they could not be worked with greater safety. Government would not pay their officers better, or perhaps so well as the companies do, and it is doubtful whether they would succeed in attracting to the service abler men. They might do the work with a smaller number of chief officers, for much of the time of the companies' managers is occupied in internecine disputes. They might handle the traffic more despotically, diminishing the number of trains, or the accommodation afforded by them, or in other ways, to insure more safety; but would the public bear any curtailment of convenience?

"One thing they could, and perhaps would do. In cases where the traffic is varied, and could more safely be conducted with the aid of relief lines, which hold out no sufficient inducement to the companies to make, the Government, being content with a lower rate of interest, might undertake to make them, though then comes the question whether, when the whole of this vast machine came to depend for supplies on annual votes of Parliament, money would be forthcoming in greater abundance than it is under the present system.

"But the consideration of this subject involves other and more difficult questions.

"Where are the labours of Government to stop? The cares of State which cannot be avoided are already heavy, and will grow heavier every year. Dockyard establishments are trifling to what the railway establishments, which already employ 250,000 men, would be. The assumption of all the railways would bring Government into conflict with every passenger, every trader, every merchant, and every manufacturer. With the railway companies there would be no difficulty; they would sell their undertakings to any one provided the price was ample.

"Looking at the vast growth of railway traffic, one measure occurs to me as conducive to the safety of railway passengers, and likely to be demanded some day; it is to construct between important places railways which should carry passengers only or coals only, or be set apart for some special separation of traffic; though there will be some difficulty in accomplishing this. Landowners, through whose properties such lines would pass, would probably wish to use such lines for general purposes. Nevertheless, it may have to be tried some day.

"It would be instructive, were it practicable, to compare the relative proportion of accidents by railway and by the old stage coaches, but no records that I am aware of exist of the latter that would enable such a comparison to be made. It is practicable to make some sort of comparison between the accidents in the earlier days of our own railways and the accidents occurring at a later date.

"The Board of Trade have unfortunately abandoned the custom, which they adopted from 1852 to 1859, of returning the passenger mileage, which is given in the German returns, and is the proper basis upon which to found the proportion of accidents, and not on the number of passengers, without any regard to distance travelled, which has altered very much, the average journey per passenger being nearly half in 1873 what it was in 1846.

"It would be erroneous to compare the proportions of accidents to passengers carried in various years, even if the correct number of passengers travelling were given. But a figure is always omitted from the Board of Trade return, which makes the proportion of accidents to passengers appear larger than it is; this is the number of journeys performed by season-ticket holders. Some estimate could be made of the journeys of season-ticket

holders by dividing the receipts by an estimated average fare, or the companies could make an approximate estimate, and the passenger mileage could be readily obtained by the railway companies from the tickets. These additions would greatly add to the value of the railway returns as statistical documents, and render the deductions made from them correct.

* * * * * * *

"From the figures so arrived at, it appears the passenger mileage has doubled between 1861 and 1873; and at the rate of increase between 1870 and 1873 it would become double what it was in 1873 in twelve years from that time, namely, in 1885.

"The number of passengers has doubled between 1864 and 1873, and at the rate of increase between 1870 and 1873, it would become double what it was in 1873 in eleven-and-a-half years, or in 1885.

"It must, however, be remembered that the rate of increase since 1870, though very regular for 1871, 1872, and 1873, is greater than in previous years, being probably due to the rise of wages and the great development of third-class traffic, and it would not be safe to assume this rate of increase will continue.

"Supposing no improvement had been effected in the working of railway traffic by the interlocking of points, the block system, &c., the increase of accidents should have borne some proportion to the passenger mileage, multiplied by the proportion between the train mileage and the length of line open, as the number of trains passing over the same line of rails would tend to multiply accidents in an increasing proportion, especially where the trains run at different speeds.

"The number of accidents varies considerably from year to year, but taking two averages of ten years each, it appears that the proportion of deaths of passengers from causes beyond their control to passenger miles travelled in the ten years ending December 31, 1873, was only two-thirds of the same proportion of the ten years ending December 31, 1861; the proportion of all accidents to passengers from causes beyond their own control was one-ninth more in the last ten years than in the earlier, whereas the frequency of trains had increased on the average one-fourth.

"The limit, however, of considerable improvements in signalling, increased brake power, &c., will probably be reached before long, and the increase of accidents will depend on the increase of traffic, together with the increased frequency of trains.

"The large growth of railway traffic, which we may assume will double in twenty years, will evidently tax the resources of the railway companies; and unless the present companies increase the number of the lines of way, as some have commenced to do, or new railways are made, the system of expeditious and safe railway travelling will be imperilled. Up to the present time, however, the improvements in regulating the traffic appear to have kept pace with the increase of traffic and of speed, as the slight increase in the proportion of railway accidents to passenger miles is chiefly due to a larger number of trifling bruises being reported now than formerly.

"I believe it was a former President of the Board of Trade who said to an alarmed deputation who waited upon him on the subject of railway travelling, that he thought he was safer in a railway carriage than anywhere else.

"If he gave any such opinion, he was not far wrong, as is sufficiently evident when it can be said that there is only one passenger injured in every four million miles travelled, or that, on an average, a person may travel 100,000 miles each year for forty years, and the chances be slightly in his favour of his not receiving the slightest injury."

The next point treated was the economy of fuel. This and some other points were treated as follows in the concluding paragraphs of the address:—

"A pressing subject of the present time is the economy of fuel. Members of the British Association have not neglected this momentous question. At the meeting held at Newcastle-on-Tyne in 1863, Sir William Armstrong sounded an alarm as to the proximate exhaustion of our coal-fields. Mr. Bramwell, when presiding over the Mechanical Section at Brighton, drew attention to the waste of fuel. Dr. Siemens, in an able lecture he delivered by request of the Association to the operative classes at the meeting at Bradford, pointed out the waste of fuel in special branches of the iron trade, to which he devoted so much attention. He showed on that occasion that, in the ordinary heating furnace, the coal consumed did not produce the twentieth part of its theoretical effect, and in melting steel in pots in the ordinary way not more than one-seventieth part; in melting one ton of steel in pots about 2½ tons of coke being consumed. Dr. Siemens further stated that, in his regenerative gas furnace, one ton of steel was melted with 12 cwt. of small coal.

"Mr. Lowthian Bell, who combines chemical knowledge with the practical experience of an ironmaster, in his presidential address to the members of the Iron and Steel Institute in 1873, stated that, with the perfect mode of withdrawing and utilising the gases and the improvement in the furnaces adopted in the Cleveland district, the present make of pig iron in Cleveland is produced with 3½ million tons of coal less than would have been needed fifteen years ago; this being equivalent to a saving of 45 per cent. of the quantity formerly used. He shows by figures, with which he has favoured me, that the calorific power of waste gases from the furnaces is sufficient for raising all the steam and heating all the air the furnaces require.

"It has already been stated that by working steam more expansively, either in double or single engines, the consumption of fuel in improved modern engines compared with the older forms may be reduced to one-third.

"All these reductions still fall far short of the theoretical effect of fuel which may be never reached. Mr. Lowthian Bell's figures go to show that in the interior of the blast furnace, as improved in Cleveland, there is not much more to be done in reducing the consumption of fuel; but much has already been done, and could the reductions now attainable, and all the information already acquired be universally applied, the saving in fuel would be enormous. How many open blast furnaces still belch forth flame and gas and smoke as uselessly, and with nearly as much mischief to the surrounding neighbourhood, as the fires of Etna or Vesuvius? How many of the older and more extravagant forms of steam-engine still exist?

"What is to be done with the intractable householder, with the domestic hearth, where, without going to German stoves, but by using Galton's grates and other improvements, everything necessary both for comfort and convenience could be as well attained with a much smaller consumption of coal?

"If I have pointed out that we do not avail ourselves of more than a fractional part of the useful effects of fuel, it is not that I expect we shall all at once mend our ways in this respect.

"Many cases of waste arise from the existence of old and obsolete machines, of bad forms of furnaces, of wasteful grates, existing in most dwelling houses; and these are not to be remedied at once, for not everyone can afford, however, desirable it might be, to cast away the old and adopt the new.

"In looking uneasily to the future supply and cost of fuel, it is, however, something to know what may be done even with the application of our present knowledge, and could we apply it universally to-day, all that is necessary for trade and comfort could probably be as well provided for by one-half the present consumption of fuel; and it behoves those who are beginning to build new mills, new furnaces, new steamboats, or new houses, to act as though the price of coal which obtained two years ago had been the normal and not the abnormal price.

"There was in early years a battle of the gauges, and there is now a contest about guns; but your time will not permit me to say much on their manufacture. Here again the progress made in a few years has been enormous; and in contributing to it, two men, Sir William Armstrong and Sir Joseph Whitworth, both civil engineers, in this country at all events, deservedly stand foremost. The iron coil construction of Sir William Armstrong has already produced remarkable and satisfactory results; in discussing further possible improvements, the question is embarrassed by attempting to draw sharp lines between what is called steel and iron.

"There is nothing that I can see to limit the size of guns, except the tenacity and endurance of the metal, whatever we may choose to call it, of which they are to be made. Sir Joseph Whitworth, who has already done more than any other man in his department to secure good workmanship, and whose ideal of perfection is ever expanding, has long been seeking, and not without success, by enormous compression, to increase those qualities in what he calls homogeneous metal. Make the metal good enough, and call it iron if you will, and the size of a gun may be anything: the mere construction and handling of a gun of 100 tons, or of far greater weight, with suitable mechanical appliances, presents no difficulty.

"Relying on the qualities of his compressed metal, Sir Joseph is now seeking by a singular experiment to limit the travel of the recoil, as far as practicable, to the elasticity of the metal. By attaching the muzzle of the gun to an outer casing, through which the force of the recoil is carried back to the trunnions, he proposes to avail himself of this elasticity to the extent of one-and-a-half times the length of the gun; whether its elasticity alone in so short a space will suffice without other aid is, perhaps, doubtful; but other aid may be applied, and the experiment, whether successful or not, will be interesting.

"Docks and harbours I have no time to mention, for it is time this long and, I fear, tedious address should close.

"'Whence and whither,' is an aphorism which leads us away from present and plainer objects to those which are more distant and obscure; whether we look backwards or forwards, our vision is speedily arrested by an impenetrable veil.

"On the subjects I have chosen you will probably think I have travelled backwards far enough. I have dealt to some extent with the present. The retrospect, however, may be useful to show what great works were done in former ages. Some things have been better done than in those earlier times, but not all. In what we choose to call the ideal we do not surpass the ancients. Poets and painters and sculptors were as great in former times as now; so, probably, were the mathematicians.

"In what depends on the accumulation of experience, we ought to excel our forerunners. Engineering depends largely on experience; nevertheless, in future times whenever difficulties shall arise or works have to be accomplished for which there is no precedent, he who has to perform the duty may step forth from any of the walks of life, as engineers have not unfrequently hitherto done.

"The marvellous progress of the last two generations should make everyone cautious of predicting the future. Of engineering works, however, it may be said that their practicability or impracticability is often determined by other elements than the inherent difficulty in the works themselves. Greater works than any yet achieved remain to be accomplished—not perhaps yet awhile. Society may not yet require them; the world could not at present afford to pay for them.

"The progress of engineering works, if we consider it, and the expenditure upon them, has already in our time been prodigious. One hundred and sixty thousand miles of railway alone, put into figures at £20,000 a mile, amounts to 3,200 million pounds sterling; add 400,000 miles of telegraph at £100 a mile, and 100 millions more for sea canals, docks, harbours, water and sanitary works constructed in the same period, and we get the enormous sum of 3,340 millions sterling expended in one generation and a half on what may undoubtedly be called useful works. The wealth of nations may be impaired by expenditure on luxuries and war; it cannot be diminished by expenditure on works like these.

"As to the future, we know we cannot create a force; we can, and no doubt shall, greatly improve the application of those with which we are acquainted. What are called inventions can do no more than this, yet how much every day is being done by new machines and instruments.

"The telescope extended our vision to distant worlds. The spectroscope has far outstripped that instrument, by extending our powers of analysis to regions as remote.

"Postal deliveries were and are great and able organisations, but what are they to the telegraph?

"Need we try to extend our vision into futurity farther? Our present knowledge, compared to what is unknown even in physics, is infinitesimal. We may never discover a new force—yet, who can tell?"

CORRESPONDENCE.

HARDENED GLASS.

Sir,—Having noticed that certain erroneous impressions concerning this glass are current, we venture to make known the results of some experiments which have lately been carried out at these works, and to express a hope that more competent workers may take the matter up and thoroughly investigate it. It is unnecessary to treat of the history of the process of hardening glass, suffice it to say that it consists in plunging glass heated to the melting point into a bath containing an oleaginous mixture, at a high temperature, but considerably cooler than the glass itself; and that this, according to the specification of the patentee, is effected by re-heating already manufactured and annealed glass in a kiln, and passing it thence into the bath. After a rough trial of this process, which certainly answers well for flat or solid glass, we decided that it is defective for hollow flint glass, as hollow vessels, left to themselves in a kiln, are almost certain to collapse on reaching the required heat. To avoid this difficulty, and knowing that a vessel in course of manufacture, however hot, is always under control whilst it remains on the workman's rod, we placed a bath as near the mouth of the working-pot as possible, and directed the workman, instead of sending the finished vessel to the annealing oven, to drop it into the bath The vessel is caught in a wire net, and is ready for removal as soon as it has acquired the temperature of the bath. For all vessels made in one piece, *e.g.*, tumblers, finger basins, &c., this process answers well, and it is obvious that if it proves to be the best way of treating hollow flint glass, the use, for this description of glass, of the complicated machinery, described in M. de la Bastie's specification, will be done away with, and the glass will be tempered in the course of manufacture, instead of being re-heated and tempered after it has been already manufactured and annealed. We ascertained, with M. de la Bastie's aid, the right constituents and right temperature of a bath for flint glass; for although the conditions for "sheet," "plate," and "flint" glass are nearly the same, there is a difference, and it seems probable that every chemically different glass, and even every different thickness of glass, may require certain variations. In our experiments as to the hardness of the glass, we found

that it could be marked, but not cut with the diamond, and although it could be smoothed and engraved in the ordinary way, that the disturbance caused by the wheel, when penetrating to any appreciable depth, tended to weaken, or even to cause the destruction of the entire mass. The value of the invention as far as it concerns flint glass is at present somewhat modified by difficulties in manipulation.

1. It seems to be impossible to heat a vessel made up of different pieces and of various thicknesses to an absolutely equal temperature throughout, so that the whole may be equally tempered.

2. It seems also impossible to displace the air from a narrow-mouthed vessel quick enough for the inside and outside to be tempered simultaneously. However, setting aside these difficulties, we come to a point, which applies equally to all sorts of hardened glass. Hardened glass is not "unbreakable": it is only harder than ordinary glass, and though it undoubtedly stands rough usage better, it has the disadvantage of being utterly disintegrated as soon as it receives the slightest fracture; and up to the present, until broken, of being undistinguishable from ordinary glass, unless a certain pink tone noticeable in hardened flint glass can be taken as an indication. This glass is known as "toughened" glass, and we have seen the terms "malleable" and "annealed" applied to it. Nothing can be more misleading than these unfortunate epithets. The glass is hard, and not tough or malleable, and is the very opposite to annealed glass. Annealed glass is that the molecules of which have been allowed to settle themselves: the molecules of hardened glass have been tortured into their position, and until the glass is broken, are subject to an extreme tension. It is the sudden change of temperature that "hardens;" glass heated up together with the oil may be annealed, but decidedly is not hardened. A piece of hardened glass is only a modified Rupert's drop, *i.e.*, it is case-hardened: the fracture of both is identical, both resist the diamond, and both can be annealed. Moreover, in the middle of imperfectly hardened glass, a line is plainly visible, which seems to mark the extent of the case-hardening. This line resolves itself, under the microscope, into a mass of bubbles and striæ, it seems to be the nucleus of breakage, and consequently, as soon as the cutting-wheel approaches it, utter destruction ensues.—I am, &c.,

H. J. Powell.

The Glass Works, Whitefriars, Temple-street, E.C.

The Local Government Board has apppointed a commission, consisting of Mr. Clare Sewell Read, M.P., Mr. Robert Rawlinson, C.B., C.E., and Mr. T. S. Smith to investigate the practical efficiency of three different systems now in operation for disposing of town sewage, viz., irrigation, precipitation by filtration, and precipitation by a chemical process. The commissioners are visiting localities in which the processes are in operation, and will report fully to the Government.

The Duke of Northumberland will move next session for a Royal commission to inquire into the working and management of works engaged in smelting, burning, or converting ores and minerals from which noxious gases are given off; to ascertain the effects on animal life and vegetation, and to report on the best means for preventing such injury.

Captain Burton and party have just returned from Iceland. The immediate object of the visit was to examine the extensive sulphur mines which were worked in the north-eastern part of the island about the beginning of the present century, and for the reopening of which a company has recently been formed. The result of the visit seems in this respect to have been satisfactory.

The Bessemer Steamboat Company is stated to be in liquidation, and the *Bessemer* is for sale. The failure of the enterprise is said to be "in consequence of the want of the requisite accommodation in the French harbours."

GENERAL NOTES.

Patents for Inventions.—The Commissioners [illegible] Patents report has just been published. It is stated [illegible] the number of applications for letters patent recorded [illegible] the year 1874 was 4,992; the number of patents [illegible] thereon was 3,162; the number of final specifications [illegible] in pursuance thereof was 2,868; the number of [illegible] specifications upon which patents were sealed was [illegible] number of applications lapsed or forfeited, the [illegible] having neglected to proceed for their patents within [illegible] months of protection, was 1,060; the number of patents [illegible] the patentees having neglected to file final specifications [illegible] pursuance thereof, was 58, leaving 3,104 patents [illegible] The amount received during the year 1874 was [illegible] which £10,618 was profit, after all costs and charges [illegible] been defrayed. The whole cost of the office is thus [illegible] The total surplus revenue from the office since [illegible] amounts to £1,218,822. The principal items of charge [illegible] £20,749 to the Queen's printers, and £11,[illegible] for [illegible] The sum of £3,370 is divided among the Scotch [illegible] Law Officers and their clerks for "compensation." [illegible] rest of the report is the same as it has been for many [illegible] and consists of a list of the publications of the office and [illegible] places to which they are distributed, and of a memorial [illegible] some years back to the Treasury, asking for further accommodation.

Purification of Sewer Water.—At one of the [illegible] meetings of the French Horticultural Society, the [illegible] to the purification of the Seine by the employment [illegible] vation of sewer waters gave rise to some discussion. [illegible] following details on the influence of plants [illegible] with putrifying organic matter are taken from the [illegible] the society:—Dr. Jeannel, it is stated, has [illegible] had haricots macerated in water, which has [illegible] tainted, and in which the microscope revealed [illegible] of a considerable quantity of *bacteria*. In the [illegible] he placed in a glass 60 grammes (2 oz. 1 dr. [illegible] water, in which he plunged the root of a young [illegible] glass contained an equal quantity of the same [illegible] without a root. This latter retained all its [illegible] racter, while, after four days, the other had [illegible] and no longer contained *bacteria*, but in their [illegible] *infusoria*, which are only found in wholesome water. [illegible] experiment made with some water in which [illegible] meat had been placed yielded the same result. It [illegible] cient to allow a living root to act for five days for the [illegible] to lose all its bad smell and to become purified.

New Gas Furnace.—At a recent meeting [illegible] Chemical Society an account was read by Mr. C. Griffin [illegible] some improvements in gas furnaces for chemical [illegible] The furnace, as shown and described, is in two forms, [illegible] either for crucibles or muffles, but the principle in [illegible] is the same, the shape being slightly modified [illegible] the furnace was intended for use with or without [illegible] The burner consists of a circle of gas jets surrounding [illegible] a slight intervening space, a central jet. Over this [illegible] an atmopyre (or small hollow clay plug pierced with [illegible] the side) is dropped, and on the flat top of this the [illegible] stands. The advantages derived from this system are [illegible] crucible is brought directly into the focus of heat, [illegible] not require any support like the trivet grate, or [illegible] plumbago cylinder usually employed, which are [illegible] liable to break, and expensive. The other [illegible] the same as in the furnaces usually constructed by [illegible] Griffin. The power of these furnaces is given as follows: A burner consuming 20 feet of gas per hour, and [illegible] chimney 4 feet high, is capable of fusing half a [illegible] cast iron in 35 minutes from the time of lighting [illegible] of melting gold, silver, or copper in crucibles placed [illegible] a muffle measuring 5 inches long by 3 inches wide. [illegible] a chimney 6 feet high be employed, cast-iron [illegible] melted in crucibles placed within the muffle. A [illegible] larger size, consuming 40 feet of gas per hour, will [illegible] iron in crucibles placed within a muffle measuring [illegible] long by 4 inches wide. In the crucible furnace it will [illegible] 1 lb. of cast-iron in 35 minutes, 2 lbs. in [illegible] minutes, [illegible] in 55 minutes, and 4 lbs. in 65 minutes from the [illegible] lighting the gas. It is thus seen that when a white heat [illegible] been once obtained, 10 minutes time is required for the [illegible] of every additional pound of iron.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

COMMERCIAL EXAMINATIONS.

Since the Society of Arts' General Examinations were established in 1856, the Universities of Oxford and Cambridge, the Science and Art Department of the Government, and other public bodies, following the example of the Society, have instituted Examinations, which, to a certain extent, supply the place of those of the Society of Arts. None of them, however, are specially adapted to young persons entering commercial life, whether as clerks or otherwise, and the Council have therefore decided to establish examinations of a commercial character, believing that such examinations will be of great practical benefit, and specially within the province of a Society established for the encouragement of Arts, Manufactures, and Commerce.

The subjects for examination will be as follows:—

1. Arithmetic.
2. English (composition, correspondence, and précis writing).
3. Book-keeping.
4. Commercial History and Geography.
5. Shorthand.
6. Political Economy.
7. French.
8. German.
9. Italian.
10. Spanish.

Certificates will not (as heretofore in the General Examinations) be given in separate subjects, but in order to obtain a "Certificate in Commercial Knowledge," a candidate must pass in three subjects at least, two of which must be Arithmetic and English.

The papers set in most of these subjects will to some extent differ from those of former years, in being specially adapted to test the candidates' knowledge from a commercial point of view.

Prizes will be given as heretofore. The regulations are now under consideration, and the Programme will be published as soon as the details have been finally arranged.

CANTOR LECTURES.

The sixth lecture of the course of Cantor Lectures on "The Material, Construction, Form, and Principles of Tools and Contrivances used in Handicraft," by the Rev. Arthur Rigg, M.A., was delivered on March 15th, 1875, as follows:—

Lecture VI.

Tools used in Handicraft.—Saws.

We have considered the hammer, which in itself is a tool for consolidating material; we passed on to the axe, which, although usually regarded as an "edge" tool, is generally a hammer with a "wedge" pane; this is used for dividing fibrous material in the line of the fibres. From this tool we passed to a true edge tool, which in its most elementary form is the "chisel," and by various added contrivances the chisel becomes the shears and the plane. Saws, which are to engage our attention this evening, differ from all the foregoing. They can scarcely be called derivatives from these, unless the "knife" be regarded as the connecting link; for sometimes it is used as a chisel and at other times as a saw. All these tools, not excepting even the knife, are employed upon work in the direction of the grain or fibre of the material operated upon. The saw is essentially a tool for use across or at right angles to this fibre, although custom and convenience have arranged the saw for use with the fibre. Even then it is only because the fibres are not straight and parallel. When they are so, as in lath wood, then the saw is not employed. It is true that in such work as the felling of timber the axe is used across the grain, and therefore at right angles to the length of the fibre; yet if the action of the forester be observed, it will be seen that the direction of his blow is not that of the line of separation. He goes at his work *indirectly* when using the axe; *directly* when using the saw. In the former case he deals with the tree as an artist does in sharpening a lead pencil.

To cross cut fibrous wood direct with an axe will be found not only a difficult task, but very damaging both to the axe and to the wood. It seems to arise thus:—A bundle of many thousand fibres have to be separated—a heavy blow with a sharp edge is dealt at right angles to the group; those first struck yield, but are resisted in that continual yielding which would produce separation in consequence of the transmission of the energy of the blow to other fibres. When this energy is expended, and the fibres are bent like so many archery bows, the axe again descends, bending more and more until some yield, torn asunder by excessive bending. Such tearing is truly separation, but accompanied with much detriment to the crushed fibres. Where a group of straight fibres is struck with a cutting edge in the direction of their length, the only resistance to separation is that due to the longitudinal adhesion of fibre to fibre; in fact, it is not a separation of the actual material that takes place, but a tearing asunder of fibre from fibre. When, however, a group of fibres is struck at right angles to their length, then it it is no longer the adhesion of fibre to fibre that is being dealt with, but the actual cohesion of each

fibre within itself. If in the growth of timber there was no discontinuity in the straight lines of the fibres, then all longitudinal separation would be accomplished by axes or chisels. It is because this rectilineal continuity is interrupted by branches and other incidents of growth that the saw is used for ripping purposes. Were not some tool substituted for the wedge-like action of the axe, timber could not as a general rule be obtained from the log with flat surfaces. Hence the ripping saw, a tool which is intermediate between an axe and a saw proper. To study the saw as a tool fulfilling its own proper and undisturbed duties, it must be regarded in the character of a cross-cut saw. In this character it is called upon to meet the two opposing elements—cohesion and elasticity of fibre.

To deal with the treatment of fibrous wood at right angles to the length of the fibre is then clearly an operation in which considerations must enter, differing in many respects from those that decide action in direction of the grain. The object now is as it were to divide with the least expenditure of power a string which connects two ends of a tensioned bow. If a blow be given in the middle of a bow-string, the elasticity imparted by the bow to the string renders the blow inoperative. The amount of this elasticity is very apparent when one notes the distance it can project an arrow. Indeed any one who has struck a tensioned cord or a spring is well aware that the recoil throws back the instrument, and by so much abstracts from the intensity of the blow. To separate the string in this experiment even the pressure of a blunt knife blade is insufficient; for a heavy pressure, as manifested by the bending of the string, is borne before separation takes place. It may be taken for granted that in thus severing the string the power expended has been employed in two ways; first in bending the string; second in separating it. If the string be supported and prevented from bending, and the same cutting edge be applied, and the power be measured by weights or a spring balance, it will be seen how much of the former was expended in the useless act of bending the string, and therefore quite lost in the separating of it.

If the cutting instrument were a short narrow edge, or almost a sharpened point, and drawn forward, each fibre would be partially cut. A repetition of this action in the same line would still further deepen the cut. But a cutting edge requires support from a back, *i.e.*, from the thickening of the metal, otherwise it would yield. Further, a cutting edge held at right angles to the surface of the fibres may not be the most effective position. Let any one draw the point of a knife across the grain of a smooth pine plank, holding the blade first at right angles to the surface, and, secondly, inclining forward, he will observe that by the first operation the fibres are roughly scratched; by the second they are smoothly divided.

Hence, even where the edge has deepened, this back support, or metal strengthening must follow. It cannot do so upon this knife contrivance, because the sharp edge has not prepared a broad way for the thick back, which being of a wedge-like character should be acted upon by impact and not by such tension or thrust as in this case is only available. Therefore simple cutting is insufficient for the purpose of separating the fibres, but it has been suggestive.

If now something must enter the cut thicker than the edge, then it is clear that the edge alone is insufficient for the required purpose, and an edge, as a cutting edge alone, cannot be used for the separation of the fibres cross-wise. Longitudinally it may be, and is used, but in reality what appears to be thus used is a wedge, and not a cutting edge, for in a true cut the draw principle must enter. The axe and chisel do not work upon the cutting "edge," but upon the driven "wedge" principle. They are driven by impact, and not drawn by tension or thrust by pressure.

The consideration now suggested is not simply how to cross-cut the fibres, but, further, how to permit the material on which the edge is formed to follow without involving an inadmissible wedge action. It may be done as in a class of saws called metal saws; it is done, viz., making the "edge" the thickest part of the metal of the saw. This, however, ignores the true principle of the saw, and introduces the file. Were we now to consider this file-like action, we should be drawn too far away from the present question. It may, however, in passing, be well to remark that in marble cutting, where the apparent saw is only a blade of metal without teeth, this want of metal teeth is supplied by sharp sand, each grain of which becomes in turn a tooth, all acting in the manner of a file, and not a saw proper. A former method of cutting diamonds was similar to this. Two thin iron wires were twisted, and formed the string of a bow. These were used as a saw, the movable teeth being formed of diamond dust. A similar remark applies to a butcher's saw; its metal teeth really act as files. In a surgeon's saw no such action should take place, but the saw in all its delicate perfection should be a true saw, and not a thin file, in order to separate a bone in which there is life, for owing to the presence of this living principle the continuity of the bone fibre should be separated as with a lancet. As instructive examples of these file-like saws, there are two now on the table which show the construction very markedly. They have been lent for this evening, and the mode of using them described to me by their present owner.

One is as a knife, nearly 18 inches long and 2 inches broad, furnished with buckhorn handle, having on the stout back a saw (self-clearing teeth)—a very effective instrument for the purpose of the pioneer; the tradition is that this one had been employed by the Duke of Marlborough's staff to clear the ground of weeds and underwood, to lop off young branches of trees for surveying officers, and finally to serve for camp purposes, dividing the bones, &c., of animals. The other, *Couteau de Chasse*, is in the blade about 25½ inches long by 1½ inches broad, very slightly taper, and really a true old-fashioned hunting sword; both are in good preservation, and as most effective aids to colonists and campaigners they would be very useful in a museum to suggest to travellers the service to be obtained by a combination that could instantly be used as a tool, and as a weapon for offence or defence, as they could be as readily carried as any mere ordinary knife or sword. Some attempts have recently been

made or proposed to combine saw-cutting power with swords and bayonets, but it might be useful to be able to refer to the real instruments found effectual by our forefathers, which, whilst discharging the nominal duties of saws, were really operating as files.

Upon the principle that what enters a mite's mouth must be less than the mouth, we see that for the purpose of separating a bundle of fibres, the "edge" of which we have been speaking cannot be the edge with which we are familiar in axes and chisels. Such an edge drawn across will cut fibres on a surface only; this is insufficient, for a saw is required to cut fibres below a surface.

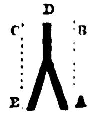
The tearing also of upper fibres from lower ones is not consistent with true work. To actually cut or separate these is the question to be considered, and the simple answer is another question. Can a narrow chisel be introduced which shall remove the piece of fibre whose continuity has been destroyed by cutting edges previously alluded to? If so, then an opening or way will have been found along which the back or strengthening part of the cutting edge can be moved. If, however, we look at the work of a single cutting edge, we notice that, although the continuity of the fibre is destroyed, yet the separated ends are still interlaced amongst the other fibres. To obtain a piece removable as by a small narrow chisel, it will be requisite to make a second cut parallel to the first. This being done there is the short piece, retained in position by *adhesion* only, which must by some contrivance be removed, for it is in the way, and the room it occupies is that in which the back of the cutting edge must move. To slide, as it were, a narrow chisel along and cut it out is more simple in suggestion than in execution.

There is another defect upon the application of what at first seems sufficient in principle, but only wanting in physical strength—it is the absence of any guide. To draw a pointed cutting edge along the same deepening line needs a very steady hand and eye. This consideration of the problem requires that some guide principle must enter.

To increase the number of cutting edges, and form as it were a linear sequence of them, may give a partial guidance, and if the introduction of our chisel suggestion be impracticable, then another device must be sought. Instead of the two parallel cutters, it will be possible to make these externally parallel but internally oblique to the line of cut, in other words to sharpen them as an adze is sharpened and not as an axe, and in doing so one obstacle will be removed, it is true, but a blemish which was non-existent will appear. The combining obliquity of the dividing edges will so press upon the intervening piece of fibre as to press it downwards into and upon the lower fibres, thus solidifying, and, in so far as this is done, increasing the difficulty of progressing through the timber.

Note the mode of operating:

FIG. 72.



The portions of wood A B D and E C D have been removed by the gradual penetration of the oblique arms—not only have they been cut, but they have been carried forward and backward and removed, leaving a clear space behind them of the width A E. But how with regard to the portion within the oblique arms? That part would either be left as an impeding hillock, or it would have to be removed by the introduction of such a plan as making rough the insides of these oblique arms. If we consider the nature of the material left in, it will be admitted to consist of particles of woody fibre adhering to each other only by the glutinous or gummy matter of the timber and not cohering. If the breadth A E is not too large, the whole of the heap would be rubbed away by the power exerted by the workman. There will therefore be not only economy in power, but economy also in material in narrowing A E. If attention be given to the form of the pieces bent from the plane of the metal of which this cutting instrument is made, it will be observed that the active portion has three edges, of which the lower or horizontal one only is operative, for the tool rides upon the fibres, divides them, and when the dividing has been accomplished, the sloping parts will remove the hillock. To act thus, the lower edges would require to be sharpened at A and E so as to clear a gate for the metal to follow. The action of the tool as described would require a downward pressure, in order to cause the cutting segments to penetrate vertically. The resistance to this downard entrance is the breadth of the "tooth," for it rides upon a number of fibres and divides them by sliding over; the complete action requires not only downward pressure for the cut, but also horizontal pressure for the motion, the latter both in the advance and withdrawal of the tool. These two pressures being at right angles do not aid each other, and will employ both hands of the workman. It is very obvious that the compounding of these will give freedom to at least one hand.

For the present, assume that the two pressures to be compounded are equal, then the simple operation is to employ one pressure making (say) an angle of 45° with the horizontal line of thrust. Although this be done, yet if the saws be any length, clearly the angle will vary, and therefore the effect of the sawyer's labour will be counteracted, either as a consequence of excessive thrust or of excessive pressure at the beginning or ending of the stroke. In fact, not only the position in which the handle is fixed on the saw, but the very handling itself will require those adaptations which experience alone can give.

The effect of this will be to cause the forward points to penetrate, and cross-cut the fibres obliquely. The return action will be altogether lost unless the instrument is reciprocated and sloped in the other direction.

If the tool becomes a single-handed one, and relies for its operation upon thrust or tension in one direction only (say thrust), then cutting edges on the back portions of the teeth are useless, and had better be removed.

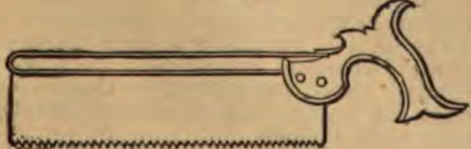
The experiment worthy of trial is, can the whole power, or nearly the whole power, be converted into a tension or thrust for cutting purposes. To do this the cutting edge must be so formed as to be almost self-penetrating; then the cutting edge is no longer a horizontal edge, but it

becomes oblique, on the advancing face, and formed thus there is no reason why it should not also be oblique on the back face, and so cut equally in both directions. The inclination of these faces to the path of the saw must be determined by the power—whether it is capable of separating as many fibres as the teeth ride between, and if these are formed to cut each way (as a single-handed tool) whether it could be done; because it necessitates a construction to which tension and thrust may be alternately applied. The nature of the wood, the power and skill of the workman, and the strength of the metal, must answer this suggestion.

The depth, or rather length of the cutting face may be decreased, and the number of teeth increased, for the fibres to be cut cannot be more vertically than can be contained between two teeth. The operative length of the tool must also be taken into account, for the combined resistance of all the fibres resting within the teeth must be less than the power of the workman. It may be well to remark that this difficulty is generally met in practice by the workman so raising certain teeth out of cut as to leave only so many in operation as the circumstances enable him to work. One advantage results by so doing—the guide principle of a longer blade is gained than could be done had the length been limited by that of the operating teeth, or had there been a prolongation of metal without any teeth upon it. To avoid complicating an attempt to deal progressively with the action of the saw, this and perhaps other considerations may for a while pass from notice. Considered as hitherto the teeth and tool are planned for operation in both tension and thrust. Now these are of so opposite a nature that a tool perfect under the one is likely to be imperfect under the other. When the necessary thinness of the material and the tenacity of it are taken into account, tension seems the most suitable; but although the ancients and the workmen in Asia are of this way of thinking, yet in England the opposite practice is adopted. It may be well to give a few minutes to this branch of the subject.

The form of a saw must in one dimension at least be very thin, and that without any opportunity for strengthening any part by means of ribs. When a strengthening bar is introduced at the back as in dovetail saws, see Fig. 73, the

Fig. 73.



depth of cut is limited. In order, then, to permit the guide principle to operate efficiently, this thin material must be so prolonged as under all circumstances to guide the cutting edge in a straight line. Of course we are dealing with saws to be used by hand, and not with ribbon or machine-driven saws.

If a light saw blade be pressed against an object or hooked on one, then tension causes this straight blade to be more and more straightened. On the contrary, if pressed forwards by thrust the weakness of the blade is evidenced by the bending. Now formed as saw teeth are, either to cut in both directions, or in the forward direction only, then there is always one direction in which the work to be done is accomplished by a thrust upon this thin metal. Clearly the metal will bend. If, however, the teeth are such as to cut in one direction only, and that when the tension is on the metal, the rest tends to preserve that straightness of blade upon which an important quality and use of the tool depends. That this tension system can be efficient with a very narrow blade is clear from the extensive use of ribbon saws. There is, however, a property in the breadth of the blade which applies equally to the tension and thrust systems—it is the guide principle. The breadth of the blade operates by touching the sides of the gateway opened by the teeth. When it is desired to dispense with a straight guide for sawing purposes, it is done by narrowing the blade as in lock saws, tension frame saws, &c.

There is obviously a limit to the required breadth even for the most effectual guidance and movement: this guidance should be uniform through the entire cut; hence upon the guide principle alone, there is required a breadth of saw beyond what is requisite for the teeth. The reasoning hitherto has landed us upon a parallel blade of some (as yet) undecided breadth. When one of our ordinary hand cross-cutting saws is examined, it is observed to be taper and not parallel, the tapering being at the edge or back, where the teeth are not. This has been done to meet our practice of using the saw as an instrument for thrust instead of tension. When the teeth near the end furthest from the handle are to operate, and there is no steadiness obtained from the guidance of the sides of the already separated timber, then the whole of the thrust must be transmitted through the necessarily thin blade. An attempt to compensate for this thinness by increasing the breadth is the only course open. It is one not defensible upon any true principles of constructive mechanism, for it is not in the increased breadth or extension of surface that resistance to bending is wanted, but it is in the thickness, and that is impracticable.

If any are disposed to defend our national practice in single-handed sawing, they may see this is not the true reason for causing the saw to be formed taper, as we usually see them—there is another reason not alluded to.

In describing the transition from such tools as axes and chisels to those tools employed in cross-cutting timber, a short time was given to explain how to deal with the two requisite pressures and combine them into one.

To carry out the views of mechanicians on this branch of the subject, which is worthy of more detailed consideration than it is likely on the present occasion to receive, various problems touching the resolution of forces would enter.

Now in thrust saws the hand and arm of the workman occupy a definite position, and the line of pressure on the saw is thus very much determined by the inclination of the handle (that part grasped in the hand) to the line of teeth prolonged backwards. If the handle be placed at such an angle that a large part of the resolved thrust be

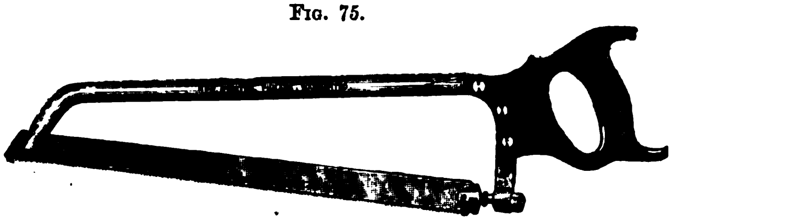
perpendicular to the line of teeth, then the "bite" may be greater than the other resolved portion of the power can overcome. At another angle the "bite" may be very little, and although the saw thus constructed would move easily, it would work "sweetly," but slowly. The construction is suitable for saws with fine teeth and for clear cuttings. It will be seen from these considerations that there should be preserved a very carefully considered relationship between the size and angle of the teeth and the position in which the handle is fixed, or rather the varying adaptability of the workman's thrust. Indeed, upon fully developed and accurate principles, the timber to be cut should first be examined, its fibrous texture determined physically, and a saw deduced from these data, having teeth and handle so related as to do the required work with a minimum of power. This multiplicity of saws is not available; and as in music the multiplicity of notes which only the violin can produce are rejected in other instruments, so here the multiplicity of theoretical saws is rejected, and a kind of rough and ready compromise is effected between the position of the handle and the angle and depths of the teeth. It would, however, well repay those whose works are usually of the same character and of the same class of timber, to consider these points, with a view to the selection of saws and position of handle suitably constructed to do the work with the least expenditure of power.

A few words upon the handles of single-handed saws. Whatever may be the other conditions required in handles, the large majority of saw-handles have the curved hooked projections A and B; these are connected with the pres-

FIG. 74.

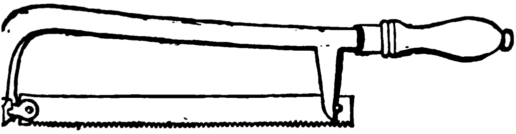
sure of the sawyer on the teeth. If, in sawing, the hand bears upon the upper hook (A), then an increased pressure is given to the forward teeth; if upon the hook (B) the pressure on the saw teeth is released, and consequent ease in sawing results. The angle at which direct thrust ought to act upon the line of teeth in the saws is obviously very different. Each material may be said to have its own proper angle. In Fig. 74 provision is made by the two set screws opposite A and B for varying the intersection of the line of thrust

FIG. 75.



with the line of teeth. It will be further noticed that in the handle of the "one man saw," Fig. 78, the upper hook is wanting, and this because under any circumstances the weight of the saw is more than sufficient, and therefore it is not requisite that any resolved portion of the workman's energy should be compounded with this. Not so with the other hook; that is retained in order that thus the weight of the saw may be taken from the work. For these reasons the line of direct thrust is nearly parallel with that of the teeth. We seem to be guilty of much inconsistency in the placing as well as in the formation of saw handles. Mark how very unsuitably the handle is made and placed in our metal saws. Compare the handling of these two saws. Fig. 75 is American, Fig. 76 is English.

FIG. 76.



A brief recapitulation of what has been said may suitably close this far from exhausted branch of the subject.

There have been considered:—

The effect of impact transverse to fibre.

The effect of thrust transverse to fibre.

The passing of a cutting edge transverse to fibre.

The reduction of length of cutting edge transverse to fibre.

The introduction of combined vertical with horizontal cut.

The rounding off the back of cutting edge.

The pressures required in sawing.

Tension compared with thrust.

The angular position of handle.

The resolution of forces operating.

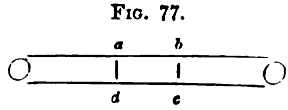
Now may be considered the circumstances which influence the form and position both of the teeth and the edges to be put upon them, in the case of hand saws operating either by thrust alone, or by thrust and tension combined (as in the two-handled cross-cutting saws used by two men, or in the whip and frame saw used in saw-pits). Unless specially mentioned the thrust hand-saw for cross-cutting will be the only one considered.

It may be well at the outset to explain that the coarseness and fineness of saws are estimated by the number of teeth points in an inch. The saw-maker uses the term "pitch," but not in the sense as employed in wheels and screws. By

pitch he "means the inclination of the face of the teeth up which the shaving ascends." Clearly if the saw is to cut when drawn in both directions, the slope of the teeth from the points must be the same on both sides; indeed, this may be considered the primitive form of saw teeth, and derived as the saw is said to have been from the backbone of a fish, it is the form that would be suggested. To use a saw with such teeth in the most perfect manner would require that the action at each end should be the same; hence, these are the forms of teeth generally met in the ordinary two-handled saw used for the cross-cutting of timber. Soft Caen stone is frequently cut into slabs or smaller blocks by such a saw. The teeth of these saws are generally wide spaced, and the angle included in their point is from 40° to 60°. The forms, however, of teeth, to cut in both directions, are sometimes more varied, especially when the material is not of the uniform non-fibrous character of Caen stone. When this equality of tension in both directions cannot be had, and the workman is required to cross-cut the timber by a one-handled saw, it is clear that he must consider the action as that of tension or thrust alone—one of these only. The only reason why both are not adopted seems to be that were it so, very different muscular motions and postures of the body would be introduced, and probably experience has shown that these are more fatiguing than the alternate pressure and relaxation which takes place in the ordinary process of hand-sawing. Now, if the cut is in the thrust only, then the form of the back of the tooth must be the very reverse of that of the front, for it ought to slide past the wood, and not separate the fibres. In this case the back of the tooth may be sloped away as shown on the diagrams, or it may be shaped otherwise. The faces of the teeth are no longer bound to be formed in reference to an equality at the back. Indeed, with the liberty thus accorded, there has arisen an amount of fancy in the forms of teeth which fancy has developed into prejudice and fashion. Names dependent either upon uses or forms are given to these, and they are distinguished by such names in the trade. Peg tooth, M tooth, half-moon tooth, gullet tooth, briar tooth; also "upright pitch," "flat pitch," "slight pitch." Of these varieties, custom has selected for most general use in England the one in which the face of the tooth is at right angles to the line of the teeth. The backs of the teeth are, therefore, sloped according to the distance between the teeth and the coarseness or fineness of the saw. This is called ordinary, or hand-saw pitch.

A consideration of the action of the saw in cross-cutting timber settles the cutting edge, and so suggests the mode of sharpening. Taking our ordinary cross-cutting single-handled saw as the type, the forward thrust is intended to separate the fibres, and this not in the way of driving a wedge, but in the actual removal of a small piece by two parallel cuts. For example, if O O be a fibre

Fig. 77.



then the action of the saw must be to cut clean out the piece, *a b*, so making a space (*a b*) wider than the steel of which the saw is made. The cleaner the cuts (*a d*) (*b c*) are the better. Now this clean cut is to be made by the teeth advancing toward the fibre. If that come on in axe fashion, then the separation is accomplished by the direct thrust of a sharp edge, in fact, by a direct wedge-like action. Now it has been explained in a former part of this lecture that a wedge-like action may be the best for separating fibre *adhering* to fibre, but it is an action quite out of place in the cross-cutting of a single fibre, in which cohesion has to be destroyed. There is needed a cutting action, *i.e.*, a drawing of an edge, however sharp, across the mark for separation; this drawing action is very important. Admit for the present that such action is essential, then the saw tooth as constructed does not supply it. Clearly the sharp edge must somehow or other be drawn and pressed as drawn across the fibre. Two ways of accomplishing this present themselves. [The illustrations used cannot here be re-produced.] The effect on the action of the workman is very different in these cases. In the first he must press the saw upon the fibre, and at the same time thrust it lengthwise. Now in soft timber, and with a saw having teeth only moderately sharp, this pressure will tend rather to force the fibres into closer contact, to squeeze them amongst each other, to solidify the timber, and increase the difficulty in cutting. Two actions are here, pressure and thrust. In the second case the pressure must be very light indeed, if otherwise, the point of the tooth will gather up more fibres than the strength of the workman can separate; indeed, as a rule, in the cross-cutting of broad timber, and all the saw teeth in action, pressure is not required, the average weight of the saw-blade sufficing for the picking up of the fibres. It is probably from the delicate and skilful handling which a tooth thus constructed requires, that hand saws are not more generally constructed with teeth of this form. In addition to these, there is the penetrating tooth, as the points of the peg tooth and others. Whatever may be the form of the teeth, the small piece *a b*, *c d*, Fig. 77, has to be removed so as to leave the ends from which it is taken as smooth and clean cut as possible, therefore the cutting edge must be on the outside of the tooth. This being so, it follows that the act of severing a fibre will be attended with compression whose effect is to shorten it. Thus condensed it is forced up into the space between the teeth. If now this space is not so formed as to allow the condensed piece to drop freely away so soon as the tooth passes from the timber, then the saw will become choked, and its proper action will necessarily cease. In large saws this is provided for in the shape of the "gums" in which the teeth may be said to be set. What in America are called "gums" are frequently in England called "throats." Saws cannot work easily unless as much care is bestowed upon the "throats" or "gums" as is given to the "teeth."

Any exhaustive attempt to deal with the considerations which present themselves to one who enters upon the question, what under all the varying conditions of the problems should be the form and set of a saw-tooth, would require more ex-

erimental knowledge and patient research than he subject seems to have received. There are nore than one hundred different forms of teeth. Sheffield and London do not agree upon the shape of the handle. The Eastern hemisphere and the Western do not agree whether sawing should be an act of tension or one of thrust.

The quantity of timber cut down in America within the last ten years is said to be not less than that which stood upon twelve millions of acres. To accomplish this must have led to investigations with respect to saws such as the requirements of this country were not likely to call forth. Through the kindness of Messrs. Churchill, of Wilson-street, Finsbury, we have now on the table not only samples of some peculiar American saws, but Messrs. Distin, of Philadelphia, have made for us short pieces of steel with some of the teeth they most highly esteem punched in them, and very beautifully made, and sharpened, and set, these sample teeth are, and, further, they have sent electros from which the large sheets before you have been printed.

As in the former lectures, it seemed most judicious to investigate the principles by considering a large and heavy tool, so in this, perhaps, it may be well now to examine this perhaps the largest made handicraft saw. This, in my hand (Fig. 78), is called a "one man saw;" it is four feet long, and a most formidable weapon it is. The enlarged diagram will make clear the plan of the teeth and also of the handle.

FIG. 78.

Long as the blade is, it is not too long, for ere is a piece of timber which, if cut with the 'one man saw," will set more fully before you s capability than any words of mine. The ravel you will observe is near, but still, within he limit of my arm. Now, to enter the wood, he teeth at the extreme end are used. These are trong, but of the form generally met with in the argest of our own cross-cut saws. Suppose we nter the saw; this done, now let the saw make full stroke. [The piece was soon separated.] he acting teeth are of an M shape, with a gullet r space between them. It will be noticed that he angle at which the teeth are sharpened is ery acute; the consequence of this, and their orm is, that they cut smoothly as a sharp knife would do; indeed, much as a surgeon's lancet would. Some teeth are formed on the principle f the surgeon's lancet, and these are called fleam" teeth. The spaces between the M's in he "one man saw" are "gums" for the reception and removal of the pieces cut out of the separated fibre. In the particular case before us, the M is three-quarters of an inch broad and three-quarters of an inch deep; the upright legs of the M are sharpened from within, the V of the M is sharpened on both sides. The legs are "set" to one side, and the V to the other side. Thus arranged, the saw cuts equally in tension and in thrust, and the *debris* is brought out freely at each end. The M tooths for this double-cutting results from an observation on two carefully-toothed short cross-cut elementary saws; see Fig. 80, where it

FIG. 79.

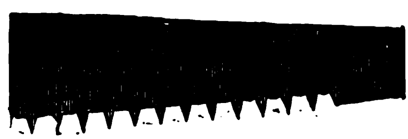
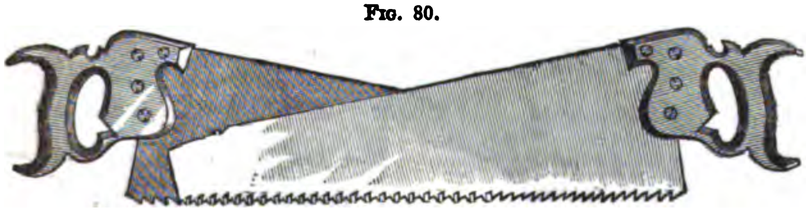


FIG. 80.



ill be noticed that the form of tooth to cut both ays, resulting from the combination, is M.

The set of this large "one man saw" is worthy notice. An inspection of the cutting points ill let you see that each point is diverted from e plane of the saw blades not more than about 32nd of an inch. When the object of "set" considered, it will be allowed that so little set is sufficient. Indeed, when we note the rapidity and ease with which it cuts through log-like timber, perhaps there are few in the room who will not acknowledge its superiority to the saws in general use.

How numerous are the varieties of saw teeth may be inferred from the diagrams in the room. [These varieties and the principles which seemed to have suggested them were briefly considered.] The annexed wood-cuts of teeth of certain cross-

cut saws used in America may illustrate the present subject. A single tooth will in some instances be observed between the M teeth: this

FIG. 81.

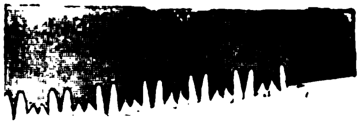
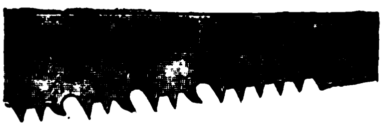


FIG. 82.

FIG. 83.



is a "clearance" tooth, and generally shorter than the cutting tooth. Sometimes it is hooked, as may be seen in Fig. 83; in such case it is shorter by 1-32nd than the cutting teeth, and acts the part of a plane iron by cutting out the pieces of fibre separated by the other or cutting teeth, which cutting teeth under these circumstances are lancet-like sharpened to very thin edges.

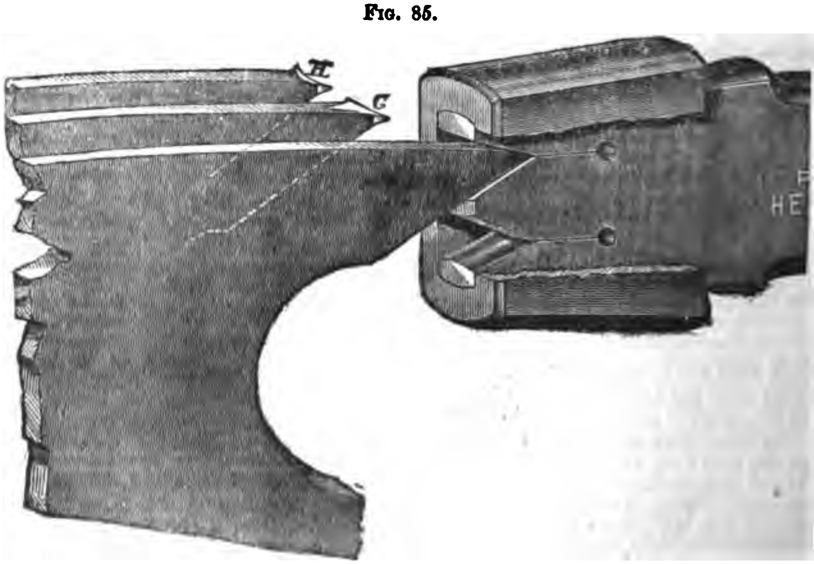
That the "set" of the teeth should be uniform in the length of the saw follows from a moment's reflection upon the object of this set. If one tooth projects beyond the line of the others, that tooth will clearly scratch the wood, and therefore leave a roughness on the plank. As more than its share of work is then allotted to it, the keenness of edge soon leaves it, and thus increases the labour of the sawyer. The American contrivance for securing a uniformity in the set of the teeth is

FIG. 84.

the "side-file." The three set screws determine the elevation of the file above the face, and the travel of the short length of fine cut file reduces all excessive "sets" to a uniform "set" through the entire length of the saw.

The "crotch punch" is also an American contrivance for obtaining a clearance set out of a

FIG. 85.



preading of the thick steel of the saw by an ingeniously formed angular punch. Fig. 85 is a diagram of the end, with part of the covering sleeve removed to show the form. If the tooth of a saw is struck with the convex-sided lower angle, the resulting tooth is shown at H; a second blow with the upper angle produces the flattened and double-set tooth G.

MISCELLANEOUS.

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

The sixth, seventh, and eighth reports of the Commission appointed to investigate the above subjects have now been issued, and the inquiry has therefore come to an end, the eighth report being the concluding one of the series. They all bear date the same day, June 18, but it is only within the last few weeks that they have been published.

The sixth report deals entirely with the condition of scientific education in secondary schools. To investigate fully the state of the vast number of schools of this class through the kingdom was a task which the Commissioners felt was two extensive for them. They therefore contented themselves with inquiring fully into the arrangement of the principal endowed schools, including all the great public schools, and applying for information to the masters of the 202 schools mentioned in the report of the Schools Inquiry Commission as possessing incomes of over £200 a year. From 128 of these replies more or less full were received, while the information collected as to the more important schools is of a very extensive and exhaustive character. It is perhaps not worth while to enter here on any examination of the details, suffice it to say that an exact account is given of the provisions made for teaching science at each particular school as it now exists, or at least as it existed at the time when the returns were made, for some of the earlier returns date two or three years back. In some cases views and plans of laboratories, &c., are given, and in all there is a minute account of the system pursued and the practical facilities provided. These all appear as appendixes to the report, which of itself is not very long. In it the Commissioners state very decidedly that in nearly all our schools the provisions for science teaching are very much behind what they should be, and this notwithstanding the considerable progress of recent years. Speaking generally, they deplore in strongly expressed terms the unsatisfactory state of science teaching in our schools. They conclude with the following recommendations:—

1. That in all public and endowed schools a substantial portion of the time allotted to study should, throughout the school course (with certain specified exceptions), be devoted to national science, and that not less than six hours a week should be appropriated for the purpose.

2. That in all general school examinations not less than one-sixth of the marks be devoted to natural science.

3. That in any leaving examination the same proportion should be maintained.

The seventh report concludes that part of the inquiry relating to the Universities and their colleges. A great portion of this part of the subject is treated in previous reports, the following institutions being those included in the present one:—(1.) The University of London. (2.) The Scotch Universities, Edinburgh, Glasgow (also the Andersonian Institution in that city), St. Andrew's, and Aberdeen. (3.) The University of Dublin and Trinity College. (4.) The Queen's University in Ireland.

The recommendations put forward in these cases are for the most part only concerned with alterations comparatively of minor importance. An increased grant to the Scotch Universities, and to the Queen's University in Ireland, is recommended.

The eighth report is the one which will be generally regarded as the most important. It deals with the question of State aid to science, or, as it has come to be generally called, "the endowment of research." The investigation of this much disputed point had been looked upon by many as the chief end of the labours of the Commission, as it was a principal cause of its appointment; and that this opinion was shared by some at least of the Commissioners, may be judged from the persistent care with which every witness whose opinion on the subject might be considered of value, was interrogated on this particular point. It may fairly be said that of the numerous witnesses called before the Commission—and very many of course were summoned with this special view—not one was allowed to go down without having fully stated his views as to the way in which the State could aid the progress of science, provided only he was known to have formed any opinion on the subject, or was in a position in which he was likely to have made any useful observations on the matter. That this naturally followed from the very origin of the inquiry is certain enough, but it may yet be permissible to point out that the opinions formulated by the Commission have not been arrived at without the most exhaustive inquiries, or a comparison of the most varied suggestions from all sources whence either information or opinion could possibly be derived. Whatever may be the public acceptance of the recommendations of the Commission, this at least must be remembered, that though only the Commissioners are actually responsible for the suggestions to which they have signed their names, these suggestions are the outcome of a deliberation to which the whole scientific world of England has contributed its quota.

This report is the only one of the set which deals entirely with the relations of the Government to science, and the advancement of scientific research, its seven predecessors, though touching occasionally on these points, being devoted in the main to scientific instruction. There is no evidence or supplementary matter appended thereto (except a page of extracts showing the amounts expended by Government on scientific objects), and the whole report is taken up with an examination of the evidence given in previous volumes and an account of the resolutions arrived at by the Commission. The subject is classified under the following heads:—

(1.) The scientific work carried on by departments of the Government.

(2.) The assistance at present given by the State towards the promotion of scientific research.

(3.) The assistance which it is desirable the State should give towards that object.

(4.) The central organisation which is best calculated to enable the Government to determine its action in all questions affecting science.

1.—*The Scientific Work carried on by Departments of the Government.*

The following is the list given of the principal branches of scientific work conducted by officers of the Imperial Government, and the departments by which they are administered:—

Topographical Survey (Treasury, Office of Works).
Hydrographical Survey (Admiralty).
Geological Survey (Privy Council).
Astronomical Observations:—
  Greenwich and the Cape of Good Hope (Admiralty).
  Edinburgh (Treasury, Office of Works).
Meteorological Observations:—
  Greenwich (Admiralty).
  Edinburgh (Treasury, Office of Works).
  The Meteorological Office.

(The Meteorological Office is not administered by any public department, but is directed by a committee, which, although appointed by the Royal Society, is independent of that body).

Botany.—Royal Gardens, Kew; Botanic Garden, Edinburgh; Botanic Gardens, Dublin (Treasury, Office of Works).

The Chemical Department of the War-office.

The Standards Department of the Board of Trade.

"Analogous work is carried on in some of the colonies and foreign possessions by departments of their respective Governments.

"In one case, that of the Royal Observatory, Greenwich, the work is examined into and reported on to the Admiralty by a board of visitors composed of men of science."

It may be noted that no reference is made to the work carried on in the chemical department of the Mint, which is admittedly of a very high scientific character. It is only needful to refer to the spectroscopic investigations carried on by Mr. Lockyer and Mr. Roberts, and to the researches into the molecular conditions of gold and silver alloys made by the latter gentleman, to demonstrate this. It may perhaps be admissible to suggest that Mr. Lockyer, as secretary to the Commission, may have been unwilling to put forward as noticeable, work in which he had so large a share, but if this was so, it may be regretted that any feeling of the sort should have interfered with a statement of fact. It may also be noted that Mr. Chisholm, in his evidence, complained that he was unable to obtain proper advice on the subject of the coinage "test-plates." It may, perhaps, be concluded that he really intended to say that he knew of no capable person except those directly interested in the question, as is obviously the case with the Mint authorities. Mr. Chisholm's own reports bear abundant testimony as to his satisfaction with the way in which the work was executed by the chemist of the Mint.* It may be added that these test-plates were made at the Mint in consequence of an application on the part of the Board of Trade to the Treasury. They are, with the other standards, kept in the custody of the Standards Department of the Board of Trade, and were prepared for it by the Mint, which works under the Treasury, and cannot therefore be taken as included in the Standards Department which is enumerated in the above list. To return to the points discussed in this part of the report, it is stated that besides the above branches of research, special committees are from time to time appointed when scientific questions arise requiring such investigations as the different departments are presumably incompetent to provide. After a statement of the amount of money thus expended by Parliament, the report goes on to discuss in detail the evidence given by the witnesses to this part of the investigation. It does not seem desirable to enter at length, in these columns, into the evidence collected, as there can be no doubt that all who feel sufficient interest in the question to follow out the discussion thus minutely will obtain the Blue-book for themselves. In noticing this, therefore, as well as the other parts of the report, only a very short statement of the general tone of the evidence will be given, accompanied by an enumeration of the names of the witnesses. It is hoped that such a sort of *précis* may be useful both as a guide to those seeking further information, and to such as wish merely for a general view of the character of the report. The recommendations of the Commissioners, which conclude the report, are appended at the end of this notice. The evidence is classed as relating to the following heads:—(1). "Insufficiency of the present Organisation." The witnesses speaking to this point were—Sir H. Rawlinson, Capt. Douglas Galton, Mr. Froude, General Strachey, Sir W. Thomson, Admiral Richards. (2). "Insufficiency of the present appliances for Investigation." Witnesses—Mr. Anderson, Mr. E. J. Reed, Mr. Chisholm. Numerous instances were given in the different departments of subjects requiring investigation which were not treated at all, or treated insufficiently, and of special cases where further appliances were required for proper research.

* The Report of the Deputy-Master of the Mint for the years 1870-1-2-3-4, give very full accounts of all the work done there. A brief notice of the last report (for 1874) was given in the *Journal* for August 20, p. 841.

2. *Assistance given by the State towards the Promotion of Scientific Research.*

Such assistance is classed as either permanent or occasional. Belonging to the first class are museums, none of which are calculated to assist students of the physical sciences, and there are no public laboratories; also the assistance given to certain learned societies either in money, or by providing them with rent-free apartments. Of such grants, that of £1,000 to the Royal Society is the most important, and of this a full account is given. To the second class are referred "Expeditions for special researches, and outfits of ships, and apparatus and grants of money for such researches." The only portion of evidence referred to is from that given by Sir E. Sabine.

3.—*The Assistance which it is desirable the State should give towards Scientific Research.*

This portion of the report is of considerable length. The extracts from the evidence are prefaced with an expression of opinion that it is "the interest, and within the proper function of the State, to give efficient aid to the advancement of knowledge, even in the cases where such knowledge is net directly required for State purposes." As to the general question, the evidence of the following statesmen is quoted—Lord Salisbury, Lord Derby, Sir Stafford Northcote. Reference is made to the opinions expressed in their evidence by many of the scientific witnesses, the remarsk of Dr. Frankland and Sir W. Thomson being quoted as typical. Mr. Farrer is also quoted as an instance of a public servant in a high official position; and Admiral Richards is referred to in the same category. The other evidence on this subject is classified under several heads. The first of these is "The Establishment of Laboratories." The witnesses quoted are—Col. Strange, Sir W. Thomson, Dr. Frankland, Mr. De La Rue, and Mr. Gore, all in favour of the erection of new laboratories; Dr. A. W. Williamson, Dr. Siemens, Dr. Burdon Sanderson, and Lord Salisbury, in favour of the extension of existing facilities. The second head is, "Establishment of Physical Laboratories." The witnesses were—Lord Salisbury, Sir G. Airy, Mr. De La Rue, Sir W. Thomson, Dr. Siemens, Dr. Frankland, Admiral Richards, Mr. Spottiswoode, and Col. Strange, who handed in some information obtained by himself from Sir William Thomson, Professor Hilgard (United States), Prof. Balfour Stewart, and M. Faye. These witnesses referred chiefly to physico-astronomical observations, and were in favour of the establishment of suitable provisions for their being carried on. The general opinion was that such observatories and laboratories should be distinct from that at Greenwich under the Astronomer Royal; but from this Sir G. Airy himself rather dissented. The paper of Colonel Strange consisted of certain questions relative to the best means for carrying on certain branches of physical research, their practical value, &c., with the answers thereto. The third head of evidence related to "Meteorology." A somewhat detailed account of the constitution and work of the Meteorological Office is given, illustrated by extracts from its annual report, and by quotations from the evidence of the following:—Mr. Scott, Major-General Strachey, Professor Balfour Stewart. Suggestions are made by these as to the proper functions of the office, improvements in its constitution, and increase in the aid given. Besides this office it is recorded that a certain amount is expended

meteorological purposes at the Greenwich and Edin-rgh observatories, and that £150 a year is allowed by Registrar-General for reports of meteorological ervations printed in his monthly returns. The rth head is devoted to "Tidal Observations," evidence being exclusively that of Sir W. Thomson, comprising a memorial on the subject addressed by British Association to the Treasury in 1872. In this quest was made that Government should take up and tinue the labours carried on by a committee of the tish Association since 1867. The request was not eded to. The fifth head is devoted to "The Extension the Government Grant administered by the Royal iety." The witnesses who spoke on this subject were nimous in their opinion of the value of the grant and the good results to be expected from its extension. witnesses whose opinions are quoted are Professor en, Mr. Spottiswoode, Professor Grant, Mr. De La , and Lord Salisbury. A memorial from the Royal iety of Edinburgh, asking for a similar grant, the mmissioners did not regard with much favour. The h and last head of evidence bearing on this part the Report relates to "The Payment of Scientific rkers." On this branch of the inquiry the Com-sioners consider that the evidence given, "both by smen and men of science, is to the same effect, and avour of increased State aid." It was also especially ed upon them that "to afford, by direct pecuniary the means of livelihood to men of distinction in pure stigation would be a great advantage to science, as petent investigators would thus be enabled and en-raged to pursue a strictly scientific career." The owing were the witnesses:—Lord Salisbury, Lord by, Sir W. Thomson, Professor Henry (Smithsonian titute), Professor Balfour Stewart, Mr. Gore, Dr. e, Dr. Siemens, Mr. De La Rue, Professor Rankine. ile differing considerably in their opinions as to the ner and extent of aid to be given, the necessity for was admitted by all.

fter these classified extracts from the evidence, the rt proceeds with some remarks on the opinions thus ented to them. The advances that had been effected this country in physical science by private and ded enterprise might be thought to render State unnecessary, but these advances compare unfavour-with the progress made in foreign countries. The of private individuals "is small when compared that which is needed in the interest of science," e learned societies are engaged in discussing and rding scientific facts, not in prosecuting researches. n the "advancement of modern science requires stigations and observations extending over areas rge and periods so long that the means and lives of ons are alone commensurate with them." With rd to the four heads of evidence above mentioned, Commissioners put forward the following observa-s:—

.) There should be collections, laboratories, and rvatories, accessible to qualified persons. It is n by the evidence that "for certain branches these not exist or are incomplete;" "the Government ice should contain within itself the means of carry-on investigations specially connected with the rtments." These requirements might be supplied grants of money to competent investigators, by itting such to laboratories primarily intended for use of the State or of institutions under State trol, by laboratories specially provided for the use nvestigators. Where practicable, the Commission r the first named method, or where costly and per-ent apparatus is required, the second.

.) An observatory for astronomical physics should be blished, distinct from the Greenwich observatory, located elsewhere. It is also desirable that such rvatories should be established in other parts of the pire than England, the districts of India for instance ring peculiar advantages.

(3.) The operations of the Meteorological Society have been of great value, and under existing circumstances it would be difficult to suggest any better organisation for the special department of the science to which the office has confined itself. If a ministry of science (as recommended in a later part of the report), were estab-lished, the Meteorological Office would be subordinated thereto. Any scheme for the proper cultivation of meteorology would comprise (*a*) arrangements for observation and recording; (*b*) arrangements for reduction &c., of observations; (*c*) investigation of physical causes. The necessity for observations at widely different points over the surface of the earth renders Government aid specially requisite in this science. At the same time much might be left to local societies in the work of col-lecting facts connected with "climatic meteorology." The practical value of the observations recorded in the Registrar-General's returns is noted.

(4.) Tidal observations might well be carried on under Government control, considering the agencies available by Government for such a purpose.

(5.) Grants of money might well be made, not only to assist investigators to the purchase of apparatus, &c., but to render such sufficiently independent of their own exertions to enable them to devote their whole time to these researches. "It is a matter of course that State aid shall only be given to investigators whose capacity and industry have been placed beyond reasonable doubt."

This is the conclusion of the third part of the report.

4.—*The General Organisation which is best calculated to enable the Government to determine its Action in all Questions affecting Science.*

The functions of the Government with regard to science are summed up under three heads. (*a.*) Treat-ment of Scientific Questions incident to Public Business. (*b.*) Direction of State-controlled Scientific Instruction. (*c.*) Consideration of Questions involving State Aid towards the Advancement of Science.

The majority of the witnesses expressed dissatisfaction at the manner in which all the scientific questions coming in one form and another before the Government were treated, and recommend the appointment of either a special minister for science, or a minister for science and education. Some witnesses were of opinion that the minister should be advised by a council, others were opposed to this view. To show the opinions expressed, the report proceeds to analyse the evidence as follows:—"Appointment of Minister of Science." As to this there was almost complete unanimity among the witnesses. Extracts are given from the evidence of Professor Owen, Sir W. Thomson, Col. Strange, Mr. De La Rue, Mr. J. Ball, Mr. Gore, General Strachey, Dr. Sclater, Professor Balfour Stewart, Mr. Farrer, and Sir G. Airy, the latter alone being opposed to the proposal.

"Council of Science." The proposal for the establishment of such a council was brought before the Government, by the Royal Society, in 1857. The report of the Royal Society is given at length. This proposal has recently been revived by Col. Strange. In the evidence given, there is great discrepancy of opinion, and there is also a great variety in the suggestions made by the different witnesses who were in favour of the proposal, while other witnesses were strongly opposed to it. The wit-nesses in favour of the establishment of a council are Colonel Strange, Sir W. Thomson, Dr. Frankland, Mr. Farrer, Admiral Richards, Dr. Balfour Stewart, Dr. Roscoe, Dr. Sclater, Dr. Hooker, Mr. De La Rue, Professor F. Jenkin, Professor Martin Duncan, Mr. Spottiswoode, Sir H. Rawlinson, General Strachey, Captain Galton, Dr. Siemens, Mr. Milne-Hume, Mr. Justice Grove, Professor Phillips, Dr. A. W. Williamson, Mr. Reed. The witnesses who think a council not to be required are Professor Rankine, Sir G. Airy, Professor

Owen, Lord Derby, Lord Salisbury, Sir Stafford Northcote, Dr. Carpenter, Sir E. Sabine.

On this evidence the report comments to the following effect. The work of the Government being carried on in many distinct departments, there is nothing to prevent analogous if not identical investigations being simultaneously carried out in different departments. Many important investigations are not undertaken at all, others are taken up in an inadequate or unsuitable manner. Much requires to be done "unless we are content to fall behind other nations in the encouragement which we give to pure science, and, as a consequence, to incur the danger of losing our pre-eminence in regard to its applications." These and similar considerations have impressed on the Commission the conviction that "a special ministry, dealing with science and education, is a necessity of the public service." Such a ministry could deal with—(1). Scientific and general education; (2). Application of public money to advancement of science; (3). Assistance to departments requiring such external help. Whether Art should be included, the Commissioners do not think it within their province to say. After careful consideration the Commissioners advise the establishment of a council, which might be, in part, nominated by Government, in part elected by the council of the Royal Society, in part formed of representatives of other learned societies. Though reference to the council would probably be the usual course in cases of of difficulty, this would not relieve the minister of responsibility.

The report concludes with recommendations to the following effect:—

1. The assistance now given by the State for the promotion of research is inadequate, and conceded or refused on no sufficiently defined principles.

2. Greater facilities for investigation are required in certain Government departments. Physical and other laboratories and apparatus are needed.

3. Investigations in physical meteorology, terrestrial and astronomical physics, can only be properly carried out by Government. In particular, an observatory should be founded for astronomical physics, and an organisation established for observing and recording tidal phenomena.

4. The national collections of natural history should be rendered more useful for purposes of research. Corresponding aid should be given to chemical and physical investigators. Where practicable such persons should be admitted to State laboratories.

5. The grants now made to private investigators should be increased, and should be sufficient to remunerate for time and labour as well as to repay expenses.

6. The amount of the Royal Society grant of £1,000 might be increased, and it might also be supplemented by direct grants to investigators.

7. A ministry of science and education should be created.

8. The appointment of a scientific council would greatly assist the labours of such a ministry.

9. This council should represent the chief scientific bodies in the kingdom. It should be constituted as suggested above. It might well discharge the functions now exercised by the Government Grant Committee of the Royal Society.

From the official Austrian report on mining, it appears that in 1874, there were 1801 mining undertakings in activity in the Austro-Hungarian Empire, classified into 370 coal mines, with 36,980 workmen; 863 brown-coal mines, with 27,449 workmen; 243 iron mines, with 8,753 workmen; and 325 mineral works of miscellaneous character, employing 14,249 workmen. Austria had 227 smelting works, with 10,730 workmen, comprising 125 blast furnaces, with 9,055 workmen.

The Council of the Royal Architectural Museum announce that the museum will in future be open free daily from 10 to 4.

SILK CULTURE IN AUSTRALIA.

(*Communicated by Mrs. Bladen Neill.*)

The documents published in the *Journal of the Society of Arts*, on the 6th August, give satisfactory proof that Australian sericiculture is attaining a position in which it will, at no distant date, command attention in the markets of Europe. Thus far the new industry appears to have been put forward in Victoria exclusively by women and girls, and it is in regard to its bearing upon the social question of employment for women, that the prospectus which we have already published more especially recommends itself to the support of the British public. In this light the prospectus states, "that in the establishment of an industry of this kind in Australia, a prospect is offered to many women and girls in the United Kingdom, who may hereafter be induced to emigrate with a reasonable and confident prospect of suitable employment to look forward to" in the colonies. We say, in the colonies, because it is hoped that the movement thus commenced in Australia may hereafter spread to other British colonies and possessions; and, in point of fact, we are informed that already negociations are on foot for introducing silk culture into one or two other colonies.

The social aspect of the question, as affording increased scope for the employment of women, cannot fail to possess strong and peculiar interest. But at the same time the movement has a very distinct interest in its industrial aspect, and it is particularly in this light that we venture to bespeak for it the attention and support of manufacturers and merchants concerned in the silk trade. It has been shown that Australia itself is capable of producing first-class cocoons, and the documents recently published, further show the high estimation in which cocoons raised in Italy from Australian "grain" (silkworm eggs) are held by Italian experts, to whom they were lately submitted. Cocoons thus produced in Italy from Australian grain have been reliably valued at 1 fr. 50 c. per kilo higher than the best Italian cocoons of this season's growth. We take it that the education of Australian grain in Italy has been entered upon only as an occasional experiment, and that the main object of the Victorian Ladies' Sericicultural Association is to locate the industry in the colonies. The projectors of the movement, nevertheless, consider it important to demonstrate in one of the silk-growing centres of Europe itself that the colonies are not only able to produce cocoons, but also first-class grain, or silkworm eggs, for exportation. With this view, a recent education of Australian grain was conducted under the supervision of Mrs. Bladen Neill, near Verona, and the result obtained was shown to be satisfactory by the author of this paper.

The main objects, however, of the Victorian Ladies' Sericicultural Company are stated as follows in the articles of association, viz.:—"The promotion of sericiculture in the Australian colonies by the planting and cultivation of such kinds or species of the mulberry tree as are found most beneficial as food for the silkworm. The obtaining of silkworm grain, its education, and reproduction. The production and reeling of silk, and preparation for sale of both grain and silk at any place in the colony of Victoria, or elsowhere as to the company may seem fit, and the doing of all such other things as are incidental or conducive to the attainment of the before-mentioned objects."

The company appears to have had a modest beginning, for the original capital is stated to have been £5,000, divided into 1,250 shares of £4 each; and as a distinctive feature of the company it is provided that "no person but a woman shall be eligible as a director." Judging from the documents already published in this Journal, it would appear that the affairs of this company have hitherto been conducted with as much energy and promise of future success as it would be reasonable to expect

in any similar enterprise managed by the so-called Lords of the Creation.

Among the practical results achieved we notice from the Catalogue of the Melbourne Intercolonial Exhibition of 1873, that one of the ladies concerned in this movement exhibited on that occasion a case of cocoons "raised from grain obtained from Mr. Charles Brady, of Anthony, near Sydney, derived from an old Italian race now found to be free from disease. The exhibitor (according to the catalogue) has introduced into Australia grain from the magnanerie of M. Roland of Orbe, Canton de Vaud, Switzerland. This gentleman's grain has been thoroughly regenerated, and has remained perfectly free from disease for the last seven years. It is in great demand in Milan and Turin, and it is confidently expected that its reproduction in Australia will be a great success."

The exhibition of this and of other specimens of silk in cocoons and hanks afforded a convenient opportunity for experts in Melbourne to record their opinion of the suitability of silk culture to the natural conditions found in Australia. Thus we find that the jurors in the section of silk and clothing at the exhibition in question wrote as follows: "At some future day Victoria will undoubtedly be a silk-producing country. Her geographical position, her meteorological peculiarities, and her large consumption of imported silks, all point in that direction. The white mulberry, *Morus alba*, the best and richest known aliment for the silkworm, grows luxuriantly in Victoria, and the true silkworm, *Bombyx morus*, thrives amazingly. Full grown mulberry trees may be seen at the Botanical-gardens, in the Royal-park, at Sunbury, and in various other places; and the names of the successful breeders of the silkworm in different parts of the colony are so numerous as to make quite a formidable list. The samples of Victorian silk in cocoon and hanks now on view at the exhibition show what a splendid article can be produced here. They cannot be surpassed in fineness and firmness of texture by silk produced in any part of the world. Few attempts have, however, yet been made at the manufacture of colonially produced silk in Victoria beyond winding it off the cocoons and gathering it in hanks." The opinion thus expressed by the jurors on silk, appears to be strengthened, as regards the matter of climate, by other reporters at the same exhibition, who state that "Victoria possesses the climatic advantages of the more favoured portions of Southern Europe. Marseilles, Bordeaux, Bologna, Nice, Verona, and Madrid, are on or near the same isothermal lines corresponding with that of the southern hemisphere passing through Melbourne, but the difference between summer and winter is far less in that city than in the places mentioned, and the climate is consequently more agreeable. Professor Neumayer determines Mafra, 700 feet above the sea (eight miles N.W. of Lisbon, and in lat. 38° 55′ N.), to be a locality experiencing mean temperature for the different seasons very near to those obtaining in Melbourne. The difference in mean of summer and winter temperatures in Melbourne, from a series of observations extending over fourteen years, is 16·1°." These, and other climatic conditions observed in the southern portions of Australia, are referred to in the official record from which these quotations are made, as being favourable to the successful promotion of silk culture.

Having thus endeavoured to show that sericiculture has been entered upon in Australia with due regard to its suitability to that country, we come to the more business-like, or practical part of the matter; and here we shall content ourselves by quoting a communication forwarded to the Silk Committee of the Society of Arts by the author, who is now in England as the representative of the company of sericiculturists in Victoria:—

—"It is urgently necessary to send out to the ladies and girls now at work in Australia some of the latest and most approved apparatus used in Italian and French magnaneries and reeling establishments. To this end an urgent appeal is made to the women of England to assist their colonial sisters in a work which recommends itself so strongly to their sympathies. A large sum of money will be required—quite beyond the small means of these ladies. It will be easily seen that a work depending on increased plantations and new machinery cannot in the hands of women and young girls in the colonies become all at once a commercial success. It is true that a small quantity of raw material is now being manufactured into silk goods in Italy, and that brought to England by myself is also being manufactured into various useful articles of clothing. The importation will largely increase year by year, and thus in time enable the association in Victoria to become self-supporting, but at present it must be largely dependant upon extraneous aid. The generous help given by many public bodies in this country, as well as by private individuals, to further the employment of women, induces the directors to feel sure that when there is no doubt that this most womanlike employment will prove profitable and socially beneficial, an appeal such as this will not be made in vain. It is hoped that in particular the Chambers of Commerce in the different centres of the silk manufacture will take a liberal view of this matter, and contribute towards the outfit now required. It is, in fact, evident that the especial self interest of the silk manufacture in England ought to attract some support from those bodies, the movement being one which tends to increase the supply of the raw material employed in the silk trades."

It is intended not only to purchase machinery with the latest improvements for reeling and carding, but to erect in Australia suitable buildings for the reception of the same, and for the accommodation of a large staff of women and young girls employed in this industry; and if the funds will allow, to assist other mulberry growing colonies in establishing similar associations for women, for whom more severe manual labour is not suitable. Before closing this notice we may mention that California is also developing into a silk-producing country. M. Bonnehomme, now in England, states that he has established a market without limit in Italy and France with great success for Californian grain, produced under advantages of climate and soil not greater than in Australia. He can obtain as much as 40 frs. per oz. for first-class grain, and is of opinion that Australia and California are equally adapted for the production of the finest races of silkworms. Donations in aid of Australian sericiculture may be addressed to Lady Macarthur and Mrs. Bladen Neill, 27, Princes-gardens, South Kensington, S.W.; to Sir Antonio Brady, 110, Cannon-street, E.C.; to Mr. R. A. Brooks, St. Peter's-chambers, Cornhill; or to the Bank of New South Wales, 4, Threadneedle-street, E.C.

The following is the list of promised patrons:—Countess of Shrewsbury, Viscount Canterbury, Bishop of Melbourne, Mrs. Perry, Bishop of Goulburn, Mrs. Thomas, Lady Lucy Calvert, Sir E. Tulke, Bart., Lady Tulke, Miss Tulke, Sir D. Cooper, Bart., Lady Cooper, Hon. Mrs. C. Bright, Mr. C. Bright, Sir James Ferguson, Sir G. and Lady Bowen, Sir Henry Bulwer, Sir Henry Barkly, Lady Macarthur, Sir Antonio Brady, Lady Brady, Colonel R. Carey, Mr. J. E. Millais, R.A., Mr. G. A. Sala, Mr. Herbert (Under-Secretary of State), Mr. Hugh Childers, M.P., Mrs. Childers.

The Imperial German railways, and those working in Germany under State direction, have been authorised by the Minister of Commerce to grant to exhibitors proceeding to Philadelphia from Germany the privilege of gratis return tickets.

In 1874 there were forwarded in Cisleithanian Austria 13,792,557 telegrams, being an increase of 1,844,220 on 1873. The total length of line, including private lines in Vienna and suburbs, is 82,718·60 kilometres, against 78,237·90 at the end of 1873.

CORRESPONDENCE.

HALL-MARKS.

Sir,—Reform in the present system of Hall-marking is most urgently called for. The exceedingly well-written article on Hall-marks that appeared in your number of August 13, shows in a very clear manner that this is the case, and the writer suggests, with modesty, partly the means by which it might be accomplished.

The two great points to be aimed at seem to be:—1. Security to the public. 2. Revenue to the Government. All other considerations pale before these.

To protect the public the jeweller might be compelled to give a stamped invoice for every article he sells of a value over 5s., stating the maker's mark and quality of the gold.

A public assayer or inspector to be appointed in the same way as there exists a public analyst; and a heavy fine imposed on defaulters. The jeweller would then have to fall back upon the manufacturer in cases of inaccuracy.

Every manufacturer should have to take out a manufacturing license for the different qualities of gold he wishes to work. This would do away with the host of small irresponsible makers, and would afford an additional guarantee to the public.

An *ad-valorem* duty on all gold manufactured into jewellery, including watchcases, should also be levied. This would pay for a thorough system of inspection, and would make the new organisation not only self-supporting, but would also add to the revenue.

To attempt to revolutionise the entire system of Hall-marking would be to attempt a thing that cannot be accomplished. We have not been able to alter our weights and measures, however complicated and absurd they may be; we have not succeeded in altering our coinage to the decimal system though this be admitted to be the most rational; in brief, we cannot upset in a day the habits, notions, customs, and prejudices that have been gradually forming since centuries; we must, therefore, if anything is to be done, first touch the general outline of the evil, and then by degrees attack the inner parts, until we regenerate the whole. If we begin at the details we confuse and frighten. We require for the present no new code of Hall-marks.

There is another great evil upon which the writer of the article above mentioned lightly touches in passing, but which is very important, namely—the definition of a plated article.

Let us suppose, for example, a thick ring or bracelet perfectly hollow, or let us better say—a tube to be worked into these articles, the metal of which is as thin as a sheet of note paper; this tube is 15-carat gold, is sent to the Hall, is found correct, is stamped and returned: this is what the manufacturer wanted. There is the passport, here is the Government certificate; any one who knows what the Hall-mark means will pass it. Let us now weigh this tube: it weighs a trifle over two pennyweights, and is worth, say 6s. Now comes the workmanship. The more skilled than honest manufacturer fills this beautiful tube with solder, lead, or other equally valuable stuff, finishes the article off with exquisite taste, and puts it on the scales. It now weighs ten times as much, and is worth for the metal alone, let us say for instance, £3; for does it not bear the Hall-mark? The unsuspecting, unwary customer buys it, and lays it perhaps by for a rainy day, for has he not paid five pounds for it!

Not many days ago I was called upon in one of our courts of justice to give evidence as to the nature of a piece of jewellery of this description, and it was maintained for the defence in the coolest possible way, that the article was gold, though necessarily loaded. But I sustained that an article cannot be termed gold if not all through of the same material. If the truth can be twisted in this manner in a court of justice, what arguments can the public bring to bear against the abominable sophistry of the jewellers.

The same deception is practised with regard to stones and gems, which are known as doublets (half gem, half glass) or foiled stones (pale-coloured stones underlaid with high-coloured tinsel), but I am engaged at present exclusively with the metal, and will perhaps avail myself of some other opportunity of instructing the public with regard to paste.

Reform then, there can be no doubt, is even more called for respecting the stamping of thin gold, which are afterwards worked into anything, than to really *bonâ-fide* articles. For if gold resists the attack of nitric acid, and is all through alike, it is at least gold of some sort, though perhaps not the best.

Legislation could be easily applied to this, and the establishment of a clear definition of the term plated article, together with a few heavy fines, would very soon set matters right.

I hope that some of your readers will give us the benefit of their views on this subject, as by having many opinions we may arrive at some definite scheme, which might be recommended to the attention of Parliament.—I am, &c.,

Alfred Lutschaunig.

LOCAL SCHOOLS FOR COOKERY.

Sir,—1. Having watched the development of the National Training School for Cookery from its beginning, I think it may be generally useful to direct attention to the present state of the arrangements of the school, so that the country at large may take advantage of them.

2. The school, which by the way is in vacation till the 13th of September, is now fully organised for training teachers to give instruction in localities varying with the circumstances of each place.

3. It has been demonstrated that any village school with 100 girls and upwards, may have simple cookery suitable for artisans and labourers taught in these; but the school will first send a girl to the training school to be taught in the artisan class for three weeks at a fee of three guineas. The annual capital required by the village school ought not to reach £20; this includes the purchase of food, which is consumed by the children, who are found in numbers able to pay 2d. a head for the dinner which they help to cook in learning.

4. If the locality has several elementary schools, with a population of about three or four thousand, including neighbouring villages, then an organisation is possible which would teach cookery, not only in elementary schools, but to the ladies of the middle classes, who are or wish to be wives, and not to ladies only, but to domestic servants and artisans' wives.

5. In this case, as in that of the elementary school, the first want is to get a teacher, but this is not difficult to meet.

6. Let a locality feel the want of a school for cookery, and its first work is to subscribe about £25, and then to send a competent person to the National Training School to become a certificated teacher; such a person should be well educated, as well educated as a good elementary schoolmistress. She may be the daughter of a clergyman, doctor, lawyer, or half-pay army or navy man, but she must have the desire to earn her living, and be content with an income of from £80 to £100 a year for giving (say) forty weeks' instruction. So much the better if she have had any experience of teaching children in a Sunday or other school, and acted as a district

itor. She must have no defect in speaking, as she ll have to address numbers in a class. Her age should between 20 and 30.

7. When such a young lady has been selected by the ality, she should be sent to the National Training hool at South Kensington, to go through a complete urse of instruction, which lasts twelve or thirteen eks, for which a fee of ten guineas must be paid on ning the school. In addition to this fee, there will the expense of travelling and living in London, ich may be put down at twelve pounds more.

8. Having obtained her diploma, she may either turn to the locality from which she came, or may be t on the staff of the National Training School, when will be guaranteed two pounds a-week while teach-, or one pound a-week whilst retained in the National aining School, when her services are not required out it.

9. If a locality wishes to have a full organisation for a okery school of its own, say for 40 weeks' duration, or n less, a local committee should be formed.

10. The committee would arrange the rota of instruc- n to be given by the teachers, who might give the sons a week of two hours' duration each. The rota ght consist of one lesson a week to a class of ladies in morning, each lady paying 2s. 6d. a lesson for a course ten lessons, or more for a single lesson. Once a week the evening, a lesson might be given to artisans' ves and domestic servants, at sixpence a lesson.

11. The remaining four lessons might be given to four mentary schools, which should pay ten shillings a son for each school. From 10 to 20 children might end a lesson in their own school.

12. The Education Department counts instruction in okery as attendance at school, and pays 4s. for each l who passes an examination, if she obtain or has ained a fourth grade certificate.

13. To establish a moderate-sized local school for okery which shall teach the gentry, the shopkeepers, mestic servants, and artisans and labourers' wives, the al committee should first raise in sums of ten shillings d upwards a guarantee fund of £150 for twelve months, out £30 of which should be paid at once, in order to d the teacher to be trained and provide utensils.

14. The receipts for instruction, &c., might be reckoned follows:—

om gentry pupils, receiving 10 lessons in form, classed in succession, each pupil paying 2s. 6d. a lesson, say	£60
om domestic servants and artisans, say	10
ur elementary schools, each 20 lessons, with 20 students, say	40
le of food, say................................	10
Total............	120

15. The working expenses would consist in paying the cher £2 a week for forty weeks, and in providing a llery-maid, coals, food, and perhaps the rent of a suit- le kitchen.

16. If the locality wished to try an experiment for a orter time than 40 weeks, then the local committee ght make arrangements with the National Training hool for Cookery to send a teacher for this shorter riod, but the charge for the teacher would be increased, d travelling and other expenses would have to be ded. All these details may be obtained of the secre- y of the school, Exhibition-road, Kensington.

17. At the present time, when great numbers of the ddle classes are away from their homes to get health the sea-side, much suffering from bad cookery is under- ne, for every youthful drab is turned on to cookery. e cure is only to be found in local schools for cookery tributed over the country.—I am, &c.,

H. C.

17th August, 1875.

RIVER POLLUTION.

SIR,—You may well suppose that in this little out-lying island, we English people are not always very well informed of much that passes "at home," but amongst the other English newspapers that come here, I frequently obtain a sight of the *European Mail*, which is published expressly for the West Coast African Settlements. In the number for June, 1875, I found the report of a paper read before the Society of Arts, by Jabez Hogg, Esq., on river pollution, and the impurities of water supplied to large towns.

The son of a once well-known London physician of high standing, I was in my youth sent for two years to study at a metropolitan hospital, besides a previous training in chemistry and pharmacy, so that I am very well aware of the vast importance of having an abundant supply of pure water for all domestic purposes, but more especially for cooking and drinking, and that not only in town and cities, but also in country villages and detached dwellings, when in the frequent absence of wells, the water is frequently obtained from ponds of stagnant water, highly charged with impurities of every kind. I well remember when farming in Suffolk, fifty years since, the house was supplied with water for all purposes by a pump, not from a well, but from a small pond in the garden in front of the house, supplied I suppose by a spring, as it never went dry, whilst other larger ones failed in seasons of drought. As for my farm teams, they, poor animals, usually drank from a pond at the back of the house, into which in wet weather the draining of the farm-yard discharged itself. I only now wonder that I did not lose the whole of them instead of eight in as many years, after drinking such a vile compound, often as green as grass! Fool that I was to suffer the poor dumb creatures to drink such a poisonous fluid, when I had a small brook of pure water in the meadows just below me, always accessible. Such is the force of example, that because my predecessor on the farm had always done the same, with the like fatal result, we neither of us discovered the true cause of the mischief. I was young at the time, and did not heed such things.

It is no wonder that you have of late been suffering from attacks of typhoid and low fevers, diarrhœa, &c., which have at last been traced to water impurity, as the chief, if not only cause.

A Londoner by birth, I am old enough to remember, as a boy, often looking on with wonder at the then water works of old London-bridge, by which at flood tide a supply of something very much resembling in colour poor pea-soup, was pumped up and forced on through old decaying wooden pipes for the use of that part of the City. All that has now passed away, but not so the impurity of the present greatly increased supply, which remains surcharged with a large amount of impurity, a slow poison, to sap the life of those who are obliged, *nolens volens*, without hope of relief to drink it.

Mr. Hogg very properly prescribes filtration, and at the same time very highly recommends the use of the "Silicated Carbon Filter" for that purpose. Good, doubtless for those who can afford to buy them, but unfortunately nine-tenths of the community are mostly unable to purchase such costly articles, and very probably would, from ignorance in such matters, be either unable to make proper use of them, or to keep them in working order if they had them. And yet it is for the million that the supply without stint is chiefly needed, who are the greatest consumers of that refreshing fluid to quench the thirst of those "that labour and are heavy laden" in a worldly sense, and which has been so abundantly provided by an All-wise Providence, but which man, in his selfishness, has polluted and rendered totally unfit for drinking purposes.

I do not trouble myself about "the upper ten," who, probably, are not much given to water drinking, as they do little or nothing to excite thirst, and if they wish it

have the means of obtaining it as pure as "filters" can make it, but it is for the small traders, the mechanic, the artisan, the host of day labourers who earn their bread "by the sweat of their face," that I plead as most needing it, and yet are the least able to obtain it.

Under these many adverse circumstances, with no prospect of any speedy relief, on the principle "that half a loaf is better than no bread," I venture to offer a very simple and entirely inexpensive plan to overcome at least a considerable portion of the difficulty, and which I have been in the practice of adopting in my own house for considerably over twenty years with the most satisfactory results, and which consists in simply charging the tea-kettle, night and morning, with a double allowance of water for the day, allowing it to stand a little time after boiling for the impurities to settle to the bottom, and then pouring off the contents into a pitcher or any other vessel for use, and the result will be a clear bright fluid, not perhaps quite equal to spring water, but a vast improvement of that at present in use.

Boiling will certainly destroy all vegetable impurities, precipitate all earthy impurity, and most effectually annihilate all the "microscopical living organisms" existing therein, described by Mr. Hogg. As to any mineral impurities in water, I beg to decline saying anything about them, being uncertain whether fire alone, though a general purifier, will be sufficient for their removal without chemical aid. But any common observer cannot fail to see the other impurities fall to the bottom of any vessel, if the water is poured out while boiling, and not allowed to deposit the impurities in the kettle.

I well know the indolent careless indifference of the working classes, and that it will be difficult to induce them to adopt so simple a plan of practical purification. Its very simplicity will, I fear, stand in the way of its adoption. Were I now living in England, instead of being compelled to reside here, I would have printed off small fly-sheets and distributed them with no sparing hand in all the crowded alleys and back slums of the vast metropolis where disease runs riot, and I more than suspect that the impure water they are obliged to use is one great cause of their unhealthy condition. Had it not been that I was unwilling to extend this communication beyond due limits, I could have given a very remarkable instance of the effect very slightly impure water producing cholera and its immediate removal by the very simple means of changing the water supply! This occurred in the garrison in the Bahamas during the fearful prevalence of cholera which decimated the inhabitants of those islands in 1852, during all which time I was present and actively employed in endeavour-to suppress the outbreak, though with but indifferent success.—I am, &c.,

Henry W. R. Farre.

Funchal, Madeira, July 15, 1875.

GENERAL NOTES.

Trades Union Hall and College in Manchester.—The executive of the Manchester and Salford Trades Council have prepared a scheme for establishing a labour parliament in that city, including a trades hall and artisans' college, with scholarships endowed from the funds of the union, the lecturers and examiners being selected from the science professors at Owens College. The scheme provides that the subjects of study shall comprise mathematics as applicable to the various branches of the building trades and constructive work in general; chemistry for improvement in the manufacture of dyes, whether for the hank, the skein, or for cloth; and botany, as an aid to technical education in beauty of form and design in piece goods. A library, selected with a special view to the above subjects, will also form an important part of the institution.

Weather Intelligence.—The annual return prepared at the Meteorological Office shows that a review of the weather telegrams sent out in 1874 presents very nearly the same results as in the year before; 78·2 per cent. of the warnings issued were justified by the subsequent weather. The signals are simply of a warning nature, and, without conveying the impression that an expected storm will necessarily strike the port where the signal is to be hoisted, imply that extra caution in navigation is requisite. The present return differs from that of previous years in that the duration of each gale at the observatories is given—that is, the number of hours during which the velocity of the wind exceeded fifty miles per hour. One very serious storm, in October, came on so rapidly in the night time, subsequent to the afternoon reports of the previous day, that no warning could be issued by the office; and it is observed that it does not seem that the funds at present at the disposal of the office will enable it to anticipate the arrival of such gales, as for that purpose much more frequent telegrams would be required. But the result of five years' work, 1870-74, it is hoped, shows that while the office cannot give timely warning of all gales, it has been able to give such information as would, if attended to, have enabled our coasting seamen to avoid the violence of almost all the serious storms which have visited our coasts.

Sulphuric Acid.—A circular has been published calling attention to the success attending the working of Dr. Herman Sprengel's improvement in the manufacture of sulphuric acid. The process was patented in 1872, and consists in injecting water in the form of spray into the chambers instead of steam. To effect this a jet of steam escapes from a platinum nozzle at a pressure of about two pounds, and blows through the centre of a flowing jet of water by means of an apparatus similar in principle to Herapath's [illegible]. These jets are let into the side of the chamber at a distance of 40 feet. The advantages gained are economy of fuel, nitric acid, and pyrites. The method has been in use at the works of the "Lawes Chemical Manure Company" at Barking, and the returns show that a saving of coal to the amount of two-thirds of the quantity formerly burned has been effected—the total saving in steam, nitric acid, and labour being, for [illegible] months, amounting to 5s. per ton of acid of sp. g. [illegible] made from pyrites. The patentee points out that a saving of even 1s. per ton means in this country an annual gain of £50,000.

Communication in Railway Trains.—A new invention for simplifying the method of communicating between the passengers and guards in railway trains has lately been shown at the offices of Mr. W. Smith, C.E., [illegible]-street, Strand. The inventors are Messrs. Stroudley and Rusbridge, of the London, Brighton, and South Coast Railway. Each compartment is fitted with a signalling apparatus, consisting of a "pull out" knob or handle, which [illegible] fixed in the division between the two compartments, and is double, so that it can be operated by a handle in each compartment. This is connected by wires to a battery and electric bell in each guard's van, the connection between the carriages being effected by helical springs in tubes of vulcanised rubber. The principal part of the improvement consists in making the "keys," or carriage signal apparatus interchangeable, and so as to be readily detached from the wires, which are connected permanently to the framework of the carriage. The guards communicate with each other by means of an ordinary "push" fitted to each [illegible] bell case, and to enable the guard to signal danger, and yet have his hands free to apply the break, a slide is fitted which can be slid over the push, so as to keep it down and keep the bell ringing. A slip coupling is also provided for disconnecting a portion of a train when it is necessary to leave a portion of the train without stopping. The bell instruments are self-contained and complete with the requisite battery cells, and the whole apparatus can be detached and placed in any other van, where the fittings have been applied to receive the bell instruments, which are also interchangeable throughout the whole of the vans along the line. The existing cord system can also be applied in conjunction with the electric means for actuating the bells, the ordinary passenger pull-cord being attached to a binding piece or connection fitted outside the case on each side to the bell case. Several cords can be connected thereto. In the electric fittings of the passenger carriages the pull-out knob can only be put back to its normal position by the guard having the proper key, and attention may be called to which compartment of which carriage the person signalling operated on the pull-out knob.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EXAMINATIONS.

In reorganising the Examinations of the Society of Arts, one division—the COMMERCIAL—described in recent issues of the *Journal*, has special reference to men, although not excluding women, who can make capital clerks, if they please, as is well shown in France.

A second division, the TECHNOLOGICAL, is already in operation, and applies to Manufactures. These examinations obviously may be attended by both sexes.

EXAMINATIONS IN DOMESTIC ECONOMY.

A third division of the examinations has been established, and will particularly apply to women; it consists of the following subjects:—

Clothing and its Materials.
Health.
House-keeping and Thrift.
Cookery.

Whilst it may be expected that these subjects will be chiefly taken up by women, there is no reason against men taking certificates in them. In the Code of the Education Department they are limited to girls, and this is a good reason why young men should not be excluded from the Society of Arts' examinations in them, if they please to attend to these important subjects. These examinations will be by papers of questions.

FINE ARTS APPLIED TO INDUSTRY.

The Society has already held with success annual Exhibitions of Fine Art applied to Industry, and in considering the whole subject of the examinations, arrangements are in contemplation for holding Examinations in Fine Arts applied to Industry.

In this way the whole field of Arts, Manufactures, and Commerce, the special province of the Society, will be connected with a scheme of annual examinations in the future.

EXTINCTION OF FIRE IN SHIPS.

The Fothergill Gold Medal is offered for an effective means of preventing or of extinguishing fire on board ship. Communications, illustrated if need be by models or working drawings, must be sent in to the Society not later than the 31st of December, 1875. The Council will take into consideration, with a view to reward, the best written paper containing suggestions fitted to secure prevention of fire, or the means to be adopted for the safety of life and property when fire breaks out on board ship. The Council reserve to themselves the right of withholding the medal or reward offered, if, in the opinion of the Judges, none of the communications sent in are deserving.

MISCELLANEOUS.

THE SALTPETRE DEPOSITS OF PERU.

By George Fitzroy Cole, Assoc. Inst. C.E.
(Late District Engineer Iquique and La Noria Railway.)

The country wherein lies the industry I propose to describe in this paper, is situated on the West Coast of South America, and belongs to that part known as the Costa Seca or Dry Coast, being the slip of land comprised between the 4th and 40th degrees S. latitude, and which, measured from the River Tumbez, the Southern boundary of the republic of Equador, to Valdivia in Chile, embraces, within a length of over 2,400 miles, the entire seaboard of Peru, Bolivia, and part of Chile. Over this considerable extent of sea coast no rain falls to modify the parched appearance of the soil, and no humidity is obtained from the heavens beyond that acquired from the condensation of the fogs which envelope the coast during the winter months. With the rare exception of a shower of rain occurring once or twice in the year, the cultivator is dependent upon the scanty supply of water afforded by the rivers which derive their origin from the rains and snows which fall but moderately on the western slopes of the lofty Cordilleras. Thus the coast can be briefly described as consisting of a succession of valleys of great fertility, separated by arid wastes of high ground of immense extent.

The section with which I am at present dealing lies at the southern extremity of Peru, and though saltpetre exists in small quantities in Bolivia, up to now it has only been worked in the former country, in the province of Tarapacca, perhaps more familiarly known as the district lying inland of the ports of Patillos, Iquique, Mexillones, and Pisagua. The coast between these ports presents seawards a precipitous front, with its cliffs rising to a height of from 1,000 to 3,000 feet from the water. These cliffs have but little slope; therefore, all road approaches are traced in a diagonal direction upon their face, or ascended by a series of reversing inclined planes, of exceeding steepness, and perilous to the mules performing the transport service.

From the summit of the coast-cliffs the land rises with nearly an uniform ascent, proving to be, by the construction of the Iquique and La Noria Railway, after deducting for the deviations of the latter, a general inclination of 50′ until it reaches an elevated plateau known by the name of Pampa de Tamarugal. This pampa, or extensive plain, is situated at an elevation of 3,440 feet on its western side, and, extending southwards and northwards, measures about 300 miles

in length, and from 30 to 60 miles in breadth. The surface is perfectly smooth, and appears level to the eye, but in reality it rises slightly in an easterly direction, towards the Cordillera. Its surface is covered in some places by a cap of alluvial soil, but more generally consists of a finely granulated sand, which is raised by the slightest breath, and by a heavy wind is carried over the plains in broad thick clouds, which obscure the horizon, and blind the traveller with their dust. On still days curious conical-shaped clouds, resembling water-spouts, may be seen rising up in all parts of the plain, produced no doubt by the rotary motion which must occur at the meeting of two opposing currents of air. Then a tremulous motion is observed when the eye scans the horizon, and this is caused by the ascent and descent at one and the same time of layers of air at different temperatures—the cool coming down, the warm going up. At different points the horizon is broken by patches of trees; these trees are called "algarovas," and their wood is hard and brown, not unlike English oak. They seldom grow in this locality to any considerable height. The deposit of roots belonging to this tree, to be found nearly all over the pampa, indicate the existence in former days of an immense forest, and the traditions of the place explain that formerly wood was the only fuel used in the reduction of the saltpetre and other minerals in which the province abounds. The algarova requires but little moisture, and subsists on the humidity which it absorbs from the atmosphere.

The mineral containing saltpetre is called "caliche." Caliche generally lies at depths of from one to ten yards below the surface, and sometimes resembles in appearance loaf sugar, and at others rock sulphur; and again it appears white, crossed with bluish veins. Its gravity varies from that of common salt to sandstone (2·41 average), according to the amount and nature of earthy matters it may be allied with. The nitrate portion dissolves freely in boiling water, leaving behind as a residuum the earthy substances. The custom is to boil it at a temperature of from 220 to 240 degrees Fahrenheit. This valuable mineral is found beneath a covering of calcareous earth, generally assuming the appearance of half-formed sandstone, when it is serviceable for building purposes. A shaft, or hole, sufficiently wide to permit of the passage of a man, is sunk through this cap as far as the under side of the caliche, at which point the underlying earth is dug out in a circle for several feet. The chamber thus formed is charged with gunpowder (manufactured in the district), and on being fired the result is to disengage and throw up to the surface the subterranean caliche, which is picked out by hand and stacked up in heaps at some convenient point, whence it is conveyed in carts, capable of holding about a couple of tons, to the "oficins," or manufactory. Considerable skill is required in selecting the points where to begin mining operations, and it frequently occurs that large sums of money are paid for lands which on being worked prove to be worthless, either on account of the scarcity of the caliche, its bad quality, or its great depth beneath the surface. These losses are sustained on account of the difficulty sometimes experienced of obtaining labour or tools in a country so inhospitable in its resources, and possessing no real indigenous population.

At the manufactory the caliche is broken up, either by hand labour or by steam crushers, into cubes capable of passing through a 1½ inch ring. Blake's patent crusher, manufactured by Messrs. Marsden, of Leeds, has of late years been used in several manufactories, and would, I have no doubt, be more generally employed for this purpose, were the body of the machine made in sections to facilitate its transport, instead of being in one massive block weighing several tons.

In the old method of extracting the nitrate from the caliche, the broken caliche is shovelled into the boiling pan, which is placed over a fire. After from six to eight hours' boiling in a liquid composed of fresh water and the liquid remainder of a former boil—called *agua vieja*, or "old water"—the nitrate of the caliche is dissolved and forms part of the solution, which by means of a ladle is transferred to a pan, where it deposits its nitrate. In this process the caliche is boiled at a low temperature, and the salt is supposed to remain in the refuse. Great waste attends the operation of dissolving at a low temperature, which cannot well be avoided by using the direct fire employed at the *paradas*, and it is estimated that in some cases some 30 per cent. of nitrate is thrown away with the refuse, or, as it is called there, *ripia*. The water is lifted up from wells in buckets attached to ropes working round a drum, which is placed on a vertical shaft and made to revolve by a mule drawing round its circumference. Thus no steam-power is employed in this process. The increasing demand for nitrate caused the introduction of improved plant for its elaboration, and now all the important manufactories are worked by steam-power.

The improved form of *cachucha*, or boiling-tank, is either opened or closed, and the heating agency is steam, introduced at the bottom of the tank by means of a steam-coil. The coil is usually placed beneath a perforated false bottom, thereby allowing the heated vapour to circulate through the caliche lying immediately above. Sometimes an additional coil is run directly through the caliche.

Great diversity of opinion exists among saltpetre manufacturers upon the most economical form of cachucha. Some advocate the closed cachucha, which in every respect may be compared to a steam chest, because they maintain that, the steam being enclosed, there is no waste of heat, and consequently an economy is effected in coal. Their opponents assert that the steam in the cachucha condenses, and thereby weakens the solution, and that it prevents a most important operation—the stirring-up of the matter during the boiling. On the other hand, the open cachucha allows the steam which has passed through the caliche, and done its duty, to escape into the air, and enables the attendants, during the entire boiling, to constantly turn over the caliche, thereby enabling the heat to penetrate into every crevice of the mass. The result is to extract more nitrate from the caliche, and less is thrown away in the ripia; hence, by this latter system, an economy is effected in caliche, which more than balances the extra consumption of fuel.

In the closed cachucha the caliche is first placed in boxes made of perforated iron plating, which are mounted on wheels, and are pushed along a tramway into the cachucha. To overcome the difficulty of stirring up the mass, boxes have been made of a circular shape, and capable of revolving on their standards when locked to an axle worked by a wheel on the outside. This plan, however, proved a failure, on account of the accumulation of insoluble matter at the bottom of the cachucha, which completely wedged in the boxes, and the attempt to give the latter a rotary motion could only have been done at the risk of breaking the couplings and damaging the boxes themselves. This plan might be carried out by making the plant stronger, and by allowing adequate space for the insoluble matter which escapes from the boxes; but then that would be objectionable, on account of the large steam space it would afford in the cachucha, and the consequent impoverishment of the solution through the condensation of the steam.

There are other forms, known as egg-shaped cachuchas, owing to their similarity in form to an egg placed on the smaller end. These offer great facilities in the operation of charging and discharging the material. The caliche is conducted over a road to their upper part, and shot down. After being boiled, the solution is tapped, and the refuse allowed to fall into trucks placed beneath, which convey it to the spoil bank. The chief disadvantage of these cachuchas consists in the necessity of having at command considerable height for the

approach-road, and consequently they are chiefly used at those places where an adjoining hill affords that height, the manufactory being built at its base. Where no hill is available, the trucks may be raised on an inclined plane.

Chemists interested in the trade have of late been engaged in searching for a method of extracting iodine from caliche, but as the operation is known but to a few, and when known kept a dead secret, the author does not propose to touch further upon this subject.

The labour required for the different operations attendant on the production of nitrate is chiefly supplied by Bolivians. Great numbers of these people annually cross the Cordilleras, taking with them their wives and children, and offer themselves for hire at the saltpetre establishments. They earn from one to two dollars per day, and perform their work well, and they are much esteemed by the manufacturer for their docile disposition and readiness to obey orders. Their migratory habits never allow them to remain long in one locality; they remain perhaps six or twelve months, then leave in a tribe, to go to some adjacent establishment. Chinese coolies are employed at some places, but their feeble strength, and lack of *physique*, render them incapable of performing the hard work of mining, and the rough duties attendant upon this manufacture.

Mechanics, bricklayers, carpenters, and skilled artisans of any description command high wages in this district; and the manufacturers can well afford to pay them highly, as they calculate upon at least 50 per cent. of the wages returning to their pockets, by the sale of provisions and commodities of every description, of which they are the sole purveyors (the truck system).

Below is a copy of the balance-sheet of the working of an oficina, which may be taken to show a fair average of the profits made in prosperous times by careful management:—

March, 1873.

DISBURSEMENTS.

	Soles.
Elaboration	7,680
Coal, 2,300 quintals, at 1·5 soles	3,450
Mules	800
Provisions	3,000
House and office	1,200
Repairs and loss	600
Gross profit	3,670
	20,400

ENTRIES.

	Soles.
Sale of 14,000 quintals of nitrate, at 1·10 soles per quintal	15,400
Item provisions	5,000
	20,400

In this case the nitrate was delivered at the manufactory, from whence it had to be conveyed to the port by the purchaser, either by rail or by mules.

The cost of conveyance by mule service is fixed according to the distance of the manufactory from the port. Thus from La Noria to Iquique, the price is from 5 to 6 reals (Peruvian), and from other oficinas half the distance from the port the price is only half that amount. A good mule will carry three quintals, the usual load is two down to the port, and one-and-a-half up loaded with coal or provisions. Frequently the mules have to perform the journey there and back, some 28 miles each way, without touching water, owing to the total absence of that element in its natural state. For the use of the inhabitants sea water is condensed, but when the machines fail, and there is a scarcity, the price is too high to give drink to the mules; two cents. per gallon is the price paid at Iquique for condensed water, and sometimes as much as four is paid.

The construction of the Iquique and La Noria Railway did much to take the transport away from the mules, but it did not entirely succeed in doing so, owing to its inability to convey the enormous quantity of saltpetre daily brought down. The line starts in a northerly direction from the port, making towards the coast-cliffs, which it reaches at a distance of three miles, and at an elevation of some 300 feet. From that point it reverses its direction to the north, and creeps up the hill side on an incline of three per cent. until it attains the summit of the coast-cliffs at the station called Molle, which is situated at an elevation of 1,630 feet above the sea, and at a distance of ten miles from Iquique.

From thence it follows a generally direct course on to La Noria, winding itself round hill sides in curves of from 300 to 500 feet radius, sometimes raising itself high above the surrounding country where the latter dips and assumes the shape of a bowl, over the extreme edge of which the railway must necessarily pass, and at other times penetrating through deep cuttings of irregular porphyritic rocks, clearly indicating the volcanic agency that must have occurred to have caused their displacement, until it reaches the district known as La Noria. Throughout, the railway is of the 4 8½ gauge. Where there were cuttings near their *debris* supplied the fillings, and at other places trenches were dug at each side of the line. The chief want we experienced was soft earth or sand to pack in the permanent way with, which was very scarce, owing to the hard nature of the surface of the ground.

Though it is not proposed to give in this paper a detailed description of the railway, the points bearing on the transports of saltpetre are set down as follows:—

The grades between Iquique and La Noria vary from 3 to 5 per cent, and the up trains generally consist of the following loads—

	Eng. Tons.
One Fairlie locomotive in running order	54
Four American double bogie cars loaded, say 24 tons each.	96
One tank holding approximately 2,000 gallons of water and its car, say	22
One employé's car	12
Total	184

The inequality of the traffic, the up traffic not amounting to a third of the down, necessitates the hauling up of empty cars. Thus trains of from 8 to 10 empties are dispatched. The Fairlie engine has done some good service on this line, where it has shown its superiority over that of the American type. I will compare the work done with the theoretical duty the Farlies should perform. The average speed up the line is about 10 miles per hour, and loads up to 200 tons, including the engine and water tank, are hauled up inclines of 1 in 22 and even as steep as 1 in 20. Having the diameter of cylinder 15 inches, the stroke 22, and the driving-wheel 42 inches in diameter, and a mean pressure in the cylinders of 100 lbs., the following formula expresses the theoretical tractive force of the engine in lbs:—

$$\frac{15^2 \times 100 \times 22}{42} = 11{,}785 \text{ lbs. for a single pair of engines,}$$

which must be multiplied by 2 for the Fairlies, and which makes 23,570 lbs. total tractive force. The resistance due to gravity would be $\frac{2{,}240}{22} = 102$ lbs. per ton, and that due to friction say 10 lbs. The haulage force of the engine then is found thus—

$$\frac{23{,}570}{102 + 10} = 213 \text{ tons.}$$

On the downward journey, as many as 20 cars loaded with saltpetre have been lowered by these engines, but as the risk attendant upon the train breaking away is so considerable, the number has been reduced to 15 or 12,

representing a total load of some 340 tons. Each car is loaded up to 264 quintals, or nearly 12 English tons, and the bags are laid at each end, immediately over the bogie frames, leaving the middle part of the car empty. The price charged by the late company was 1½ cents per quintal per mile, being the price allowed in the concession from the Government, thus taking the distance of the manufactory from the port, about 33 miles, the cost of conveyance would be five Peruvian reals (equivalent to ten Spanish) per quintal.

From an extract taken from Consul Hutchinson's report on this trade, published in the Foreign-office Blue Book of Consular Reports for 1873, we learn that in eleven months of the year 1872 the total export of nitrate from Iquique was 3,983,798 quintals, or 362,163 per month. Since then it has no doubt increased, but we will take only that amount which would correspond to over 12,000 quintals conveyed daily to the port. For 120,000 quintals, some 45 cars would be required. Supposing the railway worked for a monopoly of both the up traffic (coal and provisions) and the down traffic, it could only approach such a monopoly with the following train service:—

Locomotives running per day.		Cars.
3	trains of provision and fuel cars, 4 cars loaded and one empty......	15
4	trains of 8 empty cars each	32
2	trains of water tanks to supply the above, 8 tanks each.	
9	Cars	47
	Water tanks......	16

This is only taking the up traffic to be one-fourth of the down; most probably it would reach as much as one-third, if not more, were the railway to secure a monopoly, then a greater number of trains would be required. The late company never possessed sufficient rolling-stock to attempt anything of this kind, and, in in addition, they had, as the present company have, to contend with the water question, which, in the author's opinion, would, were it to remain as at present, entirely prevent their securing a monopoly of the traffic. For working the first section, to Molle, the water is obtained from sea-water cleansed at Iquique, and for working the remainder of the line it is brought from a well in the interior in tanks to Molle, at an enormous cost. Until a proposed scheme for obtaining water from the interior, to be conveyed to the railway stations at Iquique through piping, is carried out, the railway company must continue to work under the great disadvantages enumerated above.

To show the large traffic returns which this important railway might, under certain conditions, earn, it is only necessary to refer to the amount of saltpetre shipped from the port of Iquique, in 1872, which approached 4,000,000 of quintals. The entries would be then, assuming a monopoly:—

	Soles.
4,000,000 of quintals, at 5 reals, taken to port	2,000,000
Up traffic, consisting of coal, corn, hay, provisions, and material of all descriptions, say one-third of above, 1,333,333, at 5 reals	666,666
Total of entries	2,666,666

Or equivalent to a sum of over £533,333 pounds sterling.

The author refrains to touch upon the working expenses, for fear of acting in opposition to the directors' wishes.

There are at present some 3,000 to 4,000 mules competing with the railway.

This line, as well as that to Pisagua to Sal de Obispo, was constructed by a private firm of Peruvians, Messrs. Montero Brothers, who are the owners of the property, and by whom it was worked until within the last five months.

Whilst dealing with the conveyance of saltpetre to the port, I must not omit to mention an unsuccessful endeavour made by a company to convey down the nitrate in a liquid state through iron piping. The company which entertained this project was called "La Compania Salitrera Barrenechea," now, I understand, in liquidation. The objects the promoters proposed to obtain were, firstly, to avoid as much as possible the use of steam in the reduction of the mineral, and thereby secure an economy in coal. Secondly, to save the freight of conveyance by rail or mule to the port. The first was sought (though I never visited the works at the mines), I believe, by dissolving the caliche in vertical pans by passing cold water through it, resembling the process of filtration. The solution drawn from the bottom of the pan was pumped up to high ground (for the mines lay in a hollow), whence it ran down by gravitation through piping to the works at the port. At the latter place the solution was boiled in large circular pans, heated by a fire placed so as to spread over the entire bottom of the pan. The result of the first experiment may be easily anticipated. The solution, impregnated with the salts it held in suspension, soon began to precipitate them, and a thick cake of nitrate and salt shortly collected at the bottom of the boilers, which were in consequence burnt, and rendered useless. Notwithstanding the wrong principles upon which the plant was designed, which the directors recognised, and which could have been remedied by an additional expenditure, the company apparently took no steps to modify these evils, and the real cause of their suspending their operations last September was, I understand, the fear they entertained as regards the quality of their lands. With caliche containing a large percentage of common salt no profit is to be made by working it, either with this or another system, though, it must be understood, I do not give any opinion upon the nature of the mines in question.

As regards the extent of land supposed to contain saltpetre, no formal measurement or survey has been made, for frequently land is supposed to contain nitrate which, on being opened, proves to be barren in that mineral.

The lands round about La Noria were those first worked, and there remains very little "virgin land" left in that quarter. There are large spaces, however, left untouched on the Pampa di Tamarugal, and nitrate is supposed to exist all along the southern border of the pampa, between the points known as Pozo di Almonte and Sal de Obispo, which are marked upon the map.

Numerous deposits are reported to exist in the south, where some oficinas have been opened, and a railway made to them from the port of Patillos, but for the reasons before stated, namely, for the want of a geological survey, it would be impossible to give any definite opinion as to the area of land containing saltpetre or its quality. Large portions of land in the south are said to contain nothing but beds of common salt.

I observe that Mr. Markham says, in his "Travels in Peru and India," "it is calculated that the nitrate grounds in this district (Tarapaca) cover 50 square leagues, and, allowing 100 pounds weight of nitrate for each square yard, this will give 63,000,000 tons, which at the present rate of consumption will last for 1,393 years." I cannot agree with Mr. Markham that the deposits cover so large an area as 450 square miles, but it might amount to 100, though that can only be a supposition, and no opinion can be made in reference to the quality of the nitrate. The estimate of one quintal to the square yard is too low in my opinion. I found, on having made an analysis of two specimens of caliche, they contained the following substances:—

1ST SPECIMEN (WHITE).

	Per cent.
Nitrate of soda	48
Common salt	40
Insoluble matters	12
	100

2ND SPECIMEN (YELLOW).

Nitrate of soda	55
Salt	35
Insoluble matters (containing sulphur)	10
	100

The mineral is found in layers of from a few inches three yards in thickness, and I think three quintals r yard of surface is a fair average for land containing trate in sufficient quantities to repay its working. Proded these lands in the south prove to be good, we may that case assume a total area of 100 square miles; t otherwise, excluding these, it would not be safe count upon more than one-third of that area, 0 square miles at three quintals per square yard ould give 42,240,000 tons, which at a consumption of 000,000 quintals per annum would last over three nturies. All these grounds have been claimed under e mining laws of the country by private individuals, d I believe the Government do not possess any of em at the present moment.

I will now describe the physical features of the untry upon which are based my suppositions as to the igin of these deposits. Ascending from the seaard the cuttings in the railway bring to view rocks of rphyritic formation. Granite is seen in a state of composition crossed with veins of quartz, and in other aces are beds of coal and sandstone. At the summit e railway cuts through a bed of white limestone embling marble by the polish it will take, and for hich rock it has been mistaken by many. To this ast range succeeds the vast plain of Tamarugal with alluvial coating, and which extends some thirty miles the foot of the second range of mountains, chiefly mposed of sandstone, and among which extinct lcanoes have been recognised. Another level plain tervenes between these latter and the range of mounins known as the Cordillera proper, among which is tuated the famous volcano "Isluga."

Returning to the Pampa of Tamarugal, a group of lls, ranging from 200 to 500 feet above its level, rders its western extremity. On the slope of these lls lie the deposits of saltpetre, and in no case has that ineral been found on the pampa itself. On its eastern de stands the second range of mountains already menoned. These mountains are pierced at frequent intervals y deep ravines, at the bottom of which small streams d their bed, but the uniform layers of boulders cked up on each side of the ravines leads the imaginaon to picture the large rivers, which at one time, no ubt, travelled down these channels on their way to ater the wooded plains of the pampa. Upon enterg the ravine of Tarapacá, two leagues of ground vered with boulders have to be traversed, and a deep lly still can be traced in the neighbourhood which ints out the course taken by a pre-historic river.

By one of those revolutions in nature, the occurrences which are proved by the researches of the geologist, e rains ceased to fall with their accustomed abundance, d have left, where formerly were forests and grassy ains, nothing but an immense arid desert. But though e rains are now insufficient to form themselves into vers, they fall with regularity, and, being absorbed by e earth, they percolate through porous strata, to empty emselves into the natural reservoir beneath the surface the pampa. Thus water may be seen jetting out in rings at the foot of the eastern range of mountains, here it is obtained in large quantities by the natives, y driving tunnels into the yellow sandstone which forms the foundation of the slope. The crust at this point is chiefly sand and a limestone having a very washed appearance, from which water is also obtained, but it does not repay the working, as it is soon dried out.

At Pica there are two basins supplied with water in this manner, the one placed some fifteen feet above the other. The top one receives from its tunnel supplies of cold water, whilst the bottom receives warm water (90° Fah.) At a point a quarter of a mile up the hill, and (perhaps) at an increased elevation of 100 feet, another basin receives warm water; thus the anomaly is presented of a cold stream running betwen two hot streams.

Following the section of the pampa westwards for about ten miles, water is found beneath the surface at a depth of three yards. In this latitude a novel kind of cultivation is practised, namely, the capillary attraction which some plants possess to an inordinate degree is utilised by making them suck up the water through several feet of earth. The upper crust of saliferous sand is cleared away to a depth of some three feet, until the alluvial soil is encountered. A trench is thus formed, measuring fifty feet wide and several hundred feet long, and the excavated material is packed up on its borders. Alfafa, vegetables, and different cereals thrive well in these pits, and the cultivation proved so successful that the Government, who in that country must have a finger in every pie, established an agency to collect rents and to plant a farm on their own account, with the object of supplying the soldiery with vegetables.

At my last visit the Government agent was erecting a windmill destined to raise the water by means of a pump, so as to attempt surface irrigation. Considering the force and constancy of the south-westerly winds, the attempt will most likely prove successful.

Resuming a westerly course at the termination of another eight miles, the water is encountered at a lower depth, namely, at about six or eight yards below the surface, but is still sweet to the taste. Another eight miles in the same direction and the western hills are arrived at, where the water is found only at depths of from 40 to 100 yards, and, with only a few notable exceptions, so strongly impregnated with saliferous matter, that it is unfit for the use of animals. Thus the pampa may be compared to a cup, slightly tilted up at one end and filled with a fluid, the surface of which is depressed from the natural level by the weight of a covering whose depth increases in proportion to its distance from the raised end. This subterranean reservoir is supplied directly from the rainy district, and as a proof of the free connection which exists between itself and its sources, it is only necessary to refer to the fact of the simultaneous rising of the water in the wells almost immediately after the commencement of the rainy season.

Now, taking into consideration the facts above enumerated, the position of the deposits beneath the surface of a lee-shore, the proximity of numerous volcanoes uniting with their lava, probably large quantities of salts, sodas, sulphurs, and other substances, and lastly, the direct communication maintained by the rivers between the volcanoes and the nitrate grounds, would it not be reasonable to suppose that these deposits derive their origin from volcanic discharge? Is it not probable to suppose the lava discharged during eruptions, and falling into the ravines, was snatched up by the rivers in the latter, and whilst its heavier particles were deposited in the neighbourhood, the lighter, consisting of the salts, were conveyed across the desert and thrown upon the opposing shore, which became coated with the deposits on the withdrawing of the waters in the dry season?

With the arrival of the fogs in the winter, this coating of soda would experience rapid liquefaction through the condensation of the fogs, and the product would be absorbed by the porous soil of the formation.

It would seem that no suitable place offered itself for

the accumulation of the deposits on the eastern side of the pampa, where they would have been rapidly dissolved, and washed off by the rains, and, indeed, where the hardness of the formation would not have permitted of their percolation.

Bolleart, in his "Antiquities of Peru, &c.," whilst opposing Darwin's opinion, that the pampa was formerly an inland sea, and obtained its salt thereby, says:—"As to iodic salts, we need not look for them to the sea, as iodine and bromine exist in the minerals of the regions;" and in another part he hints at the probability of their being derived from volcanic sources.

If Darwin was right, would not the greater part of the pampa be covered with salt on the evaporation of the sea-water? But it is not so, as no beds of salt on the pampa have been discovered after boring for a considerable depth. It lies only on the slopes of the western shore.

The heavy fogs to which I have alluded appear between the months of March and October, and on condensing leave a thin coating of chloride of sodium on projecting rocks and stones, or any impediment which seems to arrest their course.

To bring back to memory the origin of these sea fogs, I will quote what Captain Maury says about those of Newfoundland, in his "Physical Geology of the Sea," article 166:—"The fogs of Newfoundland, which so much endanger navigation in the spring and summer, doubtless owe their existence to the presence, in that cold sea, of immense volumes of warm water, brought by the Gulf Stream." A distinguished scientist, Señor Raimondi, in his "Apuntes sobre la Provincia litoral di Loreto," says at p. 7:—"The immense extent of sand stretching along the coast of Peru, in some places from 15 to 20 leagues in breadth, has likewise to do with the absence of rain, because, being a good conductor of caloric, the sand, acted upon by the sun, evaporates a current of warm air, which prevents the watery vapours already spoken of from being condensed. In winter time, the atmosphere being of course colder, and the sand, being a better conductor of heat than the water of the sea, becomes colder than the latter, so that its low temperature causes the condensation from which we have the fogs so general in winter time on the coast of Peru."

It appears to me, in addition to this last reason given by Raimondi, that the fogs are caused just in the same manner as those off Newfoundland, with the difference that, in lieu of warm water pouring itself upon cold, the cold water of Humboldt's current, coming from the south Polar regions, mingles with the comparatively warm waters of the Pacific coast, thus producing the same effect. These fogs appear at night time, when frequently the thermometer descends below freezing point, to rise again, at 10 a.m., to 60° Fah., and at noon to 80° Fah. in the shade.

To strengthen the supposition of these deposits having been created through volcanic agency, I will again quote Humboldt; at p. 397 in vol. iii. of his "Travels in South America," he says:—"The enormous masses of muriate of soda recently thrown up by Vesuvius; the small veins of that salt which I have often seen traverse the most recently ejected lavas, and of which the origin (by sublimation) appears similar to that of ologist-iron deposited in the same vents; the layers of gem salt and saliferous clay of the trachyte soil of the plains of Peru, and around the volcanoes of the Andes of Quito, are well worthy the attention of geologists who would discuss the origin of formations."

I must mention that the grounds are nearly everywhere covered with flat pieces of clinkstone or phonolite, averaging in size from a few inches to a square foot. A strong opinion is entertained by the natives that these blocks of stone are aerolites. As they belong to the trachytic family, it is probable to suppose their having been washed down from the volcanic mountains, and to account for their being found on the top of hills of moderate height, an upheaval might have occurred subsequently to their being deposited.

If we admit Humboldt's view as regards the sometime disposal of materials discharged from volcanoes, the origin of the saltpetre deposits will have been almost proved to demonstration, for the volcanoes would supply the materials which would be conveyed by the hydraulic agency I have attempted to describe, to the site they now occupy, where, after being dissolved by the fogs—naturally converted into liquid—and absorbed by the earth, in union with nitrogen derived from the atmosphere, they are dug out as nitrate of soda, for the use and to promote the prosperity of man.

The author has abstained in this paper from touching upon the use which is made of nitrate in this and in other countries, for he considers the important position it occupies in various compounds, and its large employment in agriculture, well deserve a special study and the preparation of a second treatise.

THE PROGRESS OF WOOL PRODUCTION IN OUR COLONIES.

By P. L. Simmonds.

Of the various occupations and industries which have taken root in our colonies, none is more remarkable, and has been fraught with greater advantage, both to the colonists and the mother country, than the extension of the great pastoral interest which has spread flocks and herds over vast territories of unoccupied waste land, and carried wealth and material improvements in its train.

The important influence of the wool industry is evident in the social progress made in our colonies. It has civilised and given employment to Kafirs, Zulus, and Maories. It has been the means of improving steam navigation, and introducing railways and telegraphs in the Cape Colony, Australia, Tasmania, and New Zealand.

Within little more than three-quarters of a century our colonies have risen to more than double the pastoral wealth which the mother country possesses. In this paper I propose to deal only with sheep, and therefore pass over all other live stock. When we find that the Australian colonies possess half as many more sheep as there are owned in the United Kingdom, and indeed more than any European State, that the Cape has 10,000,000 sheep, our North American colonies 3,000,000, and some few other of the colonies help to bring up the total number to about 72,000,000 head of sheep, we shall perceive how important our colonial possessions are, even as mere purveyors of the raw material of wool for our home manufactures.

If we trace back the early progress of sheep farming in the colonies, we find that New South Wales was the first in the field, exporting wool in 1795. Victoria and South Australia commenced in 1836, New Zealand in 1839, and Queensland in 1860, and the Cape Colony shipped wool in 1820. While New South Wales took 35 years to reach an export of 899,750lbs., the Cape Colony produced in 28 years 911,118lbs., and has since outstripped the old Australian colony, which had the start of some 30 years.

Before passing to a separate consideration of the wool-producing colonies, let us look at the figures of our requirements past and present for wool. In 1823, the last year of the high import duty of 6d. per pound, the entire importation of wool was 19,336,000lbs.; in 1841, the last year of the low duty of 1d. per pound, the imports had risen to 56,170,000lbs.; and in 1853, the year before the commencement of the Russian war, it had increased to 117,248,000lbs. In 1823 the importations consisted almost exclusively of wool, the growth of Spain and Germany. Even as late as 1841 the Australian colonies contributed only 12,399,000lbs.; British India furnished 3,000,000lbs.; and the Cape Colony 1,079,000lbs. The

pid progress made in the production by our British ssessions beyond the seas since then will be found ced in the subsequent details and tables furnished.

If we were dependent only upon the home production wool for our woollen clothing we should fare very dly, since our stock of sheep is not equal to that of the pulation, and the average single fleece of a sheep uld scarcely make one garment a year for each person. reover, the stock of sheep is limited by the restricted sturage and the current demands for our daily food, d can never, therefore, be largely extended as in the lonies.

It is difficult to ascertain precisely our home yield of ol. A Bradford paper (which should be well informed) ently computed the yield of British wool for 1874, at 7,072,379 lbs., which was estimated to be an aggre- te increase, in round numbers, of 1,600,000 lbs. over clip of 1873, of 11,360,000 lbs. over that of 1872, d of no less than 15 per cent., or 22,260,000 lbs. over yield of 1871.

Let us, taking this calculation for home production (of out 4½ pounds of wool per sheep), see what wool s available for manufacture in 1874:—

	lbs.
e imports of foreign and colonial wool were	388,800,481
e home clip	167,042,379
in wool from imported sheep	500,000
Total	556,342,860
eign and colonial wool re-exported	144,362,359
itish wool exported	10,047,333
Total	154,409,692

us leaving for home consumption 401,933,168 lbs., sides 57,361,920 lbs. of foreign woollen rags imported be re-worked up into shoddy cloth. Although the ports of wool into England have increased so largely, yet the demand for English wool has kept pace with the supply, and is likely to continue, and there has been no fall in the price of imported wool. In the last few years there has been a decline in the gross amount of our export trade, and hence the leading manufactures of the kingdom have suffered, but we shall find that the woollen industry of the country constitutes a very important part of the aggregate export foreign trade. Relatively, in their total value, the three principal manufactures of the kingdom stand as follows in the returns of the shipments for 1874:—

Cotton-yarn and manufactures	£74,232,370
Iron and steel manufactures (including machinery and mill-work)	40,996,356
Woollen-yarn and manufactures	28,353,940

The relative position of the woollen industry is shown in the decennial return of exports, the only criterion we have to guide us.

	Value of woollen-yarn and manufactures exported.
1850	£10,040,332
1860	16,000,448
1870	31,831,217
1874	28,353,940

In 1861 there were in the United Kingdom 1,679 factories, with 2,182,609 spindles and 21,770 power-looms engaged in the woollen and worsted trades, and in 1868 (the latest date for which we have official returns) the number had risen to 2,465 factories, with 6,976,828 spindles and 122,499 power-looms. With a fair field and no favour, England, it has been well observed, will in commerce as in other things, ever keep in the van of civilisation and progress.

The great advance made in the woollen trade is best exemplified by the large supplies received and worked up in this country in the past twenty years. Below is an abstract of the quinquennial imports in lbs.:—

	1855.	1860.	1865.	1870.	1874.
BRITISH POSSESSIONS.					
stralia	49,142,000	59,166,000	109,734,000	175,081,000	225,426,101
dia	14,283,000	20,214,000	17,105,000	11,143,000	19,099,273
uth Africa	11,075,000	16,574,000	29,220,000	32,785,000	42,015,777
FOREIGN COUNTRIES.					
ain	68,000	1,000,000	115,000	25,262	} 34,758,391
rmany	6,128,000	9,292,000	6,858,000	4,405,897	
her European States	8,119,000	28,570,000	27,693,000	19,981,211	
uth America	7,106,000	8,950,000	17,867,000	8,896,764	} 17,500,939
her Countries	3,379,000	4,630,000	3,614,000	6,536,250	
Total imports	99,300,000	148,396,000	212,206,000	263,250,500	388,800,481
-exported	29,453,000	30,761,000	82,445,000	92,542,384	144,362,359
ft for consumption	69,847,000	117,635,000	129,761,000	170,708,115	244,438,122

To this must be added the following quantity of ollen rags in tons, and yarn in lbs., imported to be rked up:—

Year.	Rags, tons.	Yarn, lbs.
1860	5,934	3,007,711
1865	14,585	4,392,090
1870	17,210	10,294,415
1874	25,612	13,114,130

The following table shows the total quantity of wool ported from the principal British possessions in the ars 1858 and 1872 respectively in lbs.:—

	1858.		1872.
India	18,635,426	..	24,250,904
New South Wales	13,656,814	..	37,999,509
Victoria	21,515,958	..	58,648,977
South Australia	8,101,768	..	34,650,631
Western Australia	543,504	..	1,839,562
Tasmania	4,755,318	..	5,998,527
New Zealand	3,810,372	..	41,886,997
Queensland	..	..	17,793,392
Total for Australia	52,383,734	..	198,817,595

	1866.		1872.
Natal	220,284	..	5,654,416
Cape Colony	16,997,029	..	48,841,314
British America	1,545,412	..	3,191,834
Total	89,781,835	..	280,756,068

Value of the Wool Exported in 1872.

New South Wales	£2,496,509
Victoria	4,651,665
South Australia	1,692,609
Tasmania	434,233
New Zealand	2,587,919
Queensland	1,169,812
Western Australia	300,000
India	906,698
British America	299,455
South Africa	3,530,547
	18,019,447

The preceding tables show at a glance the present magnitude and value of the wool trade. At the close of the Peninsular war British colonial wool did not exist, and this country was the chief purchaser of French and German wools. Now France, Belgium, and Germany are the largest buyers of British colonial wool in London, and the importation of French and German merino wool has nearly ceased. About 750,000 bales of colonial wool are annually sold at the London wool sales, which, estimated at £20 per bale, means, roughly speaking, an expenditure on that product alone of £15,000,000 a-year. In 1874 the imports from the colonies were 816,000 bales, and this year that quantity will be surpassed. The Board of Trade returns give the official value of the wool from all British possessions imported in 1874 at £17,673,294.

Supposing one shepherd sufficient for each 500 sheep (an extreme limit), 116,000 male adults will be employed in tending the Australian flocks, and 20,000 in South Africa. How many more persons are indirectly employed in the annual shearing of the wool, its transit to the coast, packing, &c., cannot be ascertained, but there can be little doubt that at least one-fourth of the general population derive employment and subsistence from the breeding of sheep. The flesh in Australia is a secondary consideration, the produce of the fleece being the primary object of by far the larger portion of the sheep breeders. The sheep also gives immediate employment to thousands of others, who in their several spheres utilise different parts of it for the various uses of the great human family. Among these we have the producer, the butcher, the skinner, the tanner, shoemaker, tallow-chandler, &c. Then the fleece gives employment to the wool brokers, wool staplers, spinners, manufacturers, dyers, clothiers, &c., and the various subsidiary branches of trade these give rise to. There are more than half a million operatives engaged in the woollen and worsted factories of the United Kingdom, besides those employed in the factories of the colonies. The colonial wool trade also gives extensive employment to our shipping. Except, perhaps, in the River Plate districts, whose production appears as boundless as its plains, the growth of wool has nowhere increased in so extraordinary a degree as in the Australian colonies.

The decennial progress in our direct imports of wool from Australia, is shown by the following figures:—

	lbs.
1831	2,541,205
1841	12,399,392
1851	41,810,117
1861	74,000,000
1871	182,753,585
1874	225,426,101

This, however, does not represent the whole of the production, some being now worked up in the colonies, and some shipped to other countries than the United Kingdom.

Within the duration of an ordinary life the flocks and herds of the early settlers of New South Wales have overspread nearly the whole of the vast continent of Australia and the islands of Tasmania and New Zealand, until the export value of this produce is over fifteen and a quarter millions, and this is only the colonial value, which is far exceeded in the European markets. The yearly income from its live stock to the colony of New South Wales alone is estimated at £9,000,000 and upwards, and represents a capital of about £30,000,000.

The history of the Australian wool trade is one of the most remarkable features in the commerce of the country. In 1816, New South Wales sent us [illegible] bales; in 1828, the whole of Australia, 650 bales, weighing 120,000 lbs.; in 1836, 27,000 bales, weighing 6,000,000 lbs.; in 1851, 144,000 bales, weighing 43,000,000 lbs.; and in 1874, the quantity imported from all our settlements in Australia had advanced to nearly 225,500,000 lbs.

The importance of the Australian wools cannot, however, be estimated alone by the quantity imported, considerable as it is, for the quality is so fine, that only Saxony and the best clips of the Continent could supply their place, British wool being generally wholly unsuitable for the purposes to which colonial wools are applied.

The produce of the Australian flocks is at the present time in very high and deserved repute in England and on the Continent. This reputation arises chiefly from the peculiar softness of the cloth and other fabrics made from these wools. It is, therefore, very desirable that the growers should exert themselves to combine the highest possible degree of fineness with this softness of handle, making it a rule to breed from rams of the finest wool and purest race they can obtain; purity of blood being the great essential towards producing wool of that uniform fineness of fibre, elasticity, and closeness of staple, which can alone enable the manufacturer to make a cloth smooth on the face as well as soft to the touch.

A breed of sheep to produce fine wool is distinct from a breed to produce mutton and wool. Of fine-woolled sheep the pure merino takes the first place, producing a heavier fleece, and of equal quality. The merino sheep has another great advantage over the Saxony merino, as it is much larger, hardier, and less liable to disease. The Saxony merino requires to be always housed during night, and is found by farmers even in Saxony to be so unprofitable that the numbers kept are being gradually diminished.

In 1862, the flocks of New South Wales produced 20,988,393 lbs. of wool, of the estimated value of £1,801,186, being an average of over 3 lbs. 6 ozs. of wool per sheep, and an estimated value of nearly 1s. 6d. per lb. In 1866, the production had increased to 36,980,685 lbs. of wool, with an estimated value of £2,830,348, or a little over 1s. 6d. per lb.; thus exhibiting an increase in the production to the extent of 76 per cent. In the next four years, the exports reached in 1871, 65,611,953 lbs. of wool, the estimated value being £4,748,160, or a little over 1s. 5d. per pound. This was equal to an increase of 212 per cent. in the ten years, and nearly 80 per cent. in the previous five years. The clip of 1872 gave an average yield of 4 lb. 12 ozs. of greasy wool (or 2 lb. 14 ozs. of washed wool to the fleece) that is, 1 lb. 10 ozs. over the clip of 1862. About 41 per cent. of the wool clip of New South Wales goes to Melbourne or Adelaide for shipment.

The following shows the rate of increase in sheep in the colony:—(1862) 6,145,651; (1871) 16,278,697; (1874) 19,928,590.

In 1871, there was in New South Wales thirty-two head of sheep for every man, woman, and child in the community, and last year the returns of the chief inspector of stock gave the numbers at nearly 20,000,000. But multitudinous as the flocks and herds of Australia have become, nothing like justice has yet been done to the grazing capabilities of the country. When the vast territories of the great Australian continent shall have been

...eemed from the state of nature in which they now lie, ...t limits shall we put to the production of wool, and ...bably of preserved meat? Markets for colonial wool ...e been established on the continent of Europe, and ...the Eastern and Western States of the American ...ion, as well as in the mother country. There is, still, ...refore, ample room and range enough in Australia ...New Zealand for the profitable employment of ...ital and labour in this solid industry. The extent of ...d unalienated—that is, not granted or sold—in the ...ral colonies at the close of 1873 was as follows:—

	Acres.
Victoria	47,045,670
New South Wales	193,933,547
Queensland	432,953,462
South Australia	580,057,566
Western Australia	624,599,113
	1,877,589,358
Tasmania	12,872,115
New Zealand	50,673,211
	1,941,134,648

...e total area leased for pastoral purposes in New ...h Wales is about 138½ million acres, the great bulk ...hich is held on one and five years' leases respectively. ...pastoral holdings, or "squatting runs" as they are ...d in the colonies, range from 14,000 to 500,000 acres, ...grass from 4,000 to 180,000 sheep. Many of the ...ters have obtained enormous wealth as the reward ...eir enterprise in the pioneer settlement of the ...try. A local writer observes, "There are to-day ...re of men who began life in this colony as shep-...s, who are now worth from £30,000 to £50,000, and ...wealth of some, derived exclusively from pastoral ...uits, exceeds a million pounds sterling. The yearly ...ase of the live stock owned by one gentleman in ...South Wales is 2,000 calves and 50,000 lambs. ...rent paid to the Government for the use of the land ...m £30 to £800 per annum; the average of the ...rent for 1872 being less than a halfpenny per acre ...e whole colony."

...New South Wales the latest statistics of wool pro-...on show an average clip for the whole colony of—

...y wool, very nearly	5 lbs.
...water washed	2 lbs. 12 oz.
...ed wool	2 lbs. 10 „
...water washed	2 lbs. 7½ „

(*To be continued.*)

...e Scott-Moncrieff tramway car, which is ...d by compressed air, was recently tested on the ...and Glasgow Railway. On two journeys out of the ...the car started with a pressure of 300 lb. to the square ...nd on the third, which was commenced with a pressure ...lb., the speed attained was 10 miles an hour. The car ...rted to have been fully under control; the speed could ...reased or reduced at pleasure, and the operations of ...g, stopping, and reversing were readily performed. ...timated cost of the power is 1½d. per mile, whereas ...power is calculated at 7d. a mile. The vehicle resembles ...inary car, but is a little higher, the reservoir of air ...carried on the roof.

...e workmen of Ghent have been giving them-...a three days' holiday in Liège, visiting the principal ...rial establishments in the neighbourhood, amongst ...hat of the Compagnie de Seraing, Cockerill's Works, ...6,000 workmen are employed, and the glass works at ...t. Lambert, employing 2,000. The visit is reported to ...een both successful and agreeable.

...e commission appointed by the Prefect of the ...to report upon lightning-conductors, and the method ...structing them, recommend the use of copper terminal ...instead of platinum.

THE SUGAR TRADE OF BRISTOL.*

By Henry T. Chamberlain.

It was desirable that this subject should have been taken up by a practical scientific man, so that the manufacturing process might be treated, not only with minuteness and exactitude, but also in a closely scientific manner; but, failing that, this paper has been prepared by one who has during the last 35 years had an every-day practical knowledge of the general sugar trade of this city, with some sugar refining work, and who at the call of this association, though affected by the rays only of science which from time to time reach him, is ready and willing to impart to others, to the best of his ability, what little knowledge he may possess. The most extensive sugar refiner in Bristol has, however, kindly looked over that part of this paper which relates to actual manufacture, and approved its correctness. For about two centuries the refining of sugar has been carried on, more or less extensively, in this ancient city, and during that period many and great changes have taken place. This paper, however, is not intended to treat of much beyond the old and the new style of manufacture of the article as imported, a paper having been prepared for another section of this association on the general rise and progress of the sugar trade in Bristol, namely, in Section F, Economic Science and Statistics. In old times the method of refining was very rude, the sugar was turned into large open pans, mixed with some water, melted by fire heat, and brought to a thick consistency and a certain temperature; it was well stirred, and when sufficiently so treated it was ladled out into large moulds of the sugar-loaf shape, plugged at the ends, which were then placed downwards, and when the sugar was well set the plug was removed, and the sugar allowed to drain itself off the syrup or treacle; the result being sugar of different goodness, according to the quality of the original raw, and the carelessness or otherwise of this first rude manufacture. The sugar was then re-melted, defecated, and clarified, fit for making refined or loaf sugar. The use of animal charcoal and the manufacture of loaf sugar were great improvements, and went on up to the introduction of the vacuum pan. The sugar being melted and clarified, was run into loaf moulds, which were placed upon the floors, as with the coarser kinds, but these finer sorts were carefully liquored by white syrup poured upon them, which, passing downwards, washed through, purified and bleached into whiteness the mass in the moulds, which, after being allowed to run dry, were trimmed and papered, and then "stoved." The stove was a massive building of fire-bricks, with iron doors, and fitted with racks, heated and kept at a temperature of about 150 degrees, where the loaves were placed, and remained a few days, until all moisture had passed off, when they were taken out and stacked in a dry warehouse ready for sale. This was a very long, and somewhat tedious and uncertain process, and was much shortened by the introduction of the vacuum pan, centrifugal machine, and other improvements, which brings us to the present method of refining. It must be here mentioned that, with the exception of a moderate quantity made during the last French and German war, loaf sugar has ceased to be manufactured here. It is a fact that the French manufacturers of loaf sugar have, owing to the support of their own government, by indirect bounties and fiscal regulations in their favour, been enabled to undersell us in this particular article, not only in this city, which has so long been a place of production, but also in all other places throughout the United Kingdom, thereby not only destroying the manufacture of loaves in this country, but also seriously affecting all the higher class produce of our refiners, so that it has become impossible to make them profitably, and the manufacture of loaves

* Paper read before the British Association.

has therefore been altogether abandoned and given up, except in London, where some quantity is still made, but even this, it is fully expected, will shortly cease. The refiners now confine their operations to the production of the finest crystals, and other quality crystals, and pieces of various kinds, which are softer than crystals, from fine sparkling white to fine yellow and ordinary yellow, and syrup or treacle, all of which at their outcome from the refineries are in a very good and pure state, many of them very beautiful, and most of them pleasing to the eye, and clean to the taste, in fact, well and carefully refined and manufactured. The following description does not apply to any one particular refinery, but to the course of proceeding most generally followed in this city, particular houses possessing of course each its own ideas and system, founded upon the practical knowledge and experience of their own working, and also upon the scientific knowledge now brought to bear upon sugar refining in many of its branches. We take then the raw sugar as imported. The packages, whether cases, hogsheads, baskets, or bags, as it may be, are received into the sugar house, raised by steam pulleys to the highest floor, where they are opened and the sugar turned into the first melting pan, with a little water. In some houses this is an open pan with coil steam pipe, in others a vacuum pan. The first melting produces a rather thick syrup with all the impurities of the sugar in it. This is then run into the filter bags, which are placed round the floor, generally at a lower level, to run by gravitation to save pumping; the filter bags retain the first impurities, and the syrup passes from them into large cisterns underneath, prepared for that purpose. From these it is pumped or run into the tops of the charcoal cisterns or filters, which are tall and generally cylindrical, made of iron, and filled with many tons of animal charcoal, through which the syrup passes, and comes out free from all impurity, clear and rich, the first runnings as colourless as water, the extreme clearness depending on how long the charcoal is used. The syrup is then run into cisterns and is ready for the vacuum pan, where it is boiled at a very low temperature, which prevents all danger of burning, the heat being generated by steam. The boiling in vacuum is continued up to the granulating or crystallising point, and here the greatest skill of the practical man is requisite, to determine the right moment to cease boiling and discharge the now almost formed sugar from the pan. This is done into vessels below upon wheels, which cart it away to the centrifugal machines, where it is whirled round with inconceivable rapidity, washed with liquor whilst rotating, which with all other liquid is thrown off through the sieve-like sides of the machine and runs down into cisterns prepared for it, to be afterwards dealt with. The sugar is ready to be taken out in a few minutes, finished and fit for use; it is scooped out and carried away to the mixing floor, where it is turned over and over by manual labour, and then run down a shute into the casks, and packed. Then it is weighed and marked, and quite ready for the grocer's use, and consumption by the public. This process applies with but little change to all the various qualities at present made by our refiners, and the result is according to the strength and purity of the filtered syrup and skilful boiling in vacuum. All the syrup remaining uncrystallisable forms treacle, which is put in cisterns, and thence into tight casks, ready for use. The empty packages, or anything else saturated with sugar, are thoroughly steamed, and the sweet water and all washings are boiled and evaporated, so that every available particle of saccharine matter is obtained and nothing is lost. And let none think lightly of the business of the modern sugar refiner. The practical man requires health of body and strength of mind, determined perseverance and thorough knowledge of the business in all its branches. He has to control the entire working of his house, machinery, and men, to take a large clear view of the whole factory from roof to basement, to comprehend at a glance its largest and smallest detail, to know exactly when the least thing is wrong, and how best and quickest to set it right, in machinery, pans, pipes, cisterns, syrups, and so on; to watch the whole working of the house, and, if necessary, to alter it to suit the market demand. In addition to all this, he has to watch the market for raw material, and meet its changes and chances with a ready mind to calculate and compare. In short, to thoroughly exercise a good judgment, and having done all this, indeed all that can be done, [illegible] then outside circumstances may prevent profit being made, for there is probably at this present time [illegible] ness and manufacture more difficult to make [illegible] profitable than that of sugar refining. But to go [illegible] the causes of this position, some of which have [illegible] lately arisen, would be outside the design of this [illegible] The old sugar houses were very primitive [illegible] the workings comparatively small. Even at the beginning of the present century there were no less than [illegible] sugar refinery firms in Bristol; the names are still [illegible] known. All these were at full work on the old [illegible] some melting only three hogsheads a week, while [illegible] in 1875, one of our houses is capable of refining [illegible] than all of them put together. In this present [illegible] there are four refiners in Bristol, viz:—

	Tons.
The Counterslip (Messrs. Finzel and Sons)	1,1[illegible] a week
The Bristol Sugar Refining Company ..	[illegible]
The Castle Company (Messrs. Wills, Young, and Co.)	[illegible]
The Avonside Sugar Refining Company..	[illegible]

Thus working, or capable of working, altogether [illegible] 1,700 to 1,800 tons a week, employing many hundreds [illegible] men, and consuming large quantities of stores [illegible] descriptions, giving occupation to many other [illegible] besides creating large monetary transactions [illegible] tensive shipping and import business. [illegible] names might be mentioned of those who have [illegible] and increased the sugar trade and refining [illegible] and are passed away for ever, but to do so would [illegible] greatly enlarge this paper. But we need not [illegible] paying a passing tribute of respect and kindly remembrance to the memory of one—the late Conrad [illegible] who did more than any other to increase and [illegible] the manufacture in this city, and, indeed, to improve [illegible] manufacture throughout the United Kingdom [illegible] whole sugar-producing world. He was a man [illegible] known to many of us, of a warm heart and [illegible] position, generous, and benevolent—a man who [illegible] as the reward of his own application and industry, [illegible] flowed in upon him, had the courage to part [illegible] freely, in his lifetime, for the benefit of others. [illegible] told the writer that he considered himself but the [illegible] of all that he possessed. He has passed away [illegible] scene of action, and no doubt has now been able [illegible] a good account of his stewardship. May we who [illegible] emulate his good example.

It appears from a Board of Trade return [illegible] the percentage of double lines of railways worked [illegible] absolute block system in the present year [illegible] cent. of the English lines, 33 per cent. of the Scotch [illegible] and 11 per cent. of the Irish lines. The following [illegible] work the whole of their double lines on the [illegible] system, viz., Bristol and Exeter, Cambrian, [illegible] ness, Hammersmith and City, London and South [illegible] London Brighton and South Coast, London Chatham [illegible] Dover, Macclesfield, Metropolitan, Metropolitan [illegible] North and South Western Junction, North London, [illegible] Staffordshire, Rhymney, Sirhowy, South Devon, [illegible] Eastern, City of Glasgow Union, Glasgow and [illegible] Glasgow and Paisley, and Great North of Scotland.

An attempt to acclimatise caoutchouc-yielding trees in the island of Bourbon is being made. [illegible] *Madagascariensis*, a plant which begins to yield [illegible] the first year, is being raised in great numbers.

E GEOGRAPHICAL CONGRESS AND EXHIBITION AT PARIS.

[FROM A CORRESPONDENT.]

eturning now to the French section, of which I have ady noticed many of the chief characteristics, it seems me but justice to make the remark that the general ct and impression produced on the visitors is emitly favourable, and in particular subversive of the ular notion that, as a nation, France was behind the in matters geographical—however true that may e been of their army and staff, in comparison with ir antagonists in the last war. Indeed, anyone ing here with any such preconceived idea, would n find reason to modify such foregone conclusion, if entirely to withdraw it. The exhibits of Belin or lagrave would alone suffice to correct the accepted w; both the exhibitors named have received the rd of a First-class Medal. It is worthy of note also, t a similar mark of recognition and merit has also n paid to a French lady, Mademoiselle Caroline inhaus (a member of the Geographical Society of ris), whose name is associated with the production of relief maps which form so important and interesting ature in the Geographical Exhibition. These reliefs models are of many kinds, and serve to show in an remely graphic manner, and as it were to scale, the f physical configuration and contours of the countries districts so represented. They constitute important ncts in the new, higher, and more scientific method geographical teaching, characterised as the topophical, which appeals more directly to the intellect the imagination, awakening an intelligent interest he subject to be acquired, and elevating it far above monotonous level of mere learning by rote. To use mmon phrase, these relief maps should be seen and lied to be appreciated; wherefore this brief reference l suffice, as to enter into details would encumber r columns with intricate explanations.

The particular exhibit which won honours for the y, as above mentioned, is a complete map in relief of nce, on a horizontal scale of 1 in 1,000,000, the vertiscale being 1 in 250,000, and is the work of several s, produced in conjunction with the eminent memof the French Institute, E. Levasseur, to whom a t-class Medal has been awarded. A similar joint k, on the general scale of 1 in 1,000,000, produced by m for the Geographical Institute of France, is also ibited. One of these maps is also coloured hypsirically, with 20 tints and shades distinguishing the ous contours and levels. The adjoining districts of ghbouring countries are also included therein, such as n, Italy, Switzerland, Rhenish Germany, Belgium, Holland. It is a most elaborate work, and its cution has absorbed the labours of several years.

The "letters of distinction" awarded to Professor Van selberghe, of the Royal Belgian School of Navigat Ostend, for his universal recording meteorograph, the First-class Medal to Dr. Lemström, Professor at Helsingfors University, Sweden, for his apparatus for artificial production of the effects of the Aurora alis, relate, both of them, to instruments of the losophical class, not primarily geographical. These liances, however, fully merit something more than a ing notice, and the subjoined details will supply all is necessary for their appreciation.

The first-named apparatus may be regarded as markan important practical advance in the study and lication of meteorology, the most backward of the nces. Those who visited the Paris Exposition iverselle of 1867, may remember the meteorograph of her Secchi—to which the jury assigned the highest ours granted—which, by means of several pencils, ed, on one sheet of paper, the indications of the ometer and psychrometer, and on another sheet recorded the rainfall, and force and direction of the wind —a veritable monument, some four yards in height, and costing some £700 or £800. Regarding the meteorograph now exhibited in the Belgian section of the Geographical Exhibition at Paris, it is evident that in the past eight years considerable progress has been made in the simplification of methods and results, as well as in the element of cost—a considerable bearing essentially on the question of the general adoption of such an appliance. The Van Rysselberghe Universal Recorder, by means of a single graver, automatically engraves and graduates, on one and the same copper-plate, the indications of as many instruments as may be desired, and of whatever kind, whether situated close at hand or at a distance. Moreover, impressions of the plates can be reproduced by printing, and multiplied, so that such records can be exchanged between the different observing stations, with great ease and small cost. The size of the instrument at the Tuileries is less than 2 feet in each direction, and its cost about £160.

This automatic apparatus is applicable for all kinds of scientific observations, notably meteorology and hydrography, but also for astronomy, gunnery, and other like purposes. It acts by means of recording appliances at the various instruments, operating by magnetic agency and connections, in combination with horological and mechanical movements, and its records may be regulated at any required intervals, by the attachment of a suitable number of contact points around the dial of the clock, to be acted on by the minute hand in its hourly revolution. The electric current, thus intermittently established, releases a detent, and allows a coiled spring to effect one complete revolution of the cylinder, carrying on its surface the copper-plate which receives the records, engraved on it by the fine point of the graver, set in action simultaneously by the current on the closing of the circuit. It will be understood that the engraved or dotted line is practically continuous until intercepted by any interruption of the electric action, which is brought about in each case at the moment of ceasing to record the reading of each instrument, and for a period sufficient to make an adequate break; whereupon the circuit is again renewed, and the engraved line resumed by the next recording instrument, and then again suspended and so on. The axis of the cylinder, at its foot, is provided with a projecting toothed sector which during its revolution engages successively with cog-wheels (attached to each instrument and its recorder) arranged suitably round the cylinder.

Thus, *e.g.*, the first wheel when set in motion causes a sounding-rod to descend into the barometer tube; at the moment of contact the circuit is completed and the graver in action; consequently, the length of the engraved line corresponds exactly to and represents the barometric reading. After an interval, the cog-wheel, its sector having passed, becomes stationary; the sounder, being counterweighted, is withdrawn from the mercury to its normal position, the circuit is broken, and the graver ceases to act. The engraved line is continued subsequently, with similar interruptions, recording similarly and consecutively the readings of the ordinary thermometer, the dry and wet-bulb thermometers, the anemometer, both for force and direction, the pluviometer, &c., as each of their respective cog-wheels is set in motion by its corresponding sector. The entire revolution being completed, and all the records effected by the breaks of contiguity, the cylinder becomes stationary, and at the same time, by means of a partial movement communicated to an endless screw, the position of the graver is shifted, so that the next records are engraved by a line a short distance from and parallel to the preceding one.

In the case of indications manifested on a dial, such as those of the anemometer, the recording method varies slightly in detail; for, in lieu of the sounding-rod or "finder," descending vertically until it reaches the

surface of the mercury, a revolving "finder" is employed, which, being set free for a single revolution, goes round like a centre-seconds hand, searching for the indicator on the dial; at the moment of coincidence, the action of the graver is commenced, and the record effected exactly as in the other case.

In a precisely similar manner may be obtained records of the tidal waves, the dip of magnetic needles, and the like. Moreover it is to be remarked that by a suitable arrangement of insulated wires the records may be made at any one central place, for meteorological instruments located at stations elsewhere, or on a coast. The engraved plates and impressions printed therefrom, as here exhibited, suffice to show the graphic accuracy, promptness, and ease with which such a system of records can be maintained and spread abroad.

In another and improved variety of the instrument the cylinder-sectors and cog-wheels are replaced by a detached apparatus, in which the records are obtained by the to-and-fro motion of a horizontal carriage; but the operative principles are precisely the same. In both cases a "finder," or observing point, set in motion by clock-work, is despatched at regular intervals in search of every indicator; and, at each moment of contact, it transmits an electric signal to the graver, which, in instant obedience thereto, records the observation in a graduated form.

These instruments have been constructed for Professor Van Rysselberghe by Mr. Th. Schubart, instrument maker to the University of Ghent. Besides the apparatus for meteorological and tidal records at Ostend, there is one established for recording the tidal phenomena of the River Scheldt; and another is about to be put up for the Royal Musketry School of Belgium, at the Polygone de Brassehaet. Such a cheap and practical system of automatic record, rendered to a considerable extent independent of fallible human aid, is calculated to render inestimable service to the future of science in general, and meteorology in particular.

If Belgium has thus distinguished itself, Sweden is not backward on the field of honour, as evidenced, among other things, by the Lemström apparatus for the artificial generation of the Aurora Borealis in miniature. This apparatus is designated as "one of the results of the Swedish Arctic Expedition of 1868," and has been devised by Professor Lemström, and executed at the cost of Mr. Oscar Dickson, of Gothembourg, as a means of demonstrating that the Aurora Borealis is an electrical current, and to illustrate the theoretical explanation of that natural phenomenon.

That theory is, in brief, as follows:—The experience and knowledge which we possess of the electric condition of our earth shows that the globe itself is an electro-negative conductor, surrounded by an atmospheric stratum, which is an isolating non-conductor, and generally electro-positive. The electricity of the atmosphere may be due to the spheroidal nucleus itself, but is more probably generated by the continual evaporation going on at the earth's surface, either directly, because that process itself causes electricity, or indirectly, by the friction between the molecules of watery vapour and air. Be that as it may, electricity certainly exists in the atmosphere, and may be regarded as accumulating and concentrating more especially in one particular region or stratum thereof; for it is known that the electrical conductivity of that medium increases in a very rapid ratio with its rarefaction, or as its density decreases, attaining its maximum at a point where the atmospheric pressure becomes reduced to 5 or 10 millimetres of mercury; beyond which point, however, conductivity has been found to decrease, with further expansion, only in a slower ratio, at diminished pressures. Thus at a pressure of 5 to 10 millimetres the electrical conductivity of the atmosphere is several hundred times greater than at the pressure of 50 millimetres, and certainly ten thousand times greater than at the ordinary density, at the earth's surface, of 760 millimetres. But, as is known, the atmospheric pressure diminishes with its height, in accordance with the fixed law expressed by Laplace's well-known formula; and consequenntly, at a certain elevation above the earth, there exists a spherical ring or zone of rarified air, at a mean pressure of about 5 millimetres, and where the electric conductivity is relatively so great, that it may be regarded as a condenser in relation to the atmospheric regions, interior and exterior to it. The globe is therefore surrounded by a rarified electric conductor, concentric with it, isolation being effected and maintained by the intervening air of superior density; and as the two are in opposite electrical conditions, viz., the globe negative, the air-stratum positive, their mutual action and reaction are the necessary corollary; however, inasmuch as there is a difference of temperature between the poles and the equator, the conductive air-stratum will not only follow, but—like the snow-line—exceed the spherical form of the earth itself, and the distance between them will therefore be less, and consequently the attraction greater, at the poles than at the equator.

Assuming then a mean temperature of +28 degrees Centigrade (82 Fahr.) at the equator;—12 C. or 10 F. at the poles; and —60 C., or —76 F. for the conductive rarified air stratum; and assuming further that the air is half saturated with moisture, while the temperature diminishes in proportion to the elevation, we can calculate the difference in the respective heights by means of the following formula:—

$$x = 18{,}393 \text{ metres } (1 + 0{\cdot}002837 \cos. 2Q) \left\{ 1 + 0{\cdot}004 \frac{T+t}{[illegible]} \right\} \log. \frac{H}{h}$$

wherein x is the height, Q the latitude, T the temperature at the earth's surface, t that at the higher level, H and h, respectively, the corresponding barometric readings duly reduced.

Hence it results that the height of the barometric mean pressure of 5 millimetres is 37·34 kilometres at the equator, and 34·25 at the poles, or, respectively, about 23[illegible] and 21[illegible] English miles, and consequently we may regard the electric tension, both on the earth and in the air, as 7 times greater, and the force with which they tend to unite as 42 times greater at the poles than at the equator, approximately. Therefore it is that electricity accumulates in the Polar regions, producing electrical phenomena under the form of Aurora Borealis or Polar light.

It is a remarkable fact that thunder storms diminish, both in number and intensity, in proportion as the latitude increases, until they cease entirely beyond the 70th parallel, having previously manifested increased intensity. The explanation thereof is to be found in the depression, or approximation to the earth's surface, of the atmospheric storm region, and also in the diminution, or comparative cessation, of evaporation, the chief cause of electricity, with some minor subsidiary producing actions.

From all these considerations we may conclude that electricity of opposite kinds accumulate, at the poles, in the conductive air zone and at the earth's surface; these manifesting an attraction and tendency to unite, are kept in check and equilibrium by the isolating quality of the intervening non-conducting atmosphere. Whenever this balance is disturbed by meteorological changes, such as wind, moisture, evaporation, temperature, &c., the electric tension prevails, and manifestations result in the flashes, coruscations, rays and streamers, known as the Aurora Borealis, which impart such brilliant beauty to the Arctic sky.

In the apparatus, a small brass sphere, studded with steel points in the Polar region, represents the earth, and a series of Geissler tubes, with rarefied air, represent the air stratum. These tubes are arranged on a meridian line, radiating towards the centre of the globe, and each isolated therefrom by suitable glass and vulcanite supports and bearings; they are provided with platinum points at their two extremities, and these again are united at their

upper ends by an insulated wire to earth. The brass sphere is similarly connected with the negative pole of a static electric machine of which the positive pole is also to earth. So soon as the machine is put in operation, the conditions of the two condensers, respectively electro negative and positive, are realised, and the luminous phenomena become visible, the effect and display being intensified and enhanced by enclosing the apparatus in a dark chamber.

UTILISATION OF THE PRODUCTS OF MAIZE.

The maize crop, or Indian corn, is becoming an enormous produce in many countries, but more especially in the United States, and the great difficulty is to know to what useful purposes to apply the various portions of the plant. Some of the attempts made, more or less successfully, may be worth alluding to, for the information of those specially interested. The census of 1870 returned the crop of Indian corn in the United States at 440 million bushels, but the agricultural returns of a year or two ago stated the yield to be over 1,092 million bushels. Mr. Pakenham, British Secretary of Legation, in his report on the commerce of the United States for 1873, observes that between the total consumption and the total exports, as compared with the yield given in the official returns, there is a surplus of nearly 664,000,000 bushels of cereal products. Some of this aggregate is doubtless utilised, but there are no data or returns anywhere to show it. Inquiry from season to season only elicits the reply that when not burned it is for the most part applied to some inferior purpose or used for manure. Now such a waste as this, which is continually increasing with extended cultivation and absence of cheap facilities of transport, is lamentable. Our consumption here of maize, though large, is never likely to increase greatly, and there is the competition of other corn-growing countries in Europe, which grow maize extensively, such as Russia and the Lower Danube, and Turkey (including Moldavia and Wallachia). Any subsidiary uses that can be found are therefore beneficial, and deserve notice. The envelopes of the grain cob (the sheathing leaves enclosing the head of corn) are largely used for packing oranges and cigars, and for stuffing mattresses and palliasses. They should first be spread on an airy floor for a few days to dry before they are put into the ticks. In New South Wales very good mats are made of it. Paper and fabrics have been also made of these leaves extensively in Austria, and the yield from these is 30 per cent. of fibre, 10 of gluten, and 60 of dough of a nutritive character. Other useful products than the grain and its leafy covering have been obtained from the maize; sugar and molasses have been procured from the stalk. The grain is largely used for distillation. A bushel of corn gives over a pint of oil, which is easily purified, and burns with a clear bright flame. At a distillery in the vicinity of Lake Ontario, oil is extracted at the rate of 16 gallons from 100 bushels of Indian corn, leaving the remaining portion of the corn more valuable, and in better condition for distillation than before the oil was extracted.

It has been found that 56 lb. of Indian corn manufactured into grape sugar produces 38 lb., and that 2 lb. of this grape sugar used in brewing produces 1 lb. of saccharine in solution, so that one bushel of Indian corn used in the form of grape sugar produces an extract of 19 lbs. gravity. The extract obtained from Indian corn, properly prepared, registers on the saccharometer about the same as good malt, and for this reason has found more favour than many other cereals; but, although this is the case, from the fact that the extract is not a pure saccharine one as procured from malt, it is unavailable in brewing to a larger extent than from 30 to 40 per cent., and even not to this extent in summer time.

The cob on which the seed or grain is ranged is used for various purposes in North America. It forms a ready stopper for bottles. Ground into meal, it has in some instances been made into bread, and farina has been obtained from it in Austria, and it is an excellent food for dairy cows. A farmer in Ohio found by comparative trials that it was cheaper and more efficacious than other food. He tried corn, oats, and rye, and gave 3d. worth per day to a cow for a week. She yielded on this food 138 lb. of milk, making 6¾ lb. of butter. He then fed her with 3d. worth of cob meal per day for a week. She gave 157½ lb. of milk, making 7 lb. 7 oz. of butter. He then tried the cob meal scalded for a week; the cow gave 156¾ lb. of milk, yielding 6 lb. 6 oz. of butter. Maize cobs have recently been extensively used for fire lighters. They are first steeped in hot water containing 2 per cent. of saltpetre, and after being dried at a high temperature, are saturated with 50 per cent. of resinous matter. These lighters, which are sold at from 10s. to 16s. the thousand, are employed with advantage and economy in private houses and for lighting furnaces. By others the cobs are immersed in a mixture of 60 parts of melted resin and 40 parts of tar, after which they are taken out and allowed to dry. They are then subjected to a second operation, which consists in spreading them out on a metallic plate heated to 212° Fahr. They are finally assorted according to size, and tied up in bundles, and sold at the rate of three or four for a halfpenny. The establishment in Paris (La Société des Allumettes Landaises) for manufacturing them employs 30 workmen, and effects sales to the amount of £8,000 annually.

CORRESPONDENCE.

HALL-MARKS.

SIR,—Many years ago the Council of the Horological Institute addressed the Wardens of Goldsmith's-hall with a view to the adoption by them of a less obstructive method of impressing the Hall-mark than the relief-stamp then and still in use. The impress of such a stamp on the cases of gold and silver watches distorted the cases, and gave great additional labour in the manufacture, with consequent extra cost. The correspondence on the subject is contained in one of the earlier volumes of the *Horological Journal*. The Council advocated a linear stamp, which, simply cutting an outline in the gold, would not have distorted the shape of the case, and thus would have saved cost in the manufacture. The measures of the Council were defeated by the action of the case-makers, who feared that foreign workmen might come over to make cases and so lower wages, against whom the present custom of disfiguring the work when formed is a sufficient barrier. The case-makers held a public meeting in Clerkenwell, and voted that the present law and custom in force respecting Hall-marking cases was most desirable, and that change would be injurious. With such a resolution the members for Finsbury were disabled from Parliamentary movement.

The Horological Institute also complained of the disfigurement of the work caused by the scraping which the assayers practised in order to obtain material for the assay, which rendered it necessary that the gold should be thicker than the finished article required, so that the hollow formed by the assayer's scraping tool might be obliterated by the reduction of the whole surface to the level of the lowest point of the hollow which the assayer made. The Council referred to the practice of the Paris assayers, and through our ambassador at Paris were able to confront the custom of Paris with what the Goldsmiths'-hall alleged was the law of France. The organised opposition of the case-makers, however, availed

to check any further action on the part of the Horological Council.

There was, it must be admitted, some force in the propositions of the Goldsmith's-hall, that any alteration in the character of the stamp would put a doubt on the genuineness of the stamp until a generation had learnt the reality of the new type, and that the competition between England and Switzerland in the race of cheap production could not but be affected by the admittedly more expensive system enforced by the Hall.

Many of the elements of the question of Hall-marking are involved in this special instance of watch cases, but by no means all of them in respect of jewellery. There can be no real objection to any alloy of gold being adopted, either in respect of hardness or colour or cheapness, that the consumer may choose to use.

To limit the alloys to some definite ratios seems to interfere with a natural right. To give protection as to quality of material is well enough, but this becomes unimportant when the material is the least item in the cost of the article, and on all the other items the consumer is at the mercy of the seller or the law of *caveat emptor*.

If a person has confidence in the seller or in his judgment as to the quality of any article he wishes to buy, to subject such a one to the cost of an independent valuation, and the process of stamping with its costly obstructiveness, seems to interfere with the liberty of the subject, and to savour of arbitrary taxation.

The French manufacturer of jewellery is limited to the use of 18-carat gold. The ornaments he produces are therefore for the most part so fragile that their use in this country is limited to a small class. The French jeweller strengthens his tinsel fabrics with cement, but even then they are too frail for the bulk of the English population.

The English manufacturer alloys his gold sometimes largely, and is able to produce cheap jewellery of sufficient strength for general service.

There are many objects of jewellery that cannot be Hall-marked; the blow would destroy them. There are others so compounded of parts that the idea of certifying to the whole article being genuine is childish, so far as stamping avails for such an end, and unless a complete certificate can be produced like all half truths, an object partly Hall-marked is doubly treacherous.

The trade over which the Goldsmiths'-hall presides is not now as of old; its magnitude is now such that it has passed the bounds of personal supervision. The freedom of import from abroad still more dissipates the authority of the Hall, and the fertility of ingenuity in foreign cities to which our work may be sent invalidates the authority of a stamp which does not cover every part of the article, even if the stamp itself is not imitated, against which there is no protection. Compulsory Hall-marking, therefore, has too many objections to be admissible. Voluntary Hall-marking may well be tolerated, as between the manufacturer and the retailer it provides a security that the latter, who may be desirous of acting fairly, shall be able to authenticate the quality of his material if he shrinks from the unfortunately severe necessity of cutting indiscriminate samples of the articles he is buying and sending them for assay, a step to which there are many obstacles, first, the cost of the injury done to the finished work, next, the unpleasant relation it creates between men dealing together, the more difficult when one is pecuniarily indebted to the other, yet it is a step which no retail dealer should shrink from if he would preserve his own honour unblemished before the public.

For the public the easiest security is, first, the purchase of their jewellery from persons of established character, or if the temptation of prices or importunity of new men endeavouring to gain a footing be yielded to, then the careful claim of an invoice describing the character of the article sold from the vendor. Whether such facility as this is the only protection society should offer against fraudulent dealers is a question rather of Government than Hall-marking.

To check frauds in trade none are so competent as those in the trade, yet, except in the case of those who have retired from business, the power of punishing rivals is too dangerous for the hands of ordinary men. Yet in a well ordered organisation of society the exercise of such a power seems proper, for no class of the state from the court to the cottage is worthy of being invested with unchecked power.

For such an office I know of no better material than the courts of the City guilds, always providing that they shall contain such a proportion of trade members as shall give validity to their opinion. The inspection of the quality of work offered to the public is one of their social duties, and adapting themselves to the altered conditions of things, the same office might be usefully exercised.

The struggle for the appointment of analyst would then have been avoided, for the functions of the several guilds would have already covered the ground.—I am, &c.,

Jno. Jexx.

338, Strand.

GENERAL NOTES.

Technical Education in Saxony.—The "Technicum Mittweida," high school of engineering in Mittweida, Saxony, has completed its handsome new premises, and receives pupils for periods of from one to three and a-half years to prepare them for the profession of mechanical engineers, each youth receiving individual care, and being trained in draughtsmanship, the preparation of specifications, bills of costs, and so on, introductory to independent machine-designing. The fees for the six months' course are £6, lodging being procurable in the neighbourhood at about £2 monthly. About 400 students are in attendance, the ages varying from fifteen to thirty-eight. An analysis of nationalities shows that the greater number of students are from German States, there being, however, twenty-four from Russia, five from Holland, and two from Italy, while no Englishman is entered. Herr C. Weitzel is director.

Wine without Grapes.—At a recent session of the International Viticultural Congress, at Montpelier, says the *Journal of Applied Science*, M. Saint Pierre, a professor in the Medical College of that city, gave some facts in regard to this fabrication of imitated wines, a branch of business which has of late rapidly developed in Hérault, especially at Cette and Mèze. The product of this manufacture is mostly exported, the bulk being sent to Russia, Denmark, Holland, England, and North and South America. Cette alone makes nearly 8,000,000 gallons per annum, worth about 15,000,000 francs. Two-thirds of this is consumed in America. The only wines that can be successfully imitated are those rich in alcohol, such as the wines of Spain and Portugal. It is not true that grape-juice is the only thing omitted in the composition of these wines, as that is the cheapest ingredient. Nor is colouring matter used to any extent, as the wines to be imitated are white. The Portuguese formerly coloured their wines with elder-berries, but abandoned it on finding that it injured the wine. The imitation of Spanish wines utilises a large amount of cheap wines in the south of France, the production of which has been stimulated of late years. These wines show scarcely eleven per cent. of alcohol, but with the addition of syrup of mulberry and alcohol the strength is raised to twenty-one per cent. The professor, with great frankness, pleads for the encouragement of this industry. The members of the Congress visited Cette and Mèze, and inspected several manufactories. One of the largest at Cette had then stored over 280,000 gallons in cellars containing from 80,000 to 100,000 gallons each. The total value of the whole deposit is stated at £40,000. At Mèze one establishment astonished the visitors by the vast extent of its coopers' shops, and its steam engines of great power pumping the wine from great isterns into the casks.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EXTINCTION OF FIRE IN SHIPS.

The Fothergill Gold Medal is offered for an effective means of preventing or of extinguishing fire on board ship. Communications, illustrated if need be by models or working drawings, must be sent in to the Society not later than the 31st of December, 1875. The Council will take into consideration, with a view to reward, the best written paper containing suggestions fitted to secure prevention of fire, or the means to be adopted for the safety of life and property when fire breaks out on board ship. The Council reserve to themselves the right of withholding the medal or reward offered, if, in the opinion of the Judges, none of the communications sent in are deserving.

COMMERCIAL EXAMINATIONS.

Since the Society of Arts' General Examinations were established in 1856, the Universities of Oxford and Cambridge, the Science and Art Department of the Government, and other public bodies, following the example of the Society, have instituted Examinations, which, to a certain extent, supply the place of those of the Society of Arts. None of them, however, are specially adapted to young persons entering commercial life, whether as clerks or otherwise, and the Council have therefore decided to establish examinations of a commercial character, believing that such examinations will be of great practical benefit, and specially within the province of a Society established for the encouragement of Arts, Manufactures, and Commerce.

The subjects for examination will be as follows:—

1. Arithmetic.
2. English (composition, correspondence, and précis writing).
3. Book-keeping.
4. Commercial History and Geography.
5. Shorthand.
6. Political Economy.
7. French.
8. German.
9. Italian.
10. Spanish.

Certificates will not (as heretofore in the General Examinations) be given in separate subjects, but in order to obtain a "Certificate in Commercial Knowledge," a candidate must pass in three subjects at least, two of which must be Arithmetic and English.

The papers set in most of these subjects will to some extent differ from those of former years, in being specially adapted to test the candidates' knowledge from a commercial point of view.

Prizes will be given as heretofore. The regulations are now under consideration, and the Programme will be published as soon as the details have been finally arranged.

MISCELLANEOUS.

RIVERS POLLUTION AND WASTE OF MANURES.

In France, the application of science and art the question of the utilisation of the waste products of manufactures for agricultural production has been in advance of anything yet done in this country by any public authority. Of this the following report, laid before the Academy of Sciences, and for which it has awarded its prize, may be presented as an example.

I may claim it as following a course of experimentation by trial works under scientific direction for the application of putrescible matter, denoted as sewage, to agricultural production, made at my suggestion for the French Government, by Professor Moll, of the Conservoir des Arts-et-Metiers, and by M. Mille, the Ingénieur-en-chef. The most instructive part of the works described in the paper is that showing the prompt means requisite for the application of putrescent matter before it can enter into the putrid, stage,—the dangerous sanitary condition. Here the distinction between matter which is putrescent, and matter which is putrid, between sewage which is putrid, and sewage which is fresh, is very little known or regarded. Advanced decomposition and putridity is commonly accepted as the normal condition of all town sewage. Indeed, in many instances local authorities have been put to heavy expense to form large tanks, or sewer reservoirs—generally uncovered—to receive and detain refuse, which tanks tend to make it putrid; that is to say, to waste it before it can be applied. Such works and their expenses, to the profit of engineers and contractors, are represented to the unscientific authorities as absolutely necessary, and they thus contribute to the expenses which render sewage farming unprofitable. By late default of the central authority, first in not informing itself, and next in not supplying the best information for local guidance, the ratepayers have been burthened with excessive charges for such works which are pernicious and wasteful. Dantzig presents an example of the uninterrupted application of sewage throughout the year, and shows that the storage of putrescible matter is unnecessary, even during long and severe frosts.

In 1850, at the General Board of Health, we carefully collected information on the means of rendering land permeable to air as well as water by subsoil drainage, for the immediate absorption of putrescible matter and the prevention of waste and injury by putridity. The claim of the author of the paper for independent originality on this topic may, I believe, be accorded for France and the Continent. The results he has obtained are of much value in the development of the principles applicable to the subject. In ignorance of them, and by supersatu-

ration of a shallow surface of soil—by the creation of surface puddles, and of conditions of putridity, in fact by the creation of bad marsh surfaces, has given rise to the prejudice, that sewage application is essentially offensive and improper for the vicinity of towns, and as needing the corrective application of patented deodorants and "disinfectants," as they are called; whereas, with proper and prompt applications the principle of water carriage may be made the corrective of the great waste and offensiveness of solid applications of manures in the top dressings of market gardens in the vicinity of habitations though from custom no objections are made. For example, by departmental ignorance and sloth, to which it is time there should be a corrective, the parks are manured with putrid street scrapings. This putrid manure, after having been wasted by evaporation, is further wasted by emanations in the streets, until it is disintegrated by decomposition, when the rain may liquify the manurial particles and carry them into a shallow subsoil generally ill-prepared for absorption. Meanwhile, the surface of the parks is kept for weeks in an offensive and dangerous sanitary condition. By a proper application of the same manure in a liquified form, the process of absorption would be completed in less than an hour, and with more than the double productive results. The highest applications of the solid manures in market garden culture are beaten in quality as well as quantity by the sewage farms.

Another point of observation in the paper is the narrative of the trials made to determine the absorptive power of soils, and the extent of superficial area required for the utilisation of the liquified manures from towns or manufactories. I have always urged the adoption of preliminary trial works, by the water-pot or water-cart, to determine the area of land needed; but from the common default of such precaution, instances are almost general where threefold, and even more than fourfold, the land needed has been occupied and where there has been a three or fourfold extension of carriers and distributing apparatus beyond what is now proved to be needed. By using too small pipes, by "wire-drawing" the liquid manure, and by defective adjustments, a double or treble expense of pumping over the excessively intended area has been frequently incurred.

The author's conclusions as to the advantages of the distribution of sewage in as finely divided a state as possible, in spray, adapted to the receptive or absorptive condition of the soil, as is well known in horticulture, are corroborative of those I obtained in favour of distribution by the jet, or by flexible pipes as carriers, with lateral apertures, as against the old method of distribution by water meadows and submersion, equally objectionable on the score of expense of such works, as well as of waste of manure with inferior results.

When to these defaults of unprotected ignorance on the parts of the local authorities, and empiricism on the parts of the agents they are led to engage—are added three or fourfold rents exacted for the use of land for public purposes, excessive parliamentary and legal and professional expenses—it is easy to account for the common results, that water carriage and water distribution, essentially much the cheapest, are by such administration made the dearest, and, as late unexamined Parliamentary returns would appear to show, that sewage farming does not pay. EDWIN CHADWICK.

East Sheen, Surrey, Sept. 12.

POLLUTION AND PURIFICATION OF RIVERS.*

The estimation of the amount of oxygen held in solution† adds a third to the two methods already known as available for determining the degree of pollution of any stream. These methods are:—

Firstly—By observing green plants and aquatic mollusks.

Secondly—By microscopically examining *algæ* and *infusoria*.

Thirdly—By the amount of oxygen held in solution.

I have sought to ascertain whether these three methods agree, and I have taken the River Vesle from Reims to Braisne as my field of observation. I have gone over the banks of the Vesle by Cormontreuil, Fléchambault, Saint Brice, Macau, Compensé, Muizon, Tuilerie, Jonchery, Fismes, Bazoches, and Braisne—that is to say, for a distance of about 60 kilometres (37½ miles), the first time in April, 1873, when the water was very high; a second time in August of the same year.

The flow of the Vesle never exceeds 6 to 8 cubic metres (1,320 to 1,760 gallons) per second. In summer it is as low as 0·600 or even 0·200 metres. The daily flow of the Reims sewers is 19,000 cubic metres (4,180,000 gallons).

According to the analysis of Messrs. Maridort and Mangon, the average composition of the waters of the sewers is the following:—

	Kilos.	
Organic matter	0·833	per cubic metre.
Mineral matter	0·907	
	1·740	

Of this 0·940 is in suspension, and about 0·800 in solution.

According to this composition about 30,000 kilogrammes (66,000 lbs.) of impurity, of which 15,000 kilogrammes are solid deposit, each day pollute the Vesle.

The River Vesle has a very slight fall, the force of which is checked by the dams of numerous manufactories established on its course. Below Reims it flows over marshy ground, and almost on a level with the swamp which forms its banks. It is not embanked anywhere. At Cormontreuil, above Reims, the Vesle is clear: it flows upon a bed of sand and lime-stone. There is very little mud. Fish live there in the midst of *charas*, water-cress, iris, &c. Cray fish, *Cypris faba*, are plentiful. The water is certainly wholesome; but I never found shells or trace of mollusc spawn upon the water-plants. I do not know to what cause to attribute this absence of shellfish.

The temperature of the water varies from ten to eleven degrees (Centigrade), and the barometrical pressure varied between 75 and 76 centimetres (about 29 or 30 inches) during my first visit. The test of the water from Cormontreuil to Fléchambault by hyposulphite of soda gives 11 cubic centimetres of oxygen per litre. At Fléchambault, a suburb of Reims, an arm of the Vesle passes by some dye-works. The waters become coloured, and the fish disappear. It is the same with water-cress and *charas*. Upon the banks are found tufts of *Sparganium simplex*.

From Fléchambault to the gates of Paris the oxygen held in solution diminishes. It decreases from 11 to 9 cubic centimetres per litre. This decrease is very regular, in proportion to the distance.

Between the gates of Paris and Saint Brice, the Vesle receives the flow of the five principal sewers of Reims. There is scarcely any vegetation at the mouths of the sewers, but it becomes very active when the sewer water is diluted by the waters of the Vesle, confirming previous observations on the waters of the Seine.

At Saint Charles the sewer water is dealt with as follows:—The water is run from the sewer on to a flat, well-beaten floor, exposing a total surface of 8,316 square metres, on which straw has been spread; water running slowly and in a shallow stream over the straw, which is retained in its place by posts, deposits on it organic matters which it holds in suspension. An active fermentation takes place, and the straw becomes a very valuable manure for vines, but not of much value for other plants.

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* An essay by M. A. Gérardin, to which the prize was awarded by the Paris Academy of Science in 1874.

† Usually in this country termed "free oxygen."

Microscopical examination shows that a very considerable quantity of *Beggiatoa alba* and of *Oscillaria natans* is developed there. This treatment does not perceptibly improve the sewer water. At the exit as well as at the entrance these waters are incapable of becoming charged with oxygen held in solution. These works, made in 1852, have since 1861 been almost entirely abandoned.

At Saint Brice the water of the Vesle is thoroughly polluted. The *Beggiatoa alba* grows there abundantly. The sun hastens its decomposition. The *Oscillaria natans* springs up from the bottom of the river, and covers the whole surface of the sluggish water with a thick blackish coat. At first sight this coat seems solid. Animals have often rushed on it mistaking it for firm ground. Sometimes strangers travelling have been victims to the same mistake. At the outlet of Saint Brice, the quantity of oxygen held in solution in a litre of the Vesle water does not reach one cubic centimetre; in several places there is none. From Saint Brice, turf pits and private enclosures prevent our following the banks of the Vesle. I was only able to rejoin the Vesle six kilometres further on by road. At the mill at Macau, *Beggiatoa* and *Oscillaria natans* have nearly disappeared; the bed of the Vesle is covered with long whitish *algæ* called *hypheothrix.*

Above the mill of Macau, the water holds in solution 7·4 cubic centimetres of oxygen per litre. The river turns a turbine at the mill, and by the agitation a great quantity of gas is set free. At the time of my visit copper under its influence was not much discoloured, although at times copper, and more especially all silver articles, were rapidly discoloured. On leaving the turbine the quantity of oxygen held in solution rises to 10 cubic centimetres per litre, but this quantity rapidly diminishes; it only stands at 8·5 cubic centimetres at the extremity of the mill garden.

At Compensé Mill the banks are clothed with the rank vegetation of *Sparganium simplex ; hypheothrix* has there almost completely disappeared. Above and below the water-wheel the standard of oxygen in solution is eight cubic centimetres per litre. The same vegetation occurs at Muizon; *hypheothrix* has entirely disappeared. In weirs, and in all places where water is a little stagnant, green *algæ* exist, forming a transparent jelly in the water; these are *spirogyra.* At Muizon the Vesle gives eight cubic centimetres of oxygen per litre. At four kilometres beyond Muizon the Vesle passes through the beautiful and grand estate of the Tuilerie. At Tuilerie I only found 7·2 cubic centimetres of oxygen per litre, although I often repeated the experiment to be certain as to the result. From Saint Brice, where I found the minimum 0·5 cubic centimetres, the standard of oxygen in solution was always on the increase. But there is no possible doubt the standard is lowered one cubic centimetre per litre between Muizon and Tuilerie. Between Tuilerie and Jonchery the decrease in the proportion of oxygen in solution shows itself more and more distinctly. Above Jonchery mill the oxygen in solution decreases to 4·6 cubic centimetres, and even at the mill dam to 4·2. Below the mill the standard rises to 5 cubic centimetres litre in the open stream; *spirogyra* are very abundant. Notwithstanding the clearness of the water, the occupants of the mill complain much of the river; they declare it is worse than either at Compensé or at Muizon Mills. The test by oxygen held in solution justifies these complaints. At Fismes, upon the right bank, the Vesle shows 6·44 to 7 cubic centimetres of oxygen per litre. The manufactories upon the left bank produce little change in the composition of the water there. Vegetation is very abundant there, though less so than at Tuilerie and Jonchery. The *chara* tribe and *iris* reappear, as also do lilies. In the meadows through which the Vesle runs to Fismes, below the mills, frogs are very abundant, while there is a complete absence of molluscs on all submerged weeds. Four kilometres (two miles and a-half) below Fismes is the mill of Bazoches. From the weir of this mill the Vesle returns again to the same condition in which it was before it reached Reims. Fish and crayfish are abundant there; water-cress grows; *spirogyra* are not abundant. Above the weir of Bazoches the water shows 8 cubic centimetres of oxygen per litre; below, 10·5 cubic centimetres. Finally, at Braisne, all trace of pollution has disappeared. The Vesle gives 11 cubic centimetres of oxygen per litre, which condition continues up to the discharge of the Vesle into the Aisne.

After having gone over the banks of the Vesle when the waters were very high, it was interesting to re-examine them after a season of drought and heat. In August, 1873, I repeated my visit, stopping at the same places. The temperature of the water was 18 degrees (Centigrade), and the barometrical pressure varied between 76 and 77 centimetres of mercury (about 30 inches). Vegetation was not changed, and was found in the same places as in April. *Beggiatoa alba* and *Oscillaria natans* prevailed between the Reims sewers and the mill at Macau; *hypheothrix* between the Macau Mill and Muizon; *spirogyra* were less abundant than in April; they are specially abundant from Muizon as far as Fismes. No molluscs to be found on the weeds. The effects of pollution were more powerful than in April. At the mills of Macau and Jonchery, copper and silver became rapidly discoloured. The oxygen showed a marked diminution. At Cormontreuil I found eight cubic centimetres of oxygen per litre; at Fléchambault seven cubic centimetres. At Saint Charles and at Saint Brice the dissolved oxygen had absolutely disappeared. At Macau Mill the standard rose to 1·5 cubic centimetres. There were two cubic centimetres of oxygen per litre at Compensé and Muizon Mills. Below Tuilerie the standard went down to 1·6 cubic centimetres; at Jonchery it fell to 1·2 cubic centimetres; but on approaching Fismes it rose; and from 2·3 cubic centimetres above the mills at Fismes, it rose to 3·7 cubic centimetres below. At Bazoches the standard was 6·4 cubic centimetres above, and 7·5 cubic centimetres below the weir. Finally, at Braisne, the standard rose to 8·2 cubic centimetres of oxygen per litre.

The Vesle presents a good field for observation, and great confidence may be placed in the result of the observations, as it receives no considerable tributary in all its course (only the Ardre, which falls into it above the Mill of Bazoches). Its flow being somewhat large, and several mills occurring in its course, the mass of water is fairly homogeneous, and the analyses are well suitable for comparison. The following table give the result of the analysis:—

Oxygen held in solution in the litre of the River Vesle Water at different points in its course.

Stations.		Date of Observations. April, 1873. cubic centimetres.	Aug., 1873. cubic centimetres.
At Cormontreuil		11·0	8·0
Below Fléchambault		9·0	7·0
At Saint Brice below the Reims sewers		0·5	0·0
Mill at Macau	above	7·4	1·5
	below	8·5	1·7
Mill at Compensé		8·0	2·0
Muizon		8·0	2·0
Tuilerie		7·2	1·6
Jonchery	above the mill	4·6	1·2
	below the mill	5·0	1·4
Fismes	above the mill	6·44	2·3
	below the mill	7·0	3·7
Bazoches	above the mill	8·0	6·4
	below the mill	10·5	7·5
Braisne		11·0	8·2

It is very evident that the natural improvement of the Vesle extends as far as Muizon. From this point the improvement ceases, and the pollution goes on in-

creasing as far as Jonchery, where the minimum of oxygen is observed. From Jonchery the improvement takes place progressively, and at Braisne the Vesle returns to its normal condition. The oxygen held in solution first increases, then it decreases and increases again, passing thus from the maximum to the minimum. Almost in proportion as the quantity of water which these deliquescent substances absorb, as Desains has demonstrated. This phenomenon may be ascribed to three causes:—

1st. The silting of the Vesle is so rapid that frequent dredging is necessary from Saint Brice to Muizon; from thence, all the detritus from the sewer having been deposited, dredging is rarely resorted to. At Jonchery it is never done.

2nd. The *algæ*, characteristic of polluted water, can no longer live in these purer waters; they perish, and their *debris* produces another change in the water.

3rd. The abundant vegetation in the naturally purified waters of the Vesle makes a great quantity of detritus, the decomposition of which pollutes the water. Microscopic examination of the *algæ* shows that the Vesle passes through the state of pollution characterised by *Beggiatoa alba* and *Oscillaria natans*; its improvement is first marked by *hypheothrix*, and then by *spirogyra*. These facts are absolutely analogous to those I observed on the streams of Saint Denis. I believe they are always produced, whatever may be the cause of the pollution and change in the condition of a river.

Berthollet's maxim was, "When an experiment is to be made it must have an object and be based on an hypothesis."

My object is the purification of the rivers of Saint Denis. My hypothesis, which I was not able completely to demonstrate in 1868, was this: organic matters in the course of decomposition are essentially oxidisable. By taking up the oxygen in the water, they render life impossible for beings of a higher organisation; they reduce the sulphates, transform them into sulphites, and are the cause of the emanations of sulphuretted hydrogen, the more abundant in the basin of St. Denis, inasmuch as, the earth containing gypsum, the waters are naturally selenitic. If, therefore, instead of leaving water from manufactories to putrid fermentation in deep ditches of deposit, with a small surface, they are spread out, so as to expose a large surface to the oxidising influence of the air, the organic matters are completely oxidised, and we are thus able to run them into the streams without producing the unquestionable evils they would otherwise cause. In support of this hypothesis, it will be remembered that at the Universal Exhibition of 1867, the water from the marine aquarium was made to fall in a cascade, and was again pumped back into the aquarium. In the same manner, before the establishment of railways, the fishermen of the Vosges carried live trout all over France, by putting them in boxes, the water of which was constantly agitated by a float-wheel set in motion by a band worked by the axle of one of the carriage wheels. Practically, by the agitation of the air, water readily takes up oxygen, as the following results, very carefully obtained, prove:—

Variations in the Quantity of Oxygen dissolved in one Litre of Water before and after its fall in a cascade.

		Cubic centimetres.
26th Dec., 1872, Bois de Boulogne	Canal above the grand cascade	9·66
	Grand cascade on the rock where the water falls	10·70
10th Nov., 1872, Chantilly	Above the weir of the great lake..	8·95
	Below the weir	10·23
3rd Oct., 1872, Gonesse	Artesian wells as it issues from the tube ..	2·41
	Ditto after a fall of a metre......	4·21
21st Nov., 1872, Aubervilliers ..	As it issues from M. Maricot's well	3·60
	Ditto at the surface of the reservoir ..	2·21

The aëration of water and the oxidation of dissolved organic matter should cost nothing, and be automatic and independent of the neglect of workmen. To settle this problem I see only one possible way. The waters must be broadly spread upon land previously drained. To spread the water upon land has long since been tried. M. Dailly, was, I believe, the first who suggested it for waters of factories. Joining example with precept, M. Dailly spread over his lands the waters from his starch factory at Trappes (Seine-et-Oise), and found that these waters acted as manure. Space is not wanting at Trappes; four hectares (nine acres) of land received the waters of the starch factory, where they only worked 200 sacks of potatoes daily. M. Dailly obtained good results. The result, however, is not the same where space is limited. Thus, in a starch factory at Colombes (Seine), the waters are run on to a meadow, where they sink into an especially sandy soil. As soon as they reach the grass, it dies and becomes black, as if carbonised by fire. By accident they let the waters reach some large trees, and they perished quickly. The waters soak in slowly, give out a very disagreeable odour, and the soil becomes rapidly clogged; it is necessary to change the place of absorption at least twice a-week. The infiltrated water passes through the sand, reaching wells very far distant from the factory and completely polluting their waters. The water from the starch factory is not improved by its underground passage; on the contrary, it becomes much more polluted than when first absorbed.

At Louvres (Seine-et-Oise), similar effects are produced. The waters of a starch factory, which were prohibited passing by Goussainville to the cress beds of Gonesse, were run into an abandoned quarry and were left to chance. During two seasons all went on well, but the third year these waters, in a state of complete pollution, made their way to some mushroom beds. All the mushrooms died, and their cultivation had to be given up. At Herblay, Villette, Aux-Aulmes, Tremblay, where the waters from starch factories were spread on the soil, the water became rapidly clogged, and the infiltrated waters were abominable. It is for this reason that blind wells are impracticable. There is, therefore, some addition needed to M. Dailly's process to obviate these serious evils. For this purpose I have proposed draining the land on which the operation is to be carried out. Drainage is indispensable, as well from a mechanical as from a chemical point of view. In fact, by draining we allow a free flow to the water; it is carried where we wish, and we preserve uninjured subterraneous sheets of water and the neighbouring properties. Moreover, drainage is a process of energetic oxidation, as shown by M. Chevreul; it enables us to oxidise without expense dissolved organic matters, and prevent their putrid fermentation. I believe I am the first to have utilised these drainage works for the purification of water from

factories. Since my first experiments on this subject in 1868 the employment of artificial subsoil drainage in the agricultural utilisation of sewage waters has much extended.

In England, Mr. Bailey Denton has executed great works of purification, rendering these waters wholesome by a method which he calls "Plan of Intermittent Filtration." He has applied his method at Merthyr Tydvil, in Glamorganshire, a manufacturing town of 100,000 inhabitants, where all the water from factories and houses is treated by intermittent filtration.

To decide the question of priority, it must be remembered that my first communication on this subject was on the 29th of November, 1869, M. Dumas having then been kind enough to present to the *Académie des Sciences* a memorandum which I had addressed to him on the purification of factory waters by applying them to drained land. This memorandum, inserted in the *Compte Rendu*, fixes the date of my experiments with exactness. Without going further into the question of priority, I will continue my statement.

The examination of the River Croult has proved to me that the starch factory of Messrs. Boisseau, Bonnevie, and Lucy, at Gonesse, situated high up the river, was the first cause of the change and pollution of the water of this river; indeed, starting from this factory green plants, fish, and molluscs disappear, and *Beggiatoa alba* appears. This factory can work up daily the produce of 400 hectolitres (1,100 bushels) of potatoes, representing 28,000 (63,000 lbs.) kilogrammes in weight, furnishing 7,000 (15,000 lbs.) kilogrammes of starch, and 21,000 kilogrammes of liquor carried into the river. The quantity of water required for this factory is 130,000 litres (2,860 gallons) daily, which is thus divided:—

	Litres.	
Water necessary for rasping ..	100,000	
Water for cleansing and washing	30,000	
Total	130,000	(28,600 gals.)

The total quantity of water sent daily into the Croult after remaining in the large ditches is:—

	Litres.	
Liquor from the potatoes......	21,000	
Water for manufacturing	130,000	
Total	151,000	(33,000 gals.)

By the side of the factory, upon the banks of the river, there are 2,000 square metres (half-an-acre) of land. This land is clayey, and at a depth of 60 centimetres (2ft.) is found a subterraneous sheet of water. It is on this field that we tried purification by oxidation. In distributing 151,000 litres of substance upon 2,000 square metres, each square metre should receive 75 litres of liquid for oxidising 10½ litres of potato pulp for each working day. The season lasts 200 days at most. Each square metre should then absorb or oxidise in a season $200 \times 75 = 15,000$ litres, which is made up thus:—

	Litres.	
Water in manufacture absorbs....	12,900	
Pulp to be oxidised	2,100	
Total	15,000	(3,300 gals.)

Is it possible to make a drained soil absorb 75 litres of water square metre in 24 hours, and to oxidise 10 litres of potato pulp in the same time? This question M. Boisseau and I put to ourselves from the beginning of 1869, having undertaken the drainage works for the following season. We found no solution to our question, notwithstanding having consulted numerous works and questioned cultivators who understood drainage. In absence of all information from former experience, we undertook to experiment ourselves. The land taken for our experiments was of a rectangular form. We divided it into two equal parts by a ditch at right angles to the Croult. This ditch, which served as a strainer, is divided at the extremity of the river into two branches in the shape of a T. At the two ends of these branches are the sewers for taking the strained water to the river. The drains were placed at two metres (6½ft.) distance from each other, and at a depth of 35 centimetres (12in). They are earthenware pipes, eight centimetres (3in.) in diameter. In August, 1869, we tried the working of the plan. In a few days we were able to arrive at the following facts:—

1. The absorption of the water was complete; it was even too rapid. It was impossible to irrigate all the land in one day. A square metre of land drained in the above manner can absorb much more than 75 litres (16½ galls.) of water.

2. The process is efficacious. When the drains slowly discharge the water of the starch factory, the water loses its red colour; it is almost entirely decolorised. On the river the scum has diminished. Green weeds do not die in the Croult below the factory. We therefore persevered in this method of improvement. M. Boisseau stopped the work at the factory, and lowered the drains to 55 centimetres (22in.) in depth. He set up a wooden trough, raised above the soil with a very slight fall, receiving all the waters from the factory. In this trough he made at certain distances small openings. In passing through these openings water flows in small threads, and falls into movable gutters, formed of zinc plates slightly concave, placed end to end. To change the distribution of water, it is only necessary to move these gutters. Their length and direction may be easily varied, and the water can be distributed equally over the land. Since this process of purification has been employed at Gonesse, M. Boisseau has each year increased his manufacture, as shown by the following return:—

RETURN OF MANUFACTURE AT THE STARCH FACTORY.

Years.	Potatoes received.	Produced.		Water used for manufacturing.	Total amount of liquid distribution on the land.	Total quantity of liquids received per square metre during the season.
		Starch, &c.	Liquor.			
	Tons.	Tons.	Tons.	Tons.	Cubic metres.*	Cubic metres.
1868–1869	1,800	..	..	..	..	..
1869–1870	2,233	548·6	1684·4	11,165	128449·4	6,425
1870–1871	stoppage.	..	..	..	..	..
1871–1872	2,900	587·6	1312·4	14,500	16812·0	8,406
1872–1873	4,500	911.8	3588·2	22,500	26088·2	13,044

* A cubic metre is 220 gallons.

For the current year, 1873-1874, the quantity of potatoes is increased to about 6,000 tons. Each square metre of land will receive during this season from 17 to 18 cubic metres of liquid. There was reason to fear so large a quantity of potato pulp would pollute the ground and bring on saturation. Experience had

shown that these fears were groundless. The land has remained in good order, perfectly healthy, and its fertility is very great. From the time the starch works were stopped it has been cultivated. It is impossible to give even an approximate idea of the value of the produce, because M. Boisseau, to excite emulation in his workmen, has divided the land into plots which he lets them occupy gratuitously. Each person cultivates as he likes. The workmen having recognised that the water from the starch works in the state in which it came to them gave an excellent manure, quarrelled for the water to such a degree that M. Boisseau interfered, and regulated the quantity of water to be allowed for each plot. On this land they cultivate all kinds of kitchen herbs, peas, beans, onions, turnips, and carrots, giving very good crops. The yield of artichokes in 1872 was remarkable. At the time of recommencing work again at the starch factory, the end of August, artichokes were in full growth. Upon the land which they occupied we had distributed the water from the factory. After having seen at Colombes grass burnt up by the water from the starch works, we thought that the artichoke, a very tender plant, could not bear the trial we had given it. Nothing occurred, all the artichokes survived. Thanks to the mildness of the season, we were able to gather them up to February. Land treated with these waters does not suit potatoes. Each year we planted several beds; they produced stalks 1·45 metres (4ft. 6in.) long, and tubers of bad quality and small in quantity. The result of these experiments show that the waters from starch works may produce two very different effects. When they first leave the factory before complete fermentation, they are inodorous, and quite harmless for vegetables, for which they are used. If, on the contrary, they are kept in ditches for settlement, they soon stink, and destroy all vegetation. These two conditions succeed each other in the course of a few hours. In my opinion, starch makers should be very careful not to allow their waters to stagnate. They should endeavour to make them run in somewhat thin sheets. This precaution has the effect of facilitating the deposit of the starch, and of bringing on oxidation by the air. We recognise that the waters are properly treated when they become rapidly coloured by the oxidising action of the air. The deeper the colour, the more readily purifying action takes place in filtering through the soil. Putrifying waters are whitish, opaline, and scarcely improve by filtration. At the mouths of the drains, the water from the strainer runs into the ditch which was made in the middle of the ground. I formed a ditch, and not a collecting drain, to increase the oxidation of the air; at the end of the ditch the water falls in a cascade into the Croult. It is almost entirely colourless, but slightly amber coloured, without odour, and the taste is not unpleasant. After having received the drained water from the starch factory the Croult bears on its surface some white foam, but exhibits none of the putrid marks of pollution which previously called forth such just complaints. On the 23rd April, 1870, the first season was finished, during which the water from the starch factory at Gonesse had been purified. M. Leliévre, member of the Municipal Council of St. Denis, and myself, went over the banks of the river to take note of the results obtained. There was a great change from preceding years. No complaints were made to us; on the contrary, all the dwellers near the river whom we questioned congratulated themselves on its improvement. In fact, *Beggiatoa* and *Oscillaria natans* had not made their appearance; thousands of fishes were hatched in the river where scarcely even black leeches had been found for several years. Instead of black and polluted mud, a bottom of white sand in many places was to be seen. Water plants began to appear, and in the garden of the card-board factory of the Messrs. Cohen, at Févon Mill, Commune de Courneuve, we found in the Croult water-cress plants. We gathered some of this cress, and offered it to M. Giot, mayor of Saint Denis, to show that the purification of the Croult, which he had been seeking for many years, had at last been effected.

Several other factories exist on the Croult which affect its purity. At Gonesse, below the starch factory, there are dye and large sugar works. The dye works colour the water, but the colour is not long in being precipitated. In my opinion it only soils the river, without producing pollution. The sugar works affect to a greater extent the purity of the Croult. They produce what all similar factories do in the rivers where they discharge their water; they generate *hypheothrix* identical to that I described at Vesle, and at the Macau and Compans Mills. I find that *hypheothrix* succeeds *beggiatoa* when the water is improved, and precedes *spirogyra*, the forerunner of perfect purification.*

At Dugny there are dye and starch works; the dye works specially colour the water of the Rouillon. The starch works, less important than those at Gonesse, send their waters straight into the Croult, without submitting them to any purification. The Dugny starch works cause froth again to re-appear on the Croult much deteriorating its quality; but the Croult at Dugny is sufficiently good for the purpose of starch works so long as the water does not come down to the Croult in a putrid state of fermentation.

In spite of the flow of discharged water from these four factories, and from the house sewage from Gonesse, Arnouville, Bonneuil, Garges, Dugny, and Courneuve, &c., it is admitted that the state of the Croult at its entry to Saint Denis is satisfactory. This fact is attested by a resolution of the Saint Denis Municipal Council, dated May 20th, 1870. It is daily proved by the absence of complaints and cessation of law suits. In visiting the cemetery of the Maison d'Education de la Légion d'Honneur it is seen that a considerable mortality existed at that establishment every year in the month of June till 1868. This mortality, attributed by the medical men of the establishment to the disastrous effects of the river, has ceased since the purification of the Croult, and its being stocked with fish, green plants, and mollusca. Since 1869 plants in the Croult grow with a troublesome vigour. If not constantly mowed down, the bed of the river is blocked up, stopping the current and raising the level of the water. In May, 1869, measures had not been taken to check this unexpected growth of plants. The river was obstructed, the level raised, the pressure of water causing a breach in the banks at a place called the Marville Meadows. Several gangs of workmen were employed during the summer in cutting the weeds, and throwing them on the banks. However, it is observed that the abundance of plants diminishes yearly, as if the slime accumulated during a dozen years of pollution, and incompletely removed by cleansing, was wearing itself out. These plants are principally *charas*, *Myriophyllum*, bastard cress, and often water cress. Such a vigorous vegetation is suitable to the development of mollusca, and they are very abundant in the Croult, the most abundant being:—*Physa fontinalis*, *Cyclas cornea*, *Limnea ovata*, *Limnea stagnalis*, *Valvata piscinalis*, *Pisidia*, *Planorbis corneus*, *Planorbis vortex*, *Planorbis marginatus*. The principal *crustacea* are cray fish and *Cypris fusca*. In several places on the Croult I have made small water cress beds, which indicate to me the quality of the water. If the cress turns yellow, then more precautions are taken at the Gonesse starch and sugar factories, and, if necessary, their working is suspended for some days, so as to allow the drained earth to be well aërated. At different times and places in 1872 and 1873 I tested the oxygen in solution in the Croult by the process of hyposulphite of soda, which M. Schutzenberger and I have published.

The standard of the oxygen held in solution diminishes in going through Gonesse. Leaving Arnouville it

* The water from these sugar works is now purified by being spread over a drained meadow. Before being run over the meadow the water deposits in ditches earth and small roots which it brings down. The deposit in this ditch is a valuable manure for certain lands.

OXYGEN HELD IN SOLUTION IN A LITRE OF CROULT WATER.

STATIONS.		Dates of Observations. 1872. 3rd October.	1872. 20th September.	1873. 9th January.	1873. 15th January.	1873. 10th March.	1873. 22nd May.	1873. 20th September.
		Cubic centimetres.	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.
nesse	Above the starch factory	7·4	8·0	8·2	8·0	9·0	9·0	9·0
	Above the sugar works	5·2	6.2	6·0	6·0	5·0	6·0	6·0
	Below the town	3·2	3·0	3·5	4·5	5·0	5·0	5·2
nouville		3·5	4·0	4·5	5·0	6·0	5·5	4·6
rges	Above the town	4·5	6·3	5·5	5·5	8·0	6·5	7·0
	Below the town	6·0	8·0	7·0	6·5	9·0	8·0	7·5
gny......	Crête de Palluel Mill	7·2	8·5	8·0	8·5	9·3	8·4	8·6
	At the "Pierres de Niveau"	5·0	4·5	6·6	6·0	8·6	7·6	8·0
Denis ..	Basset Mill	5·0	5·3	7·0	6·2	9·0	9·5	9·0
	Choizel Courtyard	4·2	4·5	5·0	4·5	6·0	7·0	7·0

s, and attains its maximum at Dugny, at M. te de Palluel's mill, where the Croult receives Morée, where the standard of the oxygen held in ution varies from ten to eight cubic centimetres litre. A little lower down where the Croult eives the waters from the starch works and dye rks of Dugny, its standard again lowers. It rises in between Dugny and St. Denis. At the entrance St. Denis at Basset Mill, the standard attains a second ximum. The factories below the mill at Basset again er the standard in going through the park of the ison de la Légion d'Honneur. Beyond this park Croult is used by 200 establishments situated on its nks, which have had a right to its waters from time memorial. It is interesting to notice the sudden ects produced by the influx of a sewer or of an artesian ll. The success of my experiments on the purification the water from the starch factory at Gonesse induced to repeat the same at the Bourget starch factory. e manufacturers do not agree in my theory of the exriments at Gonesse. The greater part attribute the ccess to the simple filtration of the water through the rth, and do not admit the necessity of oxidation. Antheaume, proprietor of the Bourget starch works, one of those who thought that filtration through the l sufficed for purification. He had seen at Gonesse w considerable was the quantity of water the drains uld discharge. In his garden he placed drains at 2 tres (6 ft. 8in.) apart, and 50 centimetres (20 in.) deep, on a surface of 500 square metres (595 sq. yards). is drainage acted during the season of 1871 and 1872. e experiment resulted in the destruction of beautiful it trees which were reached by water from the starch rks. These waters were not oxidised, but putrified e ground, and caused a frightful stench.

The River Molette, which received these waters, remained also polluted as before the employment of drainage. During the summer of 1872 M. Antheaume procured one hectare (2½ acres) of land at 200 metres (218 yards) distance, and at a higher level than the factory. They were obliged to use force pumps to send the water into the land through Doulton's earthenware pipes. The land is of a rectangular form, and situated on the highest part of the hill on which Bourget stands. The soil is sandy and light, easily pervious to water. The Bourget starch factory can, as that at Gonesse, rasp 400 hectolitres (1,100 bush.) of potatoes daily. The land used for purification at Bourget being five times larger than that at Gonesse, there was room to give more space for the drains. I placed them ten metres (11 yards) distant from each other, and 1 metre (40 in.) deep; I made them discharge into a strainer, dug in the middle of the field. The water from the starch factory brought by the stoneware pipes is distributed by means of a wooden conduit which surrounds the land. The distribution of the water is the same as at Gonesse. At the beginning of the season of 1872 and 1873 two small accidents caused these experiments to be delayed. The force pump was too weak to pump all the factory water over the land. The earthenware pipe was broken by a heavily laden carriage passing over a cross-road. Time was lost in making these two repairs; the waters were not regularly purified till December, 1872. The improvement of the Mollette was thus delayed two months. I tested the quantity of oxygen held in solution in the Mollette at different times. Before reaching Bourget the Mollette only contains from five to six cubic centimetres of oxygen per litre, in consequence of the defective state of the dredging, and especially because it frequently receives the sluice-waters from the Bondy sewer.

OXYGEN HELD IN SOLUTION IN THE LITRE OF THE RIVER MOLLETTE WATER.

STATION.	Date of Observations. October, 1872.	9th January, 1873.	10th March, 1873.	22nd May, 1873.	20th September, 1873.
	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.	Cubic centimetres.
At the point where the Mollette passes above Vieille Mer	0·00	5·32	8·00	4.8	7.6

The improvement of the River Mollette is unquestionable. *Beggiatoa* have completely disappeared there since December, when the drainage of the starch factory at Bourget commenced. The manufacture of glucose, from which the water is not yet purified, causes the appearance of the *hypheothrix*, the characteristic of moderately impure water, but not reaching putrid fermentation. The experiments at Gonesse and Bourget prove that the waters from starch works are purified by straining over drained land. The more largely the water is diffused the better is the effect. I advise manufacturers who employ my process, to be careful to let the waters fall drop by drop on the land, and to avoid making streams. Streams or trenches on a drained land effect filtration, but complete oxidation is not produced, and this seems a necessity for purification. If it be simply desired to arrest matters in suspension, water may be distributed by trenches, but if it be wanted to purify water containing dissolved organic matters it is absolutely necessary to employ the process established at Gonesse and at Bourget, spreading the water over the land in thread-like streams by means of troughs. I have made two other experiments, one at Crèvecœur, upon the waters used there for washing and cooking sheep's heads; the other at Aubervilliers, on the waters of the cardboard factory, confirming the accuracy of the practical rule which I have laid down.

River Montford.—The cardboard factory at Aubervilliers is the one which most affects this stream. In the examination which I made of these waters in 1869 I found *Bacterium termo*, showing an urgent necessity for the purification of these waters.

The first works for this purpose were commenced in July, 1870. The war stopped them. They were again begun and finished in 1871. M. Maricot and his sons-in-law and partners, Messrs. Lourdelet and Schaeffer, first tried to reduce the quantity of water which they must get rid of, so they made use of the same water twice over for diluting the pulp, thus leaving only 15 cubic metres to discharge daily. I had therefore only 15,000 litres (3,300 gallons) of water to treat daily; but, as a set off, these waters were charged to saturation. Before the factory there was a large open space; 900 square metres (1,080 square yards) were at my disposal for the treatment of the waters. I made in this land fifteen parallel drains distant 1·50 metres (5 ft.) from each other. The drains were 8 centimetres (3 in.) in diameter, and 60 (2 ft.) in depth. Parallel to these drains, and at an equal distance from each consecutive drain, I laid down trenches in the soil perfectly levelled, with a slight fall. The water from the cardboard factory was sent into these drains; I could not proceed as at Gonesse and Bourget. The working of the cardboard factory is always going on; the starch works only during the winter. To distribute the concentrated water from the cardboard factory on cultivated plants would most probably cause them to perish, besides these waters were extremely thick. Filtration seemed to me more necessary than oxidation. I could not lower the drains more than 60 centimetres (24 inches) because of the level of the stream on leaving the factory; and it was absolutely necessary to avoid having force pumps for raising the water to the level of the mill dam. In England drains are placed beneath the trenches. I prefer making the trenches and drains alternate. By my plan the water has to run further, and the flow is moderated, for it has always a tendency to run too rapidly, and the drain thus directs the liquid towards the roots of the cultivated plants. These roots are very active purifiers. The English method of vertical infiltration does not offer these advantages. When the land of the cardboard factory was thus prepared, and the strainer ditch opened at the outlet of the drains, water was sent into the trenches. The filtration was good, the drains acted regularly for some time, and then they ceased to run. A considerable quantity of cardboard stuff choked up the drains, though this stuff was not to be found in the ground which the water had traversed. In comparing this with similar facts which I have observed in water from starch works, photographic works, &c., I can only suggest a doubtful solution of the phenomenon. Cardboard stuff contains a considerable quantity of size from old papers. While these materials are in solution they check the complete precipitation of the tissues; but when they are destroyed by the oxidising action of drains, the stuff is precipitated and forms by degrees in the drains the deposit found there. It has, therefore, been necessary to discover a practical way of meeting this. In the yard of the factory there is a watertight tank of masonry. This tank was made by order of the *Conseil d'hygiène et de salubrité* of the department of the Seine, for the waters of the factory to settle. It holds 100 cubic metres (22,000 gals.) We divided it into two equal parts by a solid wall. When one of these parts is full a hectolitre (2¾ bush.) of slaked lime mixed with water is added. It is stirred up and then left to itself. Whilst this is going on, taking three days for the purpose, the second division is filled. After waiting three days the water in the first division in which the lime has been put is pumped up. This water is clear, of an amber colour when cold, of a green colour when hot, and it is inodorous. At the bottom of the reservoir an abundant deposit is found. This deposit is collected. Analysis shows it to be rich in cardboard stuff. Messrs. Maricot, Lourdelet, and Schaeffer estimate that they recover by this operation seven per cent., of the raw materials, so that the treatment of the residues largely covers the expense of the purification of the water. The purification of the waters of the cardboard factory by my method causes no sacrifice to the manufacturers who will take the trouble to do it, and the best proof I can give of the fact is that Messrs. Maricot and Co. are perfectly decided to continue the purification of their water, whenever a sewer which is projected is ready to carry it away for them. The water pumped into the reservoir is received into a trench of *Béton Coignet*, which M. Lourdelet has had constructed with the greatest care. On this trench are put 15 small wooden sluices, those sluices which admit the water into the various channels for distribution when required. The water slowly filters in the ground. After the action of the lime it no longer contains the stuff, but it still holds in solution some fine matters which are precipitated under the influence of air. In examining this microscopically they can be seen agitated by a *brownian* action, of which it exhibits a striking example. These miscroscopic particles, which are precipitated by the air, form a deposit in each furrow, and from time to time must be removed from the soil to prevent it becoming clogged. Cultivation is evidently necessary to cleanse the earth by removing from it the products brought from the cardboard works. We imagined that few plants could be benefited by this water, but our apprehensions were unfounded. The workmen planted artichokes, pumpkins, beans, &c., and all grew with an extraordinary vigour. This unexpected result is explained by microscopic examination of the waters of the strainer. In fact, in the strainer ditch, the water turns green, and has a green scum. This green material is nothing but swarms of *euglènes*, nourished by the gelatine from the old paper. On carefully examining the River Vivier from the cardboard factory to Montfort no more *bacteria* are found. At the very mouths of the drains the water takes up oxygen. From the pond at Aubervilliers it holds in solution 2 cubic centimetres of oxygen per litre. The *euglènes*, abundant at the mouths of the drains, give place to *rotifera* and to the *larvæ* of insects. So far, it is true that organic matter nourishes organised beings, and that beings of an inferior organisation are replaced by beings of a higher organisation as soon as the improvement has taken place which admits of their living. Upon Montfort stream there is another establishment, well known as contributing to the bad state of its water, namely, M. Artus' factory for treatment of sheeps' heads. Water coming from this establishment

tains lime, blood. grease, and the refuse of the lings of the sheeps' heads. I undertook the purification of these waters by following the same process as before. M. Artus obtained a piece of land facing his factory, which was part of a market garden. This land only separated from the factory by the Montfort stream. The earth there is pure *humus*. The drains placed perpendicularly to Montfort stream, which serves as strainer.

The factory waters are collected in a watertight reservoir, are raised by a pump, and carried by means of wooden channels to the extremity of the land. They spread by means of a trench parallel to the stream divide themselves by furrows parallel to the drains. These furrows alternate with the drains, following the plan already explained. In spite of this arrangement, absorption is perhaps a little rapid. I do not advise changing the present arrangement, as the land will, later lose some of its filtering qualities. The aëration of the soil by these drains is well done. No trace of putrid fermentation can be found at any depth, notwithstanding that the arrangement has been working more than a year. The drained land is cultivated as a kitchen garden. The factory waters form a capital liquid manure, and never touch the leaves but soak down to the roots. The result is unquestionable; as a further convincing proof, compare the production obtained without trouble by M. Artus with that of neighbouring market gardeners who use a great quantity of manure, and water largely.

In 1868, at the commencement of my researches, the question of purification of factory and household waters engaged the attention of France and other countries. Deposition, filtration, chemical treatment, and agricultural utilisation, were proposed. In every case where it was tried, agricultural utilisation was more and more approved, whilst often expensive and costly experiments, of other processes of purification, have been found insufficient. During the last few years the necessity for drainage has been admitted for cleansing the waters, carrying them off, and preventing their soaking into the soil. According to my opinion, the drainage of land irrigated by sewage is more useful in a chemical than in a mechanical point of view. This is the essential and fundamental aim of my experiments. Drainage in accordance with my method, being as energetic as it is economical, it is easy now to utilise factory waters and render them inoffensive, and get rid of those serious evils to which, for so long a time, the researches of chemists have been directed.

Experiments have been made by A. Stockhardt from 1849 till within a recent period, concerning the effect of smoke from smelting furnaces and chimney stalks on vegetation. It appears that the damage done was ascribable exclusively to the sulphur acids contained in the vapours, and not to their lead, arsenic, or finely-divided carbon. It was found that a distance of 630 metres protected the most sensitive vegetation from the effect of dense smoke, if sent out from a chimney not less than 25 metres high. Wide-branched trees are less affected than trees of straight growth.

It is said early next session the Duke of Northumberland will move for a Royal Commission to inquire into the working and management of works and manufactories for smelting, burning, or converting ores and minerals, in which sulphurous acid, sulphuretted hydrogen, and other gases are given off; to ascertain the effects produced thereby on the health of animal and vegetable life; and to report on the best means to be adopted for the prevention of injury thereto arising from the exhalation of such acids and gases, and upon the legislative measures, if any, required for that purpose.

Dr. Thomas Farley, F.R.S.E., in describing to the British Association some new solvents for gold, platinum, &c., showed that many ordinary dilute acids with hydrogen dioxide (or oxygenated water) can dissolve the precious metals—gold, silver, and platinum.

THE PROGRESS OF WOOL PRODUCTION IN OUR COLONIES.

By P. L. Simmonds.

(*Continued from page 883.*)

In the preparation of the wool for market, sheep-owners have within the last few years made very great advances. On many of the principal stations the hot water system has been adopted, and very large sums expended in pumps, spouts, and other machinery and appliances.

The coarse-woolled sheep are chiefly depastured in the coast districts, where they thrive better than the merino. A flock of full-grown pure-bred Leicesters will shear from 5 lbs. to 7 lbs. of washed wool per head; and lambs, from three to four months old will cut from 3 lbs. to 4 lbs. of washed wool.

It is in the country to the west of the main Dividing Range that the fine-woolled sheep are mostly depastured. Great success has attended the efforts made within the last few years to improve the flocks, so that the clip is not only better got up, but there is, on many stations, a younger, stronger, better woolled, and a doubly valuable class of sheep to that which existed five or six years ago. In some districts more than 90 per cent. of the lambs are saved. The average for the colony of New South Wales, in 1870, was 78½ per cent., and that result was obtained under a system as rough and negligent as could well exist.

The fine-woolled sheep in the colony came originally from the choicest flocks of France, Spain, and Saxony. The process of acclimatisation has modified the original type of the Spanish merino. There has been a very decided gain in the softness of the wool, and an improvement in its elasticity. The wool has increased in length, but diminished in density, so that the weight of the fleece remains about the same. So admirably adapted is the Australian climate to the production of fine wool, that experience has shown the colonists have nothing to gain by the importation of stud sheep from Europe.

Sir W. Macarthur, in a letter to a colonist, thus speaks of the first operations of introducing merino sheep into New South Wales:—"All I can relate respecting the animals in the two originally imported lots of merinos I have gathered in conversations with my father and with my mother. The latter, by her care, preserved the little flock during my father's two enforced absences in Europe, from 1802 to 1805, and from 1808 to 1817. The originals of the merinos from the Cape were undoubtedly from Spain—a present from the King of Spain to the Dutch Government, I have always understood, but I cannot say when. They could have been derived in no other manner, for the Spanish Government was always very jealous of their exportation, and did not even permit them to be sent to their own colonies in America. I believe the whole stock was brought on here from the Cape in 1797. I have understood that there were amongst them fleeces of singular beauty—combining great fineness, regularity, and elasticity, with remarkable length, toughness, and silky softness; and that the sheep from Kew were darker in colour, more 'throaty,' and neither so fine nor so 'silky' as these fine long-woolled sheep of the Cape lot. I have heard my father say, that when in England, between 1802 and 1805, and after he had roused the attention of the fine-cloth manufacturers to the fact that fine wool, such as they had only known as the product of Spain, and at that time believed to be producible only in that country, could be grown here, and, in time, supplied in greater quantities than they had ever imported, a manufacturer, eminent in the woollen trade, called upon him with a sample of his own wool and asked if it was really a fact that it had been produced here, and when so assured, he urged my father to persevere, giving, amongst other encouragement, the assurance that when wool such as that

sample could be sent to England in quantity, there would be a great revolution in the woollen trade, explaining that from such wool there would arise a new class of fabrics, of the most delicate texture, from combing wool—a prediction which began to be verified about twenty years afterwards, but which I remember to have heard related some years previously. Up to that time merino 'Spanish' wool, as it was always termed, was employed solely in the clothing branch of trade, for broadcloths and kerseymeres; and for that purpose was of course carded. There is, therefore, no doubt that the fine combing wool, some of it at all events of singular beauty, was the produce in the first instance of the merinos from the Cape. This was pointed out as a novelty by the manufacturer, who had the sagacity to foresee what changes it would occasion, and it is therefore to be inferred was not noticeable in the wools imported from Spain. It is to be remembered, however, that these fine wools from Spain were always washed in hot water, after being shorn in the grease, having previously undergone a very imperfect sorting, so that various qualities became very intimately blended together. Fine wool from Germany, 'Saxon wool,' as it long continued to be termed, had never been heard of in England in 1804, and must have first appeared in the English markets about ten or eleven years later. It was specially a clothing wool; and from its superior getting up, as well as quality, soon took precedence of the Spanish."

The steady continuous increase in the value of wool (subject only to accidental interruptions) and the consequent increased value of the stock, led to the exploration and occupation of new country, especially in northern Queensland, chiefly through the enterprise of Sydney capitalists, who pushed their business to almost the extreme northern limits of the Australian Continent.

Leaving New South Wales, let us now pass on to Victoria. The gross exports of wool from the colony of Victoria from 1839 to 1865 amounted to 449,695,704 lbs., valued at £31,866,652; but during that period 19,759,342 lbs. of wool, valued at £1,386,629 were imported from other colonies. The balance, therefore, brings the wool actually produced in Victoria, and exported through the Customs, to 429,936,362 lbs., worth £30,480,028. From 1866 to 1872, the gross exports of wool reached 403,164,000 lbs., valued at over £27,500,000. The shipments of wool from Victoria are shown below:—

	lbs.
1840	941,815
1845	6,841,813
1850	18,091,207
1855	22,584,233
1860	24,273,910
1865	40,527,402
1870	52,123,451
1874	58,648,977

The sheep in this colony have increased as follows:—

1841	782,283
1850	5,318,046
1860	5,794,127
1870	10,761,887
1874	11,323,080

The colonial value of the wool exported from the three principal Australian colonies in 1871 gave the following proportionate rates for each head of the population:—

	Total value.	Rate.
Victoria	£4,287,011	5 17 6
New South Wales	4,748,160	9 2 11
New Zealand	1,606,144	6 0 3

The value of the exports of wool and all other animal products from each Australian colony in 1872 were respectively as follows, and will convey an idea of the importance of the pastoral interest:—

Victoria	£5,[illegible]
New South Wales	2,[illegible]
South Australia	1,[illegible]
Tasmania	[illegible]
New Zealand	2,[illegible]
Queensland	1,[illegible]
Western Australia	[illegible]
	£15,[illegible]

Even in South Australia, which is of less [illegible] as a wool-producing colony than New South Wales [illegible] Victoria, there has been rapid progress made, [illegible] following figures of exports show:—

	lbs.	Value.
1851	3,694,672	£148,[illegible]
1860	13,212,438	657,13[illegible]
1869	30,532,812	1,127,[illegible]
1872	34,650,631	1,692,[illegible]

The sheep in the colony were as follows:—

1855	1,750,[illegible]
1861	3,038,[illegible]
1874	6,617,419

This last return is at the rate of more than [illegible] to every man, woman, and child in the colony.

The pastoral districts at present occupied [illegible] only contain 70,000 square miles, leaving [illegible] open for settlement.

Queensland, the youngest of the Australian [illegible] and an off-shoot from New South Wales, [illegible] more than 7,250,000 head of sheep. In 1[illegible] colony was first formed, it had about 3,500,0[illegible] 1868, it had nearly 9,000,000, but the subsequent [illegible] is not so steady as in the other colonies. [illegible] has been also a decline of late years [illegible] exports.

	lbs.	Value.
1860	5,007,167	[illegible]
1869	22,388,650	1,[illegible]
1872	17,793,392	1,1[illegible]

There are nearly 124,000,000 acres of crown [illegible] leased, and chiefly used for the feeding of stock [illegible] natural pasture. The profitable growth of wool [illegible] fined to the Darling Downs and the high [illegible] without the tropics. The coast country and the [illegible] plains are more suitable for cattle. There is still [illegible] country in the north and west unoccupied [illegible] squatters.

For nearly a quarter of a century the quantity [illegible] produced in Tasmania has been almost stationary [illegible] 1848, 16,095 bales of Tasmanian wool arrived [illegible] land; in 1870 the number was 16,773; in [illegible] years the produce has reached 20,000 bales. [illegible] rage clip is about 2 to $2\frac{3}{4}$ lbs. from each sheep. [illegible] richest settlers are those whose attention has been [illegible] to sheep farming, and several have flocks of [illegible] 70,000 sheep. In 1872 6,000,000 lbs. of wool [illegible] shipped from the colony, valued at £435,0[illegible]. [illegible] about the same quantity as exported in [illegible] Tasmanian flocks, although not so long in [illegible] of improvement as those of Australia, are [illegible] advancing in quality, and extensive further [illegible] ment may confidently be expected to result from [illegible] severance in the same system, which has been [illegible] nently successful in the best flocks of the [illegible] as well as in Germany, the great point being [illegible] tainment of purity of blood; indeed, several [illegible] Tasmanian growers, by their skilful and [illegible] management, have so much improved their [illegible] quality, length of staple, washing and assorting, [illegible] they have materially raised them in the estimation [illegible] buyers, who have testified their approbation [illegible] increased prices they readily pay for the [illegible] question. Only 74 sheepowners at present wash [illegible] sheep in warm water in this colony, and 244 shear [illegible] in the grease.

New Zealand possesses nearly 12,000,000 sheep, or 40 each head of the population, and the exports of wool om the colony in 1872 were 41,887,000 lbs., valued at ,538,000. The immense progress made is shown by the turns of 1858, which were under 3,000,000 lbs., and in 63 only 12,586,000 lbs. were exported. In 1862 the port of New Zealand wool was 26,658 bales; in 1872, ,584, or an increase of about 293 per cent. in ten ars. In 1873 we received from New Zealand ,239,000 lbs. of wool. The New Zealand sheep-runs ve been stocked chiefly with the Australian merino riety, improved through the importation of pure xon merino rams from Germany. Although there is ery reason to believe that the growth of long wools will largely increased, the merino will always occupy the ief position in the flocks of New Zealand. The excel- nce of the merino consists in the unexampled fineness d felting property of its wool, which in fineness and the number of serrations and curves exceeds that of any her sheep the world produces. The quality of the rino-bred flocks in the colony is at present of good, t not of extreme fineness, the climate being apparently cold for the production of a very superior quality, ch as is obtained to perfection in the famed western tricts of Victoria.

The staple is generally of good length, stout grown d sound. So far as the production of wool depends the growth of native grasses, it may be said that it reached its extreme limit on the southern island, as best lands in that part of the colony are fully cked. But in the northern island there is still room expansion, as thousands of acres only await the ended cultivation of English grasses to become d for the further increase of this already enormous port.

If we glance now at the wool progress made in our th African colonies we find an almost equal advance. 1845, the export of wool from the eastern province of Cape weighed 728,765 lbs., and was valued at £30,762. e total export in 1855, was 10,155,870 lbs., valued at 3,855. In 1860, the value of the wool exported had anced to £835,665, and in 1872, 48,841,314 lbs. of l were shipped, of the aggregate value of £3,276,052. e colony of Natal shipped in 1872, 5,651,416 lbs. of l, valued at £254,495. Our direct imports from th Africa in 1874 were a little over 42,000,000 lbs., ued at close upon £3,000,000.

Many persons who have farmed sheep in Australia have ed their conviction that the Cape Colony possesses superiority over that continent as a wool-growing ntry, because it enjoys a more equable climate, a rior description of pasturage, and greater cheapness land.

In consequence of the scarcity of water, and the diffi- y of procuring cheap labour, the greater portion of sheep in the Eastern Province and the Free State shorn in the grease (unwashed), and, unhappily, y shear every eight months, instead of waiting the ve months' growth. Thus the wool from the ern district, which is the chief part of the export, es under the designation of "clothing," and not mbing" wool, being too short in the staple.

must not pass over unnoticed our supply of Indian l, which, although coarse, is yet useful for certain poses. Indian wool is chiefly imported from Bombay Kurrachee. In 1873 there was a falling off of 0,000 lbs., the exports being 20,394,718 lbs., worth ,012. The wool-staplers of Khorasan, and the pro- rs of wool on the hills north of Cabul, Ghugnee, and ous parts of Central Asia, bring it by caravans to the tier, and an increase of the produce brought down the tributaries of the Indus may be looked for.

Improvements in the staple and quality of wool pro- d in India can be effected only by the intermixture uperior breeds with the indigenous animal. Excel- pasture lands are found in the more elevated regions, climate of which is not inimical to the European constitution; an admirable field, therefore, seems open to the capitalist for a profitable cultivation of the golden fleece. The merino sheep, which have proved so success- ful in Australia and the Cape, might be introduced to improve the Indian breed, and a foundation be laid for obtaining a wool unsurpassed in quality by the best pro- duce of any of our colonies. Washing the sheep before clipping is almost entirely neglected in India, but a greater injury lies in the pernicious custom which pre- vails in Bombay, of mixing inferior with superior wool. Wool should be garbled and classed, and separately packed, and this might be advantageously carried out at Kurrachee, where the wages of labour are less than at Bombay. The wool exports from India have been as follows:—

	lbs.
1850	4,549,520
1855	14,283,535
1865	23,432,689
1870	13,327,836
1872	24,250,904

There are yet a few wool-producing colonies to touch upon before we close the inquiry. The Canadian Dominion has not much wool to spare for export. We have no later returns than 1862 available for reference; but there were then in the colony about 2,500,000 sheep. Our other North American colonies possess about 200,000 sheep. Although Canada exports from 2,500,000 to 3,500,000 lbs. of wool, very little comes to this country.

Lastly, we have an extent of country and pasturage in the Falkland Islands, where cattle and sheep range at large and thrive well. The wool, though long and coarse, is useful. We have no late returns of the live stock there, but there is a large quantity of waste land only fit for pasturage.

THE RESOURCES AND CONDITIONS OF BOSNIA.

It is difficult to obtain any precise information respect- ing the resources and conditions of Bosnia, the series of reports by Consul Holmes will, however, furnish a toler- ably accurate description. The total population, reckon- ing that the males and females are in about equal numbers, is about 1,279,296 souls. Of the male population there are 230,524 Mussulmans, 226,313 Christians, 78,188 Catholics, 1,330 of the Jewish faith, and 5,706 gipsies. During the last eighteen years it appears that the male Mussulman population has increased by 55,347, the Christian by 40,914, the Jewish by 256, the gipsies by 1,070, making a total increase of 95,587 souls. It seems hardly probable that the Mussulman population, which is less than the Christian, and liable to military con- scription, should have increased more than the latter, but the materials have been taken from the best informa- tion in the possession of the Turkish officials. From the careless and inefficient manner in which statistical details are collected in Turkey, they are certainly not exactly correct, but there is no doubt that they are right in the main point, namely, a gradual increase of popu- lation.

In most parts of the country the air is wholesome, fresh, and bracing, but no kinds of sanitary precautions are taken in respect of drainage and ventilation, whilst personal cleanliness is certainly an exception; the mortality among children, in consequence, is always enormous. No statistics can be procured, but it only requires to see them—half-clad and filthily dirty, exposed to all the variability of the climate—and to know the nature of the food they eat, to be assurred that the weak and sickly must be decimated, whilst only the very robust and strong constitutions reach maturity. Even among the better classes ignorance and inattention to all the re- quirements of pure air, cleanliness, suitability of dress to climate, and proper diet, is little, if anything, beyond that of the mere peasant.

In the Herzegovina, where the males numbered 71,954, the different faiths were distributed as follows:—the Mussulman, 29,472; Orthodox, 23,492; Catholic, 18,289; Jews, 25; gipsies, 676 souls.

There is a pretence at education; the number of the Mussulman schools, which seems so abundant, exists rather on paper than in reality, as every mosque is understood to have a school attached to it, but this, in nine cases out of ten, is purely imaginary. The Christian schools really exist, but are for the most part of an inferior description. The English Protestant School, though making but little progress itself, has given rise to a considerable effort on the part of both the Greeks and Catholics to provide education for their children in schools of their own, which are now kept up with more efficiency than formerly. The teachers are superior to what they were, and the attendance larger and more regular. This establishment, originating in the philanthropic desire of two English ladies, Miss Irby and Miss Mackenzie (now Lady Sebright), to afford some education to the women of Bosnia, has at least the merit of having stimulated this people, too fanatical to accept the boon of instruction in the form it was offered, to advance in the right direction, and improve their means of education by teachers of their own persuasion and at their own expense. This applies exclusively to the town of Serajevo, whilst throughout the province in general, notwithstanding the existence of a few primitive schools, it may almost be said that the people have no means of education. In subsequent accounts we learn that the public education remains in the same condition, with the exception, however, of a fine new military school, which has been built and opened at Serajevo, its object being to form Bosnian officers for the army. The English girls' school likewise continues, by its example, to keep the attention of the people to the condition of their own schools. Several Slav newspapers have very recently mentioned this institution in very favourable terms. The number of scholars, however, still remains less than might be desired.

The province suffers occasionally from drought, when the seed has in many cases to be sown twice; flour becomes scarce and very dear, and many water mills are thrown out of work for the want of water power, and on such occasions grain has to be imported from Bulgaria for the supply of the troops. The trade in cattle, once so flourishing in Bosnia, has entirely ceased. Since the cattle disease first broke out in 1862, it seems never to have thoroughly disappeared, and the Austrian government has strictly closed the frontiers against the importation of Bosnian cattle. No notice of the disease seems now to be taken by the Turkish authorities, although it still exists, and no efforts are made to check it, nor are any reports made upon the subject. Indian corn is in demand for the Austrian market, but as it forms the chief food of the peasantry there is not much available for exportation.

When the winters are severe the supply of fox skins is good, and the trade flourishing. Wool is consigned to merchants at Trieste, whilst prepared hides are chiefly sent to Vienna and Pesth. The fair at Leipsic generally disposes of the skins of wild animals. The tobacco is under the monopoly of the Government, who have introduced the duty on it, here as elsewhere throughout the Empire, and the privilege of cutting tobacco is now sold to certain merchants for a fixed sum, but as this will not prevent the right being accorded to others, it seems a most doubtful speculation as well as an indifferent mode of levying the taxes. The general insufficiency and poverty of most of the crops is compensated by the very large production of plums, and the great demand for this fruit in its dried state. The principal district which furnishes the fruit is the whole of the Possavina in the north of Bosnia. A good crop produces from 15,000 to 20,000 tons. The sales are managed at Beska by brokers, chiefly Mussulmans, who take large profits. The carriage of this merchandise, when the rivers are high, is by the Save to Sissek for Trieste, and by the Save and Danube for Pesth: when the Save is low, by land to Trieste and overland to Voukovar, and thence by the Danube for Pesth. All the prunes from Shamatz are carried across the Save to Rajevoselo on the Austrian bank by Turkish boats, where they are packed in barrels, and shipped to their destination. About three-quarters of the whole produce of Bosnia is exported from Beska, which is a very flourishing and daily increasing town on the Save. The rest is sent through Shamatz, Brood, and Gradiska, also situated on the same river. The best plums are produced on the sides of the low valleys descending into the great plain of the Possavina. Little or no attention is paid to the cultivation of the trees, and the fruit is rudely gathered, no care being taken to prevent breaking the branches. The produce of the orchards is shared between the farmer and the landlord, the former receiving one-third, a revenue of 10 per cent. being paid to Government by both. Austria, Croatia, and Servia produce enormous quantities of plums from apparently the same kind of trees, and similar in appearance to those produced in Bosnia, but the quality of the Bosnian plum is vastly superior, and if mixed with Servian or Croatian plums the fraud cannot be concealed, as they then soon ferment. The Servian plum, however, makes a bitter spirit called "Sligeivtz," The Bosnians also seem to have a monopoly in the art of drying the plums, which they do in [illegible] ways, and numbers of the peasants are annually hired to go into Austria and Servia to dry the plums produced there. In the Herzegovina the vine is cultivated, but the grapes are small, and the wine produced is of inferior quality.

There is a great need for good roads, but no [illegible] activity displayed in their construction. The road from Seragevo to Mostar, begun ten years ago, is still unfinished, though a certain progress has been made, and in dry weather it is now possible to perform the journey in one of the rough carts of the country. An English iron bridge has been placed across the river Narenta on the road, but at another point, where a [illegible] bridge should have been placed during the summer, there is still only a temporary wooden construction, which can only be crossed in safety by taking over the horses and carts separately. The Brood road has been repaired, though it is in a most dilapidated condition, and in no other direction has any progress been made. The proposed railway through Bosnia is for the present in abeyance. The survey of the greater part of the line was completed during the summer of 1874, and all the engineers engaged on the work, except those on the branch line from Shamatz to [illegible]vutch, who had not quite finished their survey, were discharged a short time ago. The best map of Bosnia, on which the line of the proposed railway can be traced, is that of Captain Roskiewic, sold by Artaria and Co., Vienna. The prospect of the formation of a railway through Bosnia has called attention to the mineral wealth of the province. Concessions were asked for by one of the Austrian machine manufacturers to work the mines within reach of the railway, and to establish a manufactory of steam-engines and rolling stock of all kinds for the use of the line, and to supply it with coal on the spot. If these projects are carried out, the country and the Government will derive an immense advantage from them, and the Porte would be wise to encourage them by every means in its power. The concession of the cinnabar mines of Mount [illegible], which was obtained a few years ago by a Mr. Wilkinson, has lapsed, and no one seems to have been found to take up the matter again.

In the month of August, 1864, the conscription was first introduced into Bosnia on the understanding that the troops should never be called on to serve out of the province. The measure was carried out without much difficulty. It was decided to form two native regiments, which were to be completed in three years. The p[illegible]

of service was fixed at three years in the Nizam (regulars), nine years in the Rediff (reserve), and two years in a corps named Muhafiza, or protectors, only to be called out in case of great emergency. Several years have now elapsed since the two regiments were completed. Each possesses four battalions, but these are never numerically perfect, because each year as many men pass, after their three year's service, into the reserve, as enter the Nizam, and the country does not furnish men enough to keep the battalions at their full strength. The government requires every year one soldier out of every hundred and eighty of the Mussulman population. All the men from the age of twenty-one to twenty-four are liable to conscription, during which period they are called up each year to draw lots. Those who draw blanks four times are entirely free from service in the Nizam, but are then drafted into the Rediff for nine years, being each year liable to one month's drill. The two Bosnian Nizam regiments are in every respect commanded, drilled, and paid in the same manner as the rest of the regular Ottoman army. Besides the Nizam regiments, there is a corps called the "Cordendlai," or frontier regiment. It has four complete battalions, which are distributed all along the frontiers of the province in block houses in sight of each other. The men of the Cordendlai have double the pay of the regular troops. They are not drawn by conscription, but enlist voluntarily, and are considered to be men of superior character and education. The police force consists of 2,764 men, horse and foot, distributed throughout the vilayet. They are commanded by a colonel, who resides at Serajevo, and by seven majors, who reside at each of the chief towns of the various sandjaks of the province, besides captains and lieutenants. They are sent to collect arrears of taxes, to arrest criminals, to impress animals for government service, to assemble and convey the people yearly summoned to work at road-making, &c. Their salaries are now regularly paid, which was not the case formerly. Still, they must be a great burthen to the peasantry, and little change for the better is likely to take place until at least they are allowed fair travelling expenses when sent on duty. The custom, however, of living at the expense of the people among whom they are sent is so established, that the Government may well imagine that it would be of no use to pay them their expenses, as they would still follow their old habits.

The administration of the province is sometimes in abeyance, with the exception of the most ordinary current affairs. There is no hope of any amelioration as long as the prevailing system of constantly changing the provincial governors-general continues. A stranger requires at least a year to become tolerably acquainted with the country and people he has to govern, and moreover, a certain confidence in the stability of his own position is needed to induce many man to take an interest in their affairs, and to exert himself for their welfare. Whilst this state of provincial affairs continues, and there seems no probability of any amelioration, there is no present prospect of improvement in prosperity and civilisation.

General Carrington, U.S.A., describing "Chrome Steel" before the British Association, said it was a new alloy of iron with the oxide of chromium, and that it was a greater advance than had yet been made towards a perfect metal. He described experiments which had been made upon it to prove its strength, and said that while it could not be pierced by other steel, he had never yet seen the steel that a drill of the chrome steel would not pierce in three minutes.

The New York *Tribune* states that Mr. Thatcher is about to resign the office of Commissioner of Patents, and is to be succeeded by Mr. R. H. Duell. Mr. Duell is stated to be a gentleman of ability and varied attainments, possessing rare capabilities for the administration of patent-office affairs.

Negotiations are said to have been opened between France and England for reducing the telegraphic rate between the two countries.

OLIVE CULTIVATION IN THE BALEARIC ISLANDS.

The *olea* tree, upon which the olive is grown, originally grows wild in the mountain lands in these islands, as a shrub, producing a fruit which bears no oil. When brought under cultivation grafting is practised. The ancient historians of Majorca recount that in olden times the olive was unknown in these islands, and that the art of grafting was taught to the islanders by the Carthaginians. Consul Bidwell remarks, by the appearance, however, of some of the enormous and ancient-looking olive trees now in Majorca, one would be tempted to believe that their existence dates as far back as the period to which the historian refers. Having once asked a Majorcan farmer how old he thought some of these trees were, his answer was, "I believe they may well date from the date of the Flood." It is a remarkable feature in the growth of these magnificent trees, that one seldom or never sees two alike. Almost all in the course of time assume most grotesque forms, and upon old trees whose trunks are rent open and torn into half-a-dozen shreds, one often sees the finest crop of fruit, while in Majorca they have in some places attained proportions which remind one of the forest trees of the tropics. Mr. Bidwell speaks of having seen trees, the rent trunk of which would now require the outstretched arms of half-a-dozen men to encircle, whilst one doubts, from the wild growth of these trunks, whether the branches proceed from one tree or from two or three congregated together.

In countries where more care is exercised in the prepartion of olive oil than is displayed in these islands, the "virgin oil" obtained from the fruit when first pressed is carefully separated, as being of a better quality than that which is procured by the application of hot water to the bruised fruit, and by the application of greater pressure. But the quantity of virgin oil produced in these islands is quite insignficant, although it is of excellent quality. Samples of it that had been clarified gained prizes at the International Exhibition at Vienna, but the care required to produce such oil is not often exercised. All the oil that can be squeezed out of the olives by means of the antiquated machinery still in use, is generally poured into one common tank and left to clarify as best it may; or, at most, the olives are roughly sorted, the inferior ones being made into oil for the soap boilers. The fruit, whether ripe, over ripe, half green, or wholly rotten, or whether it may have been knocked down by the beaters' canes, or beaten down by the wind and rain in stormy weather, and trodden under foot, is too commonly all picked up about one time by the women and children who are employed at the gathering season. It is then, after being sorted or not, as the case may be, crushed under the millstone, and the oil drawn by the application of boiling water. The refuse of the olives after the last crushing, which is far from getting out all the oil contained in the pulpy mass, is used to feed the fires required to boil the water. Probably, nowhere may be seen more magnificent olive trees, or better olives, than those grown at these islands; but the oil, from being unrefined, is often acrid in taste and inferior to that of other countries. The olive crop of 1874 was a very inferior one, both as regards quality and quantity, and the oil is dearer than it has been for many years past.

An exhibition is now being held in Cassel by the Association of Metal-plate Workers. The exhibits include raw material and plates; white and black plate goods; tinned, enamelled, and lacquered plate goods; brass, new silver, and plaqué goods; architects' metal goods; lamps; petroleum cooking apparatus; stoves and grates, for wood, coal, and coke; gas and water piping.

The Paris International Maritime Exhibition for 1875 will remain open until November 15th.

TESTING ALLOYS.

The following communication has been forwarded to England by Mr. Thurston, the chairman of the board appointed by the United States Government to test iron, steel, and other metals:—

"A committee of the board appointed by the President of the United States, as provided by Act of Congress, approved March 3rd, 1875, has been instructed, during such time as may be found available pending the construction of the apparatus ordered by the board for use in general work, and during such intervals as may subsequently be properly appropriated to such purpose, to investigate the mechanical, physical, and chemical properties of the alloys of the most useful metals, and to determine, if possible, their interdependence and the laws governing the phenomena of combination and of their resistance to stress. The committee desire to obtain records of all experiments which have hitherto been made in this direction, and to secure such information as may assist further researches. It is desirable that such records should embody a statement of the precise chemical constitution of each alloy examined, as obtained both by synthesis and subsequent analysis. Its specific gravity, specific heat, conductivity, its combining number, and the relation of its chemical constitution to the series of similar compounds produced by alloying the elements in the proportions of chemical equivalents, should be stated whenever possible. A few thoroughly well-studied examples will be of more service than a large number of isolated determinations of single facts. It is further desired that the ultimate strength, the elastic limit, the modulus of elasticity, the ductility, resilience, homogeneousness, hardness and other mechanical properties of the specimen be ascertained and accurately stated. Where only a part of this work can be done by the investigator, this committee is prepared to assume charge of the remaining portion of the research, when the alloy can be furnished in proper form. References to published accounts of similar works and monographs on any branch of the subject will be thankfully accepted. Special researches made for this committee will be received with appropriate acknowledgments. The departments of physics and of chemistry in the various colleges and universities will probably be able to render valuable aid, and their co-operation is earnestly requested. The schools of engineering are in a position to assist this committee very effectively and their contributions will be thankfully accepted. Suitable blanks upon which to record the data offered will be furnished upon application. Specimens of alloys for test by the committee must be accompanied by a statement upon these blanks of their precise constitution, and such information as it is possible to give, with an account of such particulars as are known to distinguish the alloy, and of the special object which it is supposed may be attained by the investigation. Where possible, it is required that one or more specimens shall be furnished of each of the specified kinds, and of precisely the form and dimensions, which will be given on application."

The offices for the Registration of Designs and of Trade Marks, having been amalgamated with the Patent-office, Mr. B. Woodcroft, F.R.S., clerk to the Commissioners of Patents, has been appointed Registrar of Designs. No formal appointment in connection with the Registration of Trade Marks has yet been made.

The telegraphic service, says the *Electrical News*, since it was first established in France, has never until the present year been worked at a profit. Down to 1873 the cost always exceeded the receipts, the deficits having varied from 500,000 frs. to 4,500,000 frs. annually. In 1874 the expenditure was just balanced by the income; while for the present year the estimates show a surplus of 2,200,000 frs.

GENERAL NOTES.

A New System of Gas Lighting.—The *Scientific American* states that there is in operation in Jersey City a system of gas lighting by hydrocarbon. The apparatus consists of an air compressor at some central locality, several small tanks (one to each lamp-post) laid under the side walk, a small air tube connecting each with the reservoir filled by the compressor, and another small tube which carries the air charged with petroleum vapour to the burner. The tank is made of galvanised iron, with top and bottom of copper, and holds 48 gallons, that quantity of oil being somewhat in excess of a six months' supply. The hydrocarbon used is a low quality of benzine. It is fed into a tank through an aperture in the top. It is stated that the cost of the gas is about 38 cents (1s. 7d.) per 1,000 feet.

Chambers of Commerce.—The programme of resolutions to be proposed at the special meeting of the Association of Chambers of Commerce, to be held at Leeds on Tuesday and Wednesday next, includes the following subjects:—"Imperial Taxes," "Registration of Firms," "Law of Partnership," "Telegraphic Charges between France and England," "Mail Service between England and France," "Metric System," "Private Bill Legislation," "Public Bills in Parliament," "Minister of Commerce," "Patent Laws Amendment," "Bills of Sale," "Telegraphs," "Limited Liability Companies," "Halfpenny Letter Post," "Public Prosecutors," "Protection of Sea Passengers," "Suez Canal Dues," "Merchant Shipping," "Lighthouse Management," "Bankruptcy Law Amendment," "Assimilation of Factory and Workshops' Acts," "Factory Act," and "County Courts."

British Association.—The following statement shows the attendances and money received during the meeting of the British Association at Bristol:—Old life members, [illegible]; new life members, 36 (£359); old annual members, 296 (£296); new annual members, 93 (£186); associates, 884 (£884); ladies, 672 (£672); foreign members, 17. Total attendances, 2,249; total money received, £2,397. The grants for subjects connected with mathematics and physics were the following:—Professor Cayley, printing mathematical tables, £159 4s. 2d.; Mr. Brooke, British Rainfall, £100; Mr. J. Glaisher, Luminous Meteors (£25 renewed), £30; Professor C. Maxwell, Testing the Exactness of Ohm's Law (renewed), £50; Professor Stokes, Reflective Power of Silver and other Substances (renewed), £20; Professor Tait, Thermo-Electricity (renewed), £50; Sir W. Thomson, Tide Calculating Machine, £200.

Indian Railroads.—A supplement to the *Gazette of India*, just arrived, gives a detailed account of the present position of the State railroads and irrigation works in India. The most important item for notice, says the *Engineer*, is the reduction of the proposed annual expenditure for the next few years from four and a-half to four millions sterling. This is in accordance with the principle of proportioning such expenditure to the prospect of ultimate receipts. But as it is now decided not only to execute the Indus Valley and Punjaub Northern, but the Gwalior line, on the broad gauge, so as to avoid any break where important military considerations come into play, the outlay on these will be larger, with no corresponding increase of traffic receipts. Moreover, the money to be raised will probably have to bear 4½ per cent. interest, instead of 4 per cent., as formerly calculated. Summing up the statement and adopting it, a resolution of the Supreme Council declares that the expenditure of "four millions annually for the next five years, charged with interest at 3½ per cent., is not likely to lead to any annual increase of charge on the revenues." The total deficiency of the railway receipts below the guaranteed interest and other charges for the same five years is estimated at an average of £2,023,000. This seems a liberal forecast, considering that the deficiency has actually fallen in the last three years from £2,357,000 to £1,565,000; but this great diminution is due largely to the famine traffic, and cannot be reckoned on as permanent. It seems that the Punjaub Northern Railway is to be completed and opened in 1876-77, the Indus Valley in 1878-79, the Scindiah line from Agra to Gwalior in 1879-80, and sundry narrow lines, begun "on the metre gauge," at various intermediate times.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EXAMINATIONS.

In reorganising the Examinations of the Society of Arts, one division—the COMMERCIAL—described in recent issues of the *Journal*, has special reference to men, although not excluding women, who can make capital clerks, if they please, as is well shown in France.

A second division, the TECHNOLOGICAL, is already in operation, and applies to Manufactures. These examinations obviously may be attended by both sexes.

EXAMINATIONS IN DOMESTIC ECONOMY.

A third division of the examinations has been established, and will particularly apply to women; it consists of the following subjects:—

Clothing and its Materials.
Health.
House-keeping and Thrift.
Cookery.

Whilst it may be expected that these subjects will be chiefly taken up by women, there is no reason against men taking certificates in them. In the Code of the Education Department they are limited to girls, and this is a good reason why young men should not be excluded from the Society of Arts' examinations in them, if they please to attend to these important subjects. These examinations will be by papers of questions.

FINE ARTS APPLIED TO INDUSTRY.

The Society has already held with success annual Exhibitions of Fine Art applied to Industry, and in considering the whole subject of the examinations, arrangements are in contemplation for holding Examinations in Fine Arts applied to Industry.

In this way the whole field of Arts, Manufactures, and Commerce, the special province of the Society, will be connected with a scheme of annual examinations in the future.

EXTINCTION OF FIRE IN SHIPS.

The Fothergill Gold Medal is offered for an effective means of preventing or of extinguishing fire on board ship. Communications, illustrated if need be by models or working drawings, must be sent in to the Society not later than the 31st of December, 1875.

The Council will take into consideration, with a view to reward, the best written paper containing suggestions fitted to secure prevention of fire, or the means to be adopted for the safety of life and property when fire breaks out on board ship.

The Council reserve to themselves the right of withholding the medal or reward offered, if, in the opinion of the Judges, none of the communications sent in are deserving.

MISCELLANEOUS.

INTERNATIONAL PATENT LAWS:—ON ASSIMILATION OF THE LAWS AND PRACTICE OF VARIOUS NATIONS IN RELATION TO THE PROTECTION OF INVENTIONS.*

By Lloyd Wise, A.I.C.E.

During the last few years there has been a good deal of talk about international patents and assimilation of Patent-laws.

In reply to a member of the English Select Committee on Letters Patent in 1872, I expressed the opinion that if an International Patent-law could be devised satisfactorily it would be of great advantage. I still think so. But I may add that, assuming the words "International Patent-law" to mean that one patent should cover the whole of the countries concerned, I fail to see a method of achieving that object.

Assimilation of the Patent-laws and practice of different nations coupled with a sort of international arrangement, is far more susceptible of accomplishment. For inasmuch as the laws in existence in various countries seem to have been borrowed to a greater or less extent from the English, it becomes self-evident that, given a good law and practice as a standard, the remodelling of other laws to accord would be an undertaking not presenting any insuperable difficulty.

An exhaustive consideration of this comprehensive subject would occupy far more time than is now available. I must be content to submit in outline, with brief explanations, some suggestions, the adoption of which I believe would conduce to a satisfactory system.

The first requisite of an efficient Patent-law administration is a competent staff of officials to prepare and keep, for official and public reference, records as ample as possible of all known industrial arts and manufactures.

In furtherance of this object, well-authenticated communications, when properly submitted in duly prescribed form, might be embodied in the records, together with the names and addresses of the contributors. The latter should be required to pay a nominal registration fee proportionate in each case to the length of the communication and the complexity of the drawings, if any. Communications beyond a certain length, duly prescribed, might be subject to an extra fee as a check to verbosity.

* Read at the Hague before the International Law Conference.

This plan of registration, besides other obvious advantages, would provide for those cases, if there be any, in which inventors at the present time take out patents, as has been alleged, simply to protect themselves against subsequent patentees.

Copies of their respective records, specifications, and other documents relating to inventions, should be interchanged by the various States at frequent intervals, so that the information available to the public in each country may be as complete and to as recent a date as possible.

It seems reasonable that where a patent has been applied for in one country, subsequent publication of the invention during a limited period, say twelve months, should not necessarily prejudice the original applicant's right to patents in other countries. To this end, on depositing his original application, the applicant should be required to specify the countries in respect of which he desires to retain the option of obtaining patents, and in respect of each such country should be required, with his original application, to deposit a nominal registration fee, and an extra copy of his provisional specification, for immediate transmission to the country to which the reservation applies. A notification of the reservation should be entered on the records of the country in which the original application is made, and a like notification should accompany every document concerning the invention officially remitted to each of the countries reserved, the applicant to be deemed to have abandoned his right to ask for a patent in any country so reserved, where not exercised within the delay above provided.

The Vienna Patent Congress laid it down that only the inventor himself, or his legal representative, should be entitled to a patent. This proposition, when considered in connection with international arrangements, opens up a very large and somewhat difficult question, who shall be deemed *the* inventor? by which I assume is deemed the *first* inventor.

If the principle is to be strictly and universally enforced that only the first man who shall have had an invention in his mind, shall be entitled to a patent for it anywhere, it is difficult to conceive that any patent could ever become fairly reliable as a property for investment. There would be constant risk of some earlier inventor turning up and invalidating the patent. For this reason, and as the fundamental object of a Patent-law is to induce the early communication of new inventions, it seems desirable that, save in cases of fraud, the original applicant should be regarded in the eye of the law as the first inventor.

Assuming the plan of registration I have hinted at to be established, I would suggest that in countries as respects which notification of reservation shall have been filed, the party filing it should take precedence of others as from the date of such filing. For example, assuming that on the 1st of January, A applied in the United States for a patent, and reserved the right of patenting in England, that on the 7th of January, B, an independent inventor of a similar thing, applied in England for a patent, and that seven days later, namely, on the 14th of January, the notification of A's invention and reservation reached England from America; then B should be required in his final specification to admit the prior existence of A's invention, and A's English patent should not be prejudiced by B's prior English application.

Every application for letters patent should undergo examination limited to the questions whether the specifications are clear and whether the invention is open to objection as being contrary to morality, or wanting in novelty, regard being had to prior publications in the Patent-office. Should the result of the examination as to novelty be unfavourable, the applicant should be nevertheless entitled to obtain his patent subject to the insertion in his specification of an acknowledgment of the existence of the prior matter found and pointed out by the Patent-office officials, with a clear statement of what he nevertheless claims.

Patents should be refused only in cases of fraud or where the invention is contrary to morality. Other points should be left to be adjudicated upon by the courts only in case the validity of the patent should come into question. There should be no publication of any report or opinion of the examining authorities as respects any application for a patent, saving reports of proceedings in disputed cases.

Thus on the one hand applicants who had been anticipated would be saved the useless expenditure they might incur if left in ignorance of the fact; and on the other hand they could not become sufferers by reason of any erroneous judgment of the examining authorities. Moreover, the public would be amply protected by having all the facts (and facts only) placed in juxtaposition before them in the specification.

Where the examining authorities have the power of refusing an application for a patent on the ground of want of novelty, there must always be considerable risk of injustice to the inventor, there being in many instances scope for diversity of opinion. Nor is the difficulty obviated by providing means of appeal. Appeals are somewhat costly, consequently, in a pecuniary sense, might may in the long run prevail over right. Moreover, where the power of refusal obtains as in the United States, there results a widespread idea that a patent once granted is practically indefeasible. Of course, people well acquainted with the law know better, but I am for the moment speaking of the outside public who may nevertheless have interests at stake.

Now I think the plan above proposed, whilst securing justice alike to the inventor and the public, would not be liable to such misinterpretation.

Provisional protection should be granted for twelve months at a nominal cost, to allow time not only for perfecting the invention so that it may be properly and fully described in the complete specification, but also for obtaining if needful the co-operation of capitalists.

The English system of provisional protection has worked very well in practice on the whole, but its duration, six months, is not in all cases sufficient to enable the invention to be perfected in time to be amply described in the final specification.

Every patent should bear date as of the day on which the original application for it was adopted. The practice in England, whereby if a second of two applicants for the same invention obtains the Great Seal first, he is permitted to prevent the grant of a patent to the first applicant, is, I think, highly objectionable, and I know of no reasonable grounds on which it can be defended as just or expedient.

Every patent should be granted for the full term, which might well be 20 years, subject to periodical payments of say £50 at the end of the fifth year, £50 at the end of the tenth year, and £50 at the end of the fifteenth year.

In the absence of prior publication or notification of reservation by an independent inventor, the validity or duration of a patent granted in any one country should not be in any way disturbed by the circumstance of a patent of earlier date having been granted elsewhere for the same invention. It is usual at present for a patent in one country to die with that previously granted for a shorter term elsewhere.

Thus an inventor resident in one of the German States—say Baden—probably applies for his home patent first, and afterwards obtains a patent in England or the United States. The invention may be valuable, and there may be capitalists ready to purchase the last mentioned patents. Now as a matter of fact—the Baden patent being for three years only—the English and United States patents, which by being applied for earlier might have been valid for 14 years and 17 years respectively, will become void on the expiration of the Baden patent. I need not explain what serious practical difficulties this feature in various Patent-laws gives rise to, especially where an invention is sought to be patented i

many countries. What may be the advantages of such a provision I have yet to learn.

The patentee should be at liberty, from time to time, on payment of a moderate fee, to add to his original patent any improvements he may have made which clearly involve the use of the main claim granted to him under the original patent. By this plan many minor improvements of much practical value in carrying out an invention, yet perhaps not such as might be considered worthy of special patents, would be recorded, and so the knowledge acquired by the public on the expiration of the original patent would be of far greater utility, as the invention would be recorded in its most perfect form.

The owner of a patent should be at liberty from time to time to amend the specification either by disclaimer or memorandum of alteration, in the manner at present practised in England, or, perhaps better, by having the patent re-issued on a new specification, as is done in the United States.

A patentee should not be compelled to put his invention in operation within any specified period. It is the object of a patentee to get his invention into successful commercial operation; the sooner it is so the sooner does he reap benefit from it.

Now the laws of many countries provide that a patent shall become void should the invention not be worked in the country within a specified time, varying in different countries, from date of the grant, likewise in the event of the working of the invention being afterwards interrupted for a certain specified time.

The intention, of course, is to promote industrial and commercial activity in the country concerned, but the practical working of such provisions is eminently unsatisfactory. Whilst they fail in many instances to achieve the object aimed at, they have the effect of seriously hampering patent property. Even in those countries where the authorities require formal proof of due working, and in default annul the patent forthwith, it constantly happens that the mere letter of the law is complied with, its spirit being utterly ignored.

It is easy to see that cases will frequently arise where compliance with such provisions will be beyond the patentee's power, by reason of pecuniary inability to do what is unreasonably required of him within the limited time allowed. Thus his patent will be forfeited without just cause.

Nor should the patentee be precluded from importing into a country in which he has a patent articles according to that patent made in another country. The circumstance that articles so made are bought and sold tends to promote trade and commerce, and it is surely to the advantage of a State to have its commerce promoted by trade in improved articles of manufacture, even though made abroad. Supposing a patentee to have a manufactory in one country, he is generally the less able to start works in another, since he cannot be in both places to look after his interests.

But where he does not by himself, or through licensees, carry on the manufacture within the country for which he holds a patent, if any responsible manufacturer in that country be desirous of working under the patent, it seems fair, though it would generally be unnecessary, to require the patentee to grant a license in consideration of a reasonable royalty. In the event of disagreement the rate might be decided by some impartial competent tribunal, the rate of royalty to be subject to revision from time to time as circumstances might show to be advisable. I am not prepared to say that this system of compelling a patentee to grant licenses should hold as against a patentee who either is himself engaged in the manufacture of the patented article within the country concerned or has a licensee there.

It seems desirable that when trying questions of validity and of infringement of letters patent, the judge should be aided by competent impartial technical assessors, and that all of them should be open to challenge on the ground of being known to hold views antagonistic to patents. I say this advisedly; it is a point to which I am desirous of directing special attention. The law is interpreted by judges who may take different views as to what amount of invention should suffice to support a patent. In this respect there are at the present time elements in the constitution of the English tribunals whose presence may well cause uneasiness to inventors—for notwithstanding his well-regulated mind and honesty of purpose, it is difficult to conceive how a judge can avoid being to some extent influenced by his own private opinions or crotchets; therefore, though the cases are not quite parallel, I would with all respect say, that as an honest judge declines to try a cause in which he has the remotest substantial interest, so it would be extremely desirable, if possible, for judges holding extreme views as to patent property, to be relieved of the duty of trying any case of the kind, seeing the inherent danger of injustice, however unintentional, to the interests of those concerned. There can be no doubt that of late expressions of opinion have escaped from judicial sources calculated to fill with alarm owners of patent property whose rights might have to be adjudicated by those who have permitted such expressions to fall from them. Unfortunately, judges only see the worst phases of patent matters, and are apt to form their views accordingly.

In submitting the suggestions I have had the honour of laying before you, I have taken as granted the desirability of Patent-laws as means of inducing progress in the industrial arts, but since we are assembled in a country whose legislators have thought otherwise, it may not be out of place to hope that interesting and valuable information on that fundamental point will result from the approaching discussion.

In conclusion, I must ask your indulgence, for I am only too sensible of the fact that this attempt on my part to promote discussion on a most important subject is a very imperfect substitute for what you would undoubtedly have had from our late respected colleague—Mr. Webster—had he been spared to attend this conference. As, however, it was my privilege on several occasions to co-operate with him in endeavouring to promote amendment in patent practice, I trust it may not be considered altogether inappropriate that I should thus endeavour to direct the continued attention of our association to a subject he had so much at heart.

OUR RAILWAYS.*

On the 31st December last 8,749 miles of double or more lines, and 7,700 miles of single lines of railway were open for traffic in the three divisions of the United Kingdom. The additional railway accommodation created during the year amounted to 62 miles of double or more lines, and 305 miles of single lines. The distribution of the lines in the three divisions of the kingdom on the 31st December, 1874, was as follows:—In England and Wales, 7,193 miles of double, &c., lines, and 4,429 miles of single lines. In Scotland, 1,048 miles of double lines, and 1,652 miles of single lines. In Ireland, 508 miles of double, &c., lines, and 1,619 miles of single lines. It must also be noticed that many of the principal English lines are increasing the number of their lines of rails; twelve companies returning, on the 31st December, 1874, a length of 119 miles of three lines of rails, and 94 miles of four lines of rails.

The traffic receipts in 1874 show an excess over those of the previous year, but owing to an increase in the working expenditure, the net receipts were somewhat below those of 1873. The number of passengers, exclusive of season-ticket holders, who travelled during 1874, amounted to 478 millions, or 22½ millions more than in 1873.

The following figures show the total receipts and percentage of working expenses in each of the last five years:—

* Railway Returns, 1874.

United Kingdom.

Years.	Total Receipts.	Per-centage of Working Expenses to Total Receipts.
	£	Per Cent.
1870	*45·0	48
1871	48·8	47
1872	53·2	49
1873	57·7	53
1874	59·2	55

Owing to the fall in the price of fuel, it is probable that the working expenses during the present year will be somewhat reduced.

A very interesting table is given in the returns, showing the rates of dividend paid on ordinary, guaranteed, and preferential stock and share capital. It is generally known that railway stock has increased in value of late years, but this is known only in a vague sort of way. The table referred to exhibits the amount of capital of railways in each division of the kingdom, distinguishing that which produces no dividend from that upon which various rates of dividend were paid, in each year from 1870 to 1874.

It is unnecessary to refer to the guaranteed and preferential stock, the interest on the bulk of which is fixed; but the following table, showing the amount of ordinary stock upon which rates of dividend under and above five per cent. were paid, will afford a general view of the value of original railway shares, which a few years back were regarded by many as almost waste paper.

Amounts of Ordinary Stock of Railways in each division of the Kingdom, on which more or less than five per cent. dividend was paid in each year.

Rate per cent. of Dividend Paid.	Years.	England and Wales.	Scotland.	Ireland.
		£	£	£
Capital of new companies, the lines of which were in course of construction, and no dividend earned.	1870	1·9†	·2‡	·4
	1871	1·5	·0	·5
	1872	2·1	·2	·5
	1873	2·6	·4	·4
	1874	2·0	·3	·2
Capital of constructed lines upon which no dividend was paid.	1870	22·2	6·6	2·3
	1871	25·5	2·6	1·8
	1872	24·4	2·5	2·7
	1873	25·5	6·0	2·5
	1874	36·2	2·0	2·8
Capital upon which a dividend of less than 5 per cent. was paid.	1870	73·1	8·1	10·8
	1871	59·7	6·0	5·2
	1872	50·4	12·3	5·0
	1873	48·8	15·6	5·4
	1874	57·8	20·4	9·8
Capital upon which a dividend of more than 5 per cent. was paid.	1870	96·8	4·4	·9
	1871	108·9	11·4	6·7
	1872	124·0	6·3	6·8
	1873	128·0	·4	6·9
	1874	112·4	·4	2·5
Total	1870	194·5	19·7	14·9
	1871	195·0	20·5	14·6
	1872	201·5	21·9	15·5
	1873	205·8	22·9	15·6
	1874	209·0	23·7	15·7

* Read—45·0 = £45,000,000.
† 1 9 = £1,900,000.
‡ ·2 = £200,000.

From these figures it appears that the percentage of ordinary stock, receiving a dividend exceeding five per cent, was—

	England and Wales. Per cent.		Scotland. Per cent.		Ireland. Per cent.
In 1870	49	..	22	..	[illegible]
In 1871	56	..	55	..	46
In 1872	61	..	29	..	44
In 1873	62	..	1¾	..	44
In 1874	53	..	1½	..	11

SILK CULTURE IN AUSTRALIA.*

It is a popular error to suppose that the Morus alba silkworm mulberry is found to thrive only in hot climates. There are many varieties of silkworm mulberries, some belonging to the plains, as in India; some to the hills, as in the north of China, and the northern slopes of the Himàlias. The true *alba* seems to have originally come from China, and this fact was curiously illustrated last year. Wishing to learn if the mulberry known by the name of the Cape mulberry in Australia was a truly Cape plant, I wrote to the Governor, Sir H. Barkly, requesting him to send me a few plants by the opportunity, and, strange to say, H.R.H. the Duke of Genoa's ship was the only one available for their transport, there being no steamers running to Melbourne. This was a fortunate circumstance, and his Royal Highness's subsequent letter of introduction to the Minister of Agriculture in Rome proved afterwards most valuable. Most kindly he allowed them to be placed on board, and conveyed them safely to Melbourne. In a few weeks the leaves appeared, and established the fact that our Australian Cape mulberries were identically the same, but degenerated by want of cultivation. The mulberries imported into Australia from the north of China showed the same form of leaf, though much finer in every way. This spring, near Verona, I noticed the famed Verona trees producing similar leaves; and in Orbe, Switzerland, there appeared again the same leaf on plants obtained from Messrs. Bonnefont's celebrated French nursery, raised from their own Chinese importations, and much to my surprise, in the garden of a friend at Eton the other day, I found two fine old trees planted during James the First's reign, showing again the same form of leaf, and in some cases remarkably perfect; cuttings from trees showing this peculiar shape would make most valuable plants. At great expense we are now importing to Australia this particular species from north China, where it has long been known by the name of the Lhou, which, some Chinamen on the Murray informed me, was the name of one of their gods or prophets. There is another variety of mulberry found in the south of China, a sort of cousin-german to the Morus *multicaulis* (*murier de Philipines*). This variety does extremely well in very hot climates, such as Queensland. The mulberry grows in all kinds of soil. A good sandy loam is particularly good, though they thrive well in granitic sand on hill slopes. A rich black loam produces a quantity of luxuriant leaf, which rears large worms, but fed on this food the worms do not yield the finest quality of silk. I believe nearly the whole of the vast continent of Australia is well adapted to the growth of this most valuable tree, as well as the Fiji Islands; many parts of New Zealand, and the African colonies of the Cape and Natal, have been proved to be equally well adapted to the growth of the mulberry.

The Governor of Tasmania, when in Western Australia, spoke of the rapid growth of mulberries at Perth and on the Murray, in my own plantation, Cape mulberries that had been twice in the same season deprived of every leaf and all young wood, as if to resent such treatment, put out in a few weeks shoots from the ground that attained a growth the same season of from 10 to 15

* Paper read by Mrs. Bladen-Neill before the British Association

feet. The *Morus Indica* is a fine tree, and there are many others, too numerous to describe. I noticed in Switzerland that the leaf of the lhou, though immense in size, was more delicate than that produced on the Eton trees, owing, probably, to the great age of the latter and want of close pruning. For the production of good grain (eggs), many parts of England would be suitable, but for silk the millions of acres of land in our colonies will certainly, some day, yield the finest in the world. In California, we hear also of large tracts of country having been planted with mulberries, and that the Californians have commenced manufacturing as well as reeling their own silk. M. Bonhomme, the manager of the Sonoma Sericicultural Association, California, confirms all I had heard in Italy. The Californian grain is in great request in many parts of Italy, and the price varies from 25 to 40 francs per ounce—not in dozens, but in hundreds of ounces. If, as he says, and I believe it is perfectly true, Italy requires 3,000,000 ounces annually of grain, what may not be the work provided for our women and girls, seeing that Japan and China, now the only two grain-producing countries in the world, might at any moment fail to supply the market, disease having shown itself in both countries, if large plantations of mulberries are made in Australia, other British colonies, and California? M. Bonhomme has been a grainer over sixteen years, has visited all parts of Asia and Europe in search of healthy grain. The result of his experience is that it is to the new countries and their virgin soils the old world must look for assistance in its old age, and thus make happy all the children who can and are willing to help their parents. May our colonial women show as much energy in the cultivation of silk as the men did in wool, and we shall soon see a trade the limits of which it is impossible to foretell. Some years since I observed the wonderful fertility of our Australian soil, even in dry seasons; 200 Cape mulberries that were left exposed and uncared for in a ploughed field, were twenty-two months without rain, except one or two very slight showers; these trees have since yielded food for many thousands of worms, and are now in full beauty. Dr. Hooker, of Kew, would confer a great benefit on the Australian colonies by causing seeds and plants of the mulberries of the northern districts of India, especially from the coldest parts in which they can be found, such as in the north of the Himàlias, to be collected and sent to these colonies. For instance, if there is a white fruited variety in Cashmere, it would be most valuable. At the Cape and Natal, mulberries have long become perfectly wild, and I trust my countrywomen will soon be able to find means to utilise this, till now, neglected source of wealth in that colony.

Sir James Ferguson, the Governor of South Australia, took considerable interest in the cultivation of the silkworm, and sent us some very good specimens of the Japanese race; but it was to Mr. Charles Brady, of Sydney, the brother of Sir Antonio Brady, who I doubt not is personally known to many here, that we are indebted for the preservation of some of these wonderful old races of silkworms now all but extinct in Europe. For years he has been educating some of the finest races procured from France by his sister, before the disease became universal. Some years previously M. Roland had done the same in Switzerland. It is a curious fact that both regenerated their race of worms—the one by the snows of Alps, and the other by the heat of an Australian sun. Mr. Brady, the most accomplished and energetic pioneer of sericiculture in Australia, had previously ransacked the world for all the best-known species of silkworms, with a view to testing the relative value of the different kinds from a commercial point of view, the one idea of his life being to successfully initiate the cultivation of the best varieties of this the most valuable and profitable to man of all the insect tribe, and which with care (and the help of women) will become second only to wool, our Australian commodity. To this idea he has sacrificed his time, money, and all other prospects in life. His labours now only require development, and promise a rich reward to our colonists if they will only take up this new industry. I have never yet seen a single man who did not think sericiculture a most feminine employment. It is but fitting fair hands should work to produce the most exquisite fabrics that are used to adorn the weaker, but not the least beautiful or interesting portion of creation.

From Mr. Brady I obtained a small sample of grain (eggs), the cocoons from which, when shown to experts in Lyons, elicited a demand for all we could produce of that quality at the highest market price. This was geat encouragement, and I determined to visit the silk-growing countries of Europe and to judge for myself as to the supposed superiority of the Japanese races, then all but universally imported into France and Italy. From Naples, Ancona, Venice, thence through the Italian Lake districts to Milan, Florence, Cuneo, Novi, Genoa, and on through Nice to Marseilles, Montpellier, Cavaillon, Cevennes, and the Ardeche; everywhere I met disease—the same sad story, small cocoons, and little profit to the poor peasants. At one railway station the country people refused to believe these cocoons had been produced the previous year, as they said that they had seen none such for twenty years. A mere accident brought to my notice a grain that had been most carefully educated for years in the little old-fashioned Roman town of Orbe, Switzerland. It was there that a pupil of Chavannes had pursued his master's system; he went still further, for he hatched out the grain on the tree, allowed the worms to feed naturally in the open air under muslin or canvas covers to preserve them from enemies, to cocoon, and, finally, the moths to lay their eggs. Of course, none but the strongest lived to propagate their species. The grain (eggs) remained on the tree exposed to the frosts and snows of an Alpine winter, thus regenerating, as he calls it, the race, and, after three years, rendering it as strong as the stock from which they were originally obtained—namely, that from the north of China. It has also been found that this regenerated stock, taken to Australia, is still further improved by the effects of our climate and the food grown to such perfection in our virgin soil. Specimens are now on the table; they speak for themselves. It would have been well for Europe had the Sydney Government followed the example of Sully, one of the most able ministers France ever had, and encouraged Mr. Brady by grants of money to pursue, on a scale commensurate with its importance, his scientific and patriotic work.

To this day the Governments of France and Italy, ever alive to the value of their silk industries, support very large and expensive establishments for the improvement of sericiculture. M. Robinet, no mean authority, writes that "in a new country the sericicole industry cannot be expected to take deep root, unless it is initiated by a large model establishment, which is a nursery not only of plants, but of worms of the right sort, and at the same time a training school for reelers and breeders."

"And," he adds, "this opinion is corroborated by facts. If we follow, step by step, the history of sericiculture, we find that in every country where it is flourishing—where, as in France and Italy, nine-tenths of the silk produced comes from within the walls of the cottage, we find that this industry invariably originated in a model establishment formed and supported by public money."

If in a nation so industrious as the French, if in a country where the sericicole industry has been flourishing for three centuries, and gives employment and bread to millions, if among producers whose silk is considered the best in the world, the Government still find it advisable to take this step, I leave it to the public to decide what the Government of new countries ought to do.

There are many who talk of the last silk season having been a good one in Italy, but I can testify to the miserable result in most cases; the same sad story of disease

and of the small cocoon of Japanese or Italian-Japanese reproductions sold in the towns and villages removed from the great centres, such as Milan and Lyons, yielding little or no profit to the poor peasants after all their labours.

If England will assist us women in what we have begun so well, we shall soon be able to supply healthy stock to these poor people, a noble and profitable work for women to take in hand, and besides this, we shall be adding another industry to our colonies that will employ thousands for whom manual labour in not suited, and in an essentially womanly occupation.

It is also curious that Mr. Brady had found regeneration by heat was nearly, if not quite, as perfect as that by cold.

Having heard various opinions, *pro* and *con.*, as to the Carret system of heating by his own peculiar stove, I arranged to meet the learned doctor with M. Roland, the Swiss regenerator by snow, at Chambèry, last May, and then it was arranged that the system should be tried near Verona and at Orbe. In both cases it was a complete success: the thermometer was kept at 30° Centigrade during the first stage, and at 35° after the fourth change. The cocoons were quite equal to those produced in the open air, and the moths and grain have since been pronounced equally good. M. Roland is of opinion that the cottage system, if I may so call it in the case of worms, like that in lunatic asylums in Australia, answers best: small numbers in a small room, with a pure draft of warm air kept up constantly by these stoves, which enables the educator to secure a pure dry atmosphere. He tested the system thoroughly. In from eighteen to twenty-two days the worms will hatch, pass their various stages, and spin.

INDIAN JUTE AND LAC.

The report that the Government proposed to make it compulsory to convey grain in sacks was received in Dundee with marked satisfaction. An extraordinary impetus would thereby have been given to the jute manufacture, and Mr. Plimsoll would have been regarded as one of the greatest benefactors of the human race; but for the moment this useful industry languishes, and a reduction of wages is met by the strike of the workmen. The jute manufacture in this country owes its development to the Crimean war, which caused serious attention to be paid to Indian fibres as substitutes for Russian flax. The jute plant, indeed (*Corchorus olitorius* and *C. capsularis*), is not, strictly speaking, indigenous to India, but was probably introduced from China many centuries ago. Until a comparatively recent date it was chiefly cultivated as a pot-herb, and even now its leaves and tender shoots are largely used for culinary purposes, and particularly in curries. The plant is an annual, growing to a height of from five to ten feet, with a stalk about the thickness of a man's finger, and seldom branching out till near the top. It is cultivated successfully in forty-seven out of the fifty-eight districts of the Bengal Presidency, and thrives in almost any soil except gravel and laterite, but prefers a rich alluvial soil, with a hot and humid atmosphere. In 1872, not far short of 800,000 acres in the northern and eastern districts of Bengal were devoted to this cultivation, and over 125,000 acres in other parts of the presidency. In the following year, however, the total area under jute did not exceed 517,000 acres, and fears were entertained that even this diminished area would interfere injuriously with the production of food cereals. On the other hand, the agriculturists, when not in bondage to money-lenders, have been sensibly enriched by this new industry, nor does it appear that the price of rice has as yet been seriously enhanced. The prevalent notion that the public health had been injuriously affected by the process of maceration is based upon very imperfect data. As a rule, the plant is left to steep and decay in disused ponds at a distance from villages, or in running streams, which carry off the decomposing skin and pulp. A more just apprehension of the gradual deterioration of the plant is worthy of the attention of the Agricultural Department. Not only has the increased demand led to the admixture of inferior fibre with a superior quality, but the cultivators are careless as to seed, and commonly set apart for that purpose stunted and ill-favoured plants. It is tolerably certain that jute has been used for the last two centuries for articles of local consumption; but it was not until almost the close of the eighteenth century that a small quantity, about 100 tons, was shipped to England as an experiment. Though the report was favourable, nothing was done to encourage the trade, and so recently as 1828-29 the total export was only 364 cwt., valued at £62. Ten years later, however, the export amounted to 107,582 cwt., valued at £20,288, while in 1872-73 the exports to Great Britain alone were entered at 5,709,436 cwt., of the estimated value of £3,772,362, besides 1,546,253 cwt. of cuttings and rejections, worth upwards of £46,000. In addition to this immense quantity, no less than 307,718 cwt. were shipped to America, and 137,126 cwt. to France, without taking into account the smaller shipments for Holland, the Cape, Australia, Ceylon, China, Italy, and Trieste. Nor is this demand surprising, when it is remembered that the jute fibre is excellent material for all kinds of cordage and gunny bags, that it can be worked with cotton and silk, and that it makes very tolerable paper.

New inventions ever and anon revive languishing industries, or give them an importance they would never have possessed. Until quite a recent period comparatively little attention was paid to shellac, while lac-dye was imported in large quantities. Since the introduction of submarine cables, however, it is the former article that is chiefly in demand. In India the principal use of lac is for the manufacture of cheap ornaments, such as bracelets, rings, beads, and other trinkets, worn by women of the lower orders. The Burmese employ it to fix handles to knife blades, &c., and in Europe it has hitherto been valued mostly by hatters, for stiffening the body and brim of silk hats. It enters also into several varnishes, as well as into sealing-wax and lithographic ink. The Japanese lacquered ware, however, has nothing in common with this production, being coated with a gum that exudes from particular trees. The Indian export trade passes almost exclusively through Calcutta. For the ten years terminating in 1872-73, the average annual export of shell and stick-lac amounted to 57,838 cwt., and of lac dye for the latter half of that period to 15,849 cwt. The best customers are Great Britain and the United States, though the demand in the Italian markets appears to be on the increase. According to Sir W. Jones, "the Hindus have six names for lac, but they generally call it lacsha, from the multitude of small insects who, as as they believe, discharge it from their stomachs, and at length destroy the tree on which they form their colonies." The lac producing insect is a species of the valuable genus coccus, of which two other species respectively produce cochineal and Arabian manna. On emerging from the incrustation in which it is born, it measures one-fortieth of an inch in length, and attains the extreme size of one-twenty-seventh. Microscopic examination has revealed an alimentary canal, a liver, tracheæ, and ovary, which last contains a red colouring matter. Lac is described as "a resinous incrustation formed on the bark of the twigs and branches of various trees." This incrustation is "of a cellular nature, of a more or less deep red or orange colour, semi-transparent and hard, breaking with a crystalline fracture." Each cell is constructed by a female, and when it is completely covered in with a resinous secretion, she lays upwards of a thousand eggs and dies. The young feed on a red substance in their mother's body until they have strength to pierce the incrustation, when they swarm on to the branch, to which they attach themselves by their

shy proboscis, and at once commence to secrete lac. hough hundreds of each family perish at their birth, so untless are their numbers that at the swarming seasons e boughs infested by them look as if they were covered ith red powder. The trees on which they are found eld a resinous, gummy liquid, and are usually the dhak *Butea frondosa*), the peepul (*Ficus religiosa*), and the oseum (*Schleichera trijuga*). By means of birds and her insects the *coccus laccus* is conveyed to fresh trees, e little creatures possessing of themselves no power of comotion. The area of production is very extensive; it Bengal, Assam, and Burmah produce the largest antity and the best quality. The chief seat of manucture is Calcutta, where the native manufacturers, howver, are accused of adulterating the lac with resin to e extent of 50 and even 60 per cent.—*Pall Mall Gazette.*

INDIAN GLASS.

In the neighbourhood of Madras, says a writer in e Madras *Athenæum*, is found an earth (composed clay and sand, and impregnated with carbonate soda) converted by the native workman into a ude glass. Much of the "frit" (the name given to e earth after it has undergone partial vitrification) is ipped as ballast to places where it is transformed into sels of ornament or utility. In bringing this industry fore our readers we shall attempt to show how much might be developed; we shall also offer a few remarks the causes which have led to no improvement in the ocess now followed by the natives who are no further vanced in the art than their ancestors were 1,000 ars ago. Many ingenious theories have been started regard to the discovery of glass; we are inclined to lieve that the fusing of the goldsmith's crucible first l thoughtful artisans to experiment with clays, or ms; borax, sal ammoniac, and other substances were obably employed as fluxes; the accidental introduction Saudoo showed them the advantage of substituting is as a reducing agent, but surprising to say they do t ever appear to have made use of or discovered the lue of potash, although the milk-hedge and certain rine plants yield large quantities of this alkali. The tive converts fullers earth into (soda) glass of a dark, pale green colour well suited for common purpose, but has not succeeded in separating the impurities which ely consist of iron, and earthy particles, and as eady noticed has to send it elsewhere to be purified cause he does not know, and has made no endeavour ascertain, what further operations are necessary. The ocess as practised in this country up to a certain stage similar to that observed in most parts of Europe, but backward state of chemical science in India, the ignorce and degraded condition of the artisan, and want of erest in her industries displayed by former governments, causes which have helped in arresting progress in an which was known and probably flourished in the ninsula at a time when Europe was steeped in barrism. To the low position in the social scale accorded the workman by Hindoo custom or law may be attrited that gradual retrogression in the very manufacres for which India was once renowned. We must serve for the reader's information that in Europe glass made by subjecting an artificial mixture of sand and e, or sand and potash, to a great heat; in this country, wever, we find that nature has already blended our terials for us, and hence the preliminary operation nsists in collecting the earth, which is purified in large s by constant washing, a process which separates the ex and soda from much of the foreign matter incorrated with them. The cleansed material is heaped up mats till a sufficient quantity has been got together, en it is put into crucibles, which are placed all round very large furnace. Each crucible holds about 15 unds of the mixture, and 60 pots are used at each eration. The fire is placed in a pit below the ground surface, in order that all the heat may be utilised, and at the expiration of from 12 to 20 hours the silex gets semi-vitrified into a black opaque mass, which workmen in Europe call frit; the crucibles are then removed, and allowed to cool, and the frit taken out of them is broken up into small fragments, and again melted in a furnace somewhat similar in form to the one already described. The second operation, however, is of greater duration, generally lasting four days, as certain impurities called glass gall (highly volatile white frothy substances with a strong saline taste) come up to the surface of the fluid in the crucible, and have to be constantly removed. The contents of the pots must likewise be perpetually stirred to enable all the air bubbles to rise to the top and escape. Up to the stage just described the practice all over the world is alike, and had the native any knowledge of the uses of the different chemical substances scattered all over India in such boundless profusion, he would introduce into the crucible some such agent as the black oxide of manganese, and would convert the translucent pale green liquid it holds into a beautifully clear colourless substance. In India as in Europe the fritting and the subsequent fusion are most troublesome processes, and are often sources of anxiety to the workmen, who regards the successful termination of these operations with the greatest satisfaction, and justly so, for during the primary calcination it is of the utmost importance to just commence the chemical union between the alkali, silex, and metallic oxides. In the second operation the dense vapour dispersing from the surface of the molten frit acts very powerfully on the pots, corroding them often so rapidly as to involve a total loss of their entire charge. The furnaces have to be watched and fed (in this country wood is the fuel employed) night and day, and the proper temperature maintained. The workman generally relieve each other every eight hours. After all the gall has been removed, and nothing but the fluid is left, the workman dips an iron rod into the pot, which he turns about till a small quantity of the molten glass (but sufficient for the purpose intended) adheres to the end of it, he then raises the point a few inches when the glass lengthens out by its own weight, a dexterous turn or two of the implement causes the glass to coil round it, and form itself into a complete ring, which is enlarged to the proper dimension by three or four additional turns of the rod. The bangle or ring, still soft and plastic, is stretched or pulled out and then pressed over a coneshaped guage made of clay (not unlike a spinning-top in size and appearance) on which a projection is formed to receive the ring which is approved of, and passes if it fits accurately, but if too large or too small it is returned to the pot, and quickly melted and altered. The skill of the artisan is something marvellous; he will manipulate three or four bangles in the minute; three to four men work together. Sometims clays are fused for the same purpose, at other times, pigments, as the sulphurets of iron or copper, are mixed with the glass to vary the colour of the wares manufactured. The substitution of an iron tube a few feet long for the rod would enable the native to manufacture bottles, and with the aid of borax, carbonate of lime, oxide of lead, oxide of manganese, white oxide of arsenic, and nitre, most of which substances are cheap, and easily procurable in this country, he could purify or cleanse his glass. Of the chemical compounds the oxides of lead and manganese are perhaps the most important agents, more especially the black oxide of the latter mineral, which used at one time to be sold to the trade as glass soap. All operations are carried out in the open air, and consequently a great waste of heat ensues; the implements are of a most primitive kind, and consist of an iron rod or two, a ladle or spoon, and a few clay gauges, but in spite of all the difficulties with which the workman has to contend he can turn out the enormous number of 1,000 bangles for the rupee. We think it a great pity that the Government have not done more in the way of technical

education in this country. Many of the old arts are now lost altogether, enamelling for instance. It is time that the manufactures of India, once so celebrated, should receive that attention and encouragement which they justly deserve. In our schools of art, and other cognate institutions, men should be employed who could impart to the Asiatic those improved modes of working which have proved so successful in Europe, and if our rulers cannot afford to establish workshops and museums specially adapted for the wants of the working classes, then they should encourage private enterprise more than they have done. In regard to the industry whose cause we are now advocating, it seems absurd that we should possess in abundance the means necessary for ensuring cheap manufacture, and yet find that nothing beyond a very crude substance, applied to no useful purpose, is made; and the fact becomes more remarkable and striking when we consider that the only difficulties are those which the native has overcome, the purification and after manipulation depending on the skill of the workman, and not on any chemical action.

GREY SHIRTINGS IN CHINA.

A correspondent of the *Daily News* gives the following account of this familiar, yet little known, trade staple:—

Take up the newspaper and turn to the telegraphic columns, and you will be sure to find grey shirtings. Now what is this to which so much importance is given that notice of it is found side by side with the intelligence of the imminent downfall of empires, the movements of monarchs, and the sinking of great war-ships? To the unitiated, grey shirtings would seem to bear a close relationship to wearing apparel of a particular class; but then the quotations appear invariably to emanate from China, and convey the idea of what a shirt-loving people these Celestials must be. Such a theory may be naturally propounded, for it is most questionable if nine-tenths of those out of the trade know what grey shirtings are—this article which takes the lead in all important news from far Cathay—and it is a matter of doubt if the ultimate fate of that commodity is even known to half the exporters. Statistics show that from this country to China, hundreds of thousands of pieces are annually exported; but, after the mere mercantile transactions which intervene between the purchase from the manufacturer and its shipment from Great Britain, no more thought is taken of it except what is called forth by the periodical prominence given to it in the exalted society of "Latest Telegrams." The climate of China, as is usually pictured by the English people, would lead them to ponder on the immense interest which is given to shirts, in a country, too, where the weather is popularly believed to be anything but conducive to the wearing of clothing at all. Certain it is that a large proportion of the four hundred millions of Chinese participate in the advantages derived from the exportation of grey shirtings, but not as shirts; and from the persistent notoriety given it, the demand would look as if greater than the supply. Be this as it may, this same trade is one of the largest which obtains from our British Isles.

It is not in the province of this writer to say how grey shirtings are made, and how they are started to China—suffice it to know that they are a kind of whitey-brown cotton cloth, varying in texture as well as in length, several peices packed together forming a bale. An attempt will, however, be made to account for one of these pieces after it has arrived at its destination at Shanghai for instance. As there is in every large mercantile establishment in China a separate department for tea and silk, so is there a special manager of the piece-goods room. The goods having been once delivered up to him after examination at the Custom-house, are stored in a "godown," or warehouse, and, being placed according to consignments, marks, and numbers, musters or samples are handed to the different brokers, who start off in their "traps" to offer them to the Chinese middleman, who in turn shows them to the native dealer. The shirtings being purchased, the merchant, who may be from far away Sze-chuen, or still farther off Yunnan, starts off up the Yang-tze, with his goods, and having passed and paid the squeezes at the numerous barriers on his route, offers his *Yang-pu* (foreign cloth) for sale to his customers in the marts in his district. Buyers flock from all directions, and traffic ensues. Small shopkeepers in out-of-the-way nooks carry off sufficient to satisfy demands on them, and others purchase for mere personal use. Having ultimately got into the hands of the last-mentioned class, the cloth is dyed and put together—or, as the Chinese have it, cut and stretched—to suit the taste of the wearer. But it is not made, as one might imagine, into shirts; that is to say, the Celestial soars above such a luxury, for he has not a shirt in his whole *kit*. True, he has a term in his language which foreigners have appropriated, and use as the equivalent for that useful garment, but to John Chinaman it conveys no other idea than a "sweat rag." His garments are simple indeed. He scorns all superfluous luxuries, and stalks abroad in simple coat and loose trousers, and as the former is lengthened it becomes an ngao, or robe, while the simpler form is a ma-kwa, or horse (riding) coat. On grand occasions he dons a kan-chien, or cut shoulder. This Westerns term a waistcoat, but Afoo wears it outside his toga, and tucks the ends into his tai-tsu, or girdle. As the weather gets cold he adds coat and pantaloons layer after layer, and in a long winter the innermost of these garments is seldom, if ever, changed—certainly not until the next recurring spring, when the warmth necessitates the relief of some of his outer clothing. The Chinese vestures have no buttons, their coats being, as a rule, fastened with a loop of the cloth, forming a button-hole, with another piece knotted in a hard knot as a button. Grey shirtings are usually dyed blue by the wearers, and in the cold weather lined and wadded, and worn outside of all. The article is also worn in the natural grey state, and when washed, or, more properly speaking, passed through the water, attains to something like white cotton. This same washing is a terrible process. The coat or other article is beaten with a large stick, or else rolled into a wisp and thrashed on a large stone, no soap being used. When the operation is over it is put in the sun to dry, and afterwards folded and pressed between two weights. Naturally this rough usage leaves its mark, and grey shirtings would need to be in plenty to replace those which have gone before; but then the length of time a suit is worn should rectify this. Of course the Chinese wear clothes of other material than this—some of costly fabrics; but as a basis of operations their garments are composed of this much appreciated, but, save to the initiated, little known British export.

The following is given as a statement of the division of labour among the operatives in the British Isles:—Number of persons employed on textile fabrics, 1,054,947; metal manufactures, 180,660; leather, [illegible]; chemicals, 49,987; articles of food, 31,255; building, [illegible]; paper, 37,422; miscellaneous, 211,522; total, [illegible]. Comparing the number of American operatives, [illegible], with the number of British operatives, 1,595,288, it appears that there are 960,026 more operatives in the United States than in Great Britain.

During the present year the exportation of small firearms and gunpowder has largely increased. In the first seven months the value of firearms sent abroad was [illegible], against £210,093 in 1874; and of gunpowder, [illegible], against £235,364 last year.

A series of tables has been published by the glass manufactory of St. Gobain, illustrative of the changes in the price of glass. In 1702 the price per square metre of glass was 165 frs.; in 1802, 205 frs. per metre; in [illegible], 127 frs. per metre; in 1856, 61 frs. per metre; in 1862, [illegible] per metre; and in 1865, 60 frs. per metre.

THE FORESTS OF SWEDEN.

n estimating the extent of the timber-producing sts and lands in Sweden, it must be borne in mind Lapland has never been surveyed, and most of the thern provinces but very superficially, except in the hbourhood of the coast. The last general measure-t, Mr. Consul Dering states, gave an area, covered with st, of 3,190 geographical square miles, or 175,698 re kilometres, *i.e.*, about 30,000,000 acres, being 42 cent. of the whole surface of the country. Of these 00,000 of acres, 5,000,000 are owned and adminis-d by the Government, while the remaining 25,000,000 in the hands of private individuals or corporations, er as freehold or under long lease from the Crown. forests in the Lappmark district belong almost ex-ively to the Government; where, however, any por-s of forests are held by private individuals on a con-nal lease from the Crown, the greatest difficulty is d in defining accurately the boundary between ernment and private property, no survey having been made of the interior of these provinces. In absence of any special provision, it is customary to sider the forest rights of each leaseholder to extend radius of half a Swedish mile, or three and a quarter lish miles, from the homestead. It can hardly be that the actual area of timber-producing forests is inishing to any great extent; some comparatively ll quantities of forest land are being brought under ivation. The same, however, cannot be said of its luctive power, which is getting rapidly smaller. is attributable, in part, to the frequent occurrence orest fires, but far more to the indiscriminate felling mmature trees. Parliament has been of late years h occupied with the consideration of a project of law cerning forests, the provisions of which could be made licable to the whole of the country.

aking the average of estimates given by the best ilable authorities, the annual consumption of forest duce, including the quantity exported, may be com-d at 7,950,133 Swedish "famns" or cords. Twenty ls per acre may fairly be considered as representing the ual forest growth in Sweden. Out of the 30,000,000 acres of forest land in Sweden, it would appear, rding to this, that the produce of about 30,000 acres nnually consumed, the time for re-growth being years. The forests are presumably capable of pro-ing in their present condition 6,000,000 of cords per um; and the remainder, viz., 1,950,133, may be taken represent the difference between the quantity of ber which might under their present mode of admi-tration be fairly cut every year without permanent ury to the forest, and the quantity actually cut every r. Herr Thomée, one of the best authorities, writing 1857, puts the growth and consumption respectively 5,700,000 and 8,865,000, which would show an excess 3,165,000; but both he and all other writers on the ject, as well as all practical men of the present day, e that under proper management Swedish forests ld yield without injury the whole of the amount timber required for the purposes of the country.

The red pine (*Pinus sylvestris*), or so called Scotch fir, the white or spruce fir (*Pinus abies*), form the staple the forests, the greater portion of which are situated the northern and central provinces. The River Dal ns the northern limit of the region where the oak and ch grow naturally, but they are cultivated up to much her latitudes. The white birch (*Betula alba*), is found profusion throughout the kingdom, and the aspen pulus tremula), the alder (*Alnus glutinosa*), the elm, the lime are common, and attain a large size in the re favoured districts. The red and white pine furnish timber used in the construction of houses, and for pbuilding, and from them tar and pulp are obtained. is pulp or fibre is used in the fabrication of paper. In shape of sawn wood and square timber, they form of the chief articles of export of the country. Birch is used chiefly for firewood, and as such forms the principal item in the coasting trade of the Baltic. Some idea of the extent of this coasting trade may be formed from the fact that no less than 25,448,678 cubic feet of wood for fuel were transported from one Swedish port to another for home consumption during the year 1872. The small size which this tree attains in Sweden has hitherto prevented its being exported to any considerable extent. It is, however, employed locally in the manufacture of furniture, agricultural implements, &c, Aspen is used in the manufacture of matches. The high rate of freight charged upon them prevents their export from the more northern provinces, the match factories, from which foreign nations draw their supply, being in the south of Sweden. This branch of industry is one of the most flourishing in the country, and employs a vast number of hands.

THE PRODUCTION OF COCHINEAL IN THE CANARY ISLANDS.

The *Journal Officiel* gives an account of the commerce and production of the cochineal (*Cactus folliaceus*) in the Canaries since its first introduction into those islands, which occurred about the year 1840, when owing to the monopoly of the superior kinds the cultivation extended with extraordinary rapidity. The profits derived by the original growers were prodigious. In 1848, the products of the islands were insufficient for the demand in the European market, and the prices varied between 11 and 12 frs. per pound Spanish of 470 grams. At this high rate, with an unfailing certainty in the crop, the annual yield of the properties thus cultivated often doubled their saleable value, whilst the cost of production did not exceed 25 per cent. Under these conditions the cultivation of the cactus continued steadily to increase, every one of the inhabitants endeavouring to join in the production of cochineal. For this purpose old vineyards were uprooted, the cereals abandoned, and in their stead fields of cacti were seen to flourish around even the smallest dwellings. The lands best suited for the purpose acquired a fictitious value, and persons who needed capital, and there were many such, did not hesitate to borrow at rates of interest varying from 12 to 18 per cent. The plantation generally proving successful led to the belief that the manufacture of cochineal was the only profitable occupation to be followed in the Canary Islands.

The consequences of this extreme activity in production was a glut in the market when the prices were forced down, so that from 1860 to 1870 the cochineal realised between 5 and 6 frs., a rate that in properties free from mortgage still yielded a profit of 30 to 40 per cent. Since 1870 the prices have continued to decline in a manner that has caused considerable alarm. In 1870 they were at 4 frs.; in 1871, at 3 frs. 50 c.; in 1872, at 3 frs.; in 1873, at 2 frs. 50 c. Since then a gradual decline has taken place to 2 frs. 20 c. In this state of affairs many producers have been unable to meet their engagements, and the country itself has been suffering from a crisis which has aggravated the situation. The culture has been relinquished by a majority of the proprietors, who have even uprooted the cactus plants, whilst others are doubtful as to whether they should continue or not. The oldest established mercantile houses, all of whom were speculators in cochineal, have been exceedingly shaken, whilst the lesser firms have disappeared altogether. The effect upon the exports has been visible, for in the season 1872-73 the quantity amounted to 5,739,720 pounds, and in 1873-74, 5,088,745, showing a decrease of 65,975 pounds. The largest proportion, upwards of three million pounds, were sent to England, whilst only 1,484,000 in the latter year were exported to France. This, however, does not represent the exact state of the trade, since much of the cochineal enters France *viâ* Cadiz, to supply the manufacturers of the south, whilst in the north they are supplied from Eng-

land. The use of the newer mineral dyes, which suffice for the chief operations of dyeing, have diminished the consumption of cochineal as much as one-half in quantity, whilst the stagnation in the European markets has at the same time lessened the demand for the textile manufactures in which the dyes are needed.

SMALL MOTORS AT THE VIENNA EXHIBITION.*

The question of motors capable of giving out a small power, is still new, having been practically dealt with in the Ericsson hot-air engine and the Lenoir gas-engine. The Otto and Langen gas atmospheric engine dates from the Universal Exhibition of 1867; it was also exhibited at Vienna, considerably improved in detail, though its principle had not been altered. More than 1,000 of these machines are now at work in Germany.

Two Lenoir engines also put in an appearance at Vienna. They are still used, notwithstanding their large consumption of gas, in large towns, where the disagreeable smell occasioned by the Otto and Langen engine has led to the rejection of the latter. For instance, the Compagnie Parisienne has no less than 28 of these motors at work in different establishments in Vienna.

By the side of these gas-engines, Lehmann's air expansion engine, constructed by the Berlin-Anhaltischen Maschinen bau Gesellschaft, at Dessau, also attracted attention. Several specimens of these engines were at work in various parts of the exhibition.

The hydraulic motor of Herr Schmid, of Zurich, is employed to advantage in towns where the water laid on is of sufficient pressure and not too dear. This engine owes its origin to a competition instituted by the town of Zurich.

On the same principle is constructed the engine of P. Kieffer, at Cologne (Kölner Wasser motoren fabrik). This machine, like the preceding, has an oscillating cylinder, but is inferior in construction and arrangement.

Herr P. Mayer, of Vienna, exhibited a water-engine, in which the water did not completely fill the cylinder, being cut off by a slide valve; a valve at the end of the cylinder allowed the vacant portion to be filled with air compressed in an air chamber, which is much too small. This engine jars considerably, and does not appear very practical.

Two models of engines by F. Siemens, of Dresden, depend upon the displacement of the centre of gravity of two liquid bodies by means of heat.

Another engine, the construction of which also depends on a new principle, is the carbonic acid engine of Herr Seyboth, of Vienna. The carbonic acid which actuates it is generated in two copper vessels coated with lead, by the action of sulphuric acid on spathose iron; the residuum is sulphate of iron, which may be sold. The hot carbonic acid produced by the reaction passes through a purifier, where it is submitted to the action of five jets of water, which free it from the last traces of sulphuric acid, and at the same time reduce it to the ordinary temperature; it passes thence into a cylinder, arranged like those of a steam-engine, in which its pressure becomes transformed into mechanical power. If the engine works without load, the resistance on the piston being slight, the pressure of the gas is also slight; and the gas which escapes has a pressure not much higher than that of the atmosphere. When a load is put upon the engine, the pressure of the escaping gas increases appreciably, and, on account of the gas expanding when it leaves the engine, the temperature becomes considerably lowered. The inventor claims that the engine performs a double office—the generation of power at a cheap rate, and the lowering of the temperature, which may be turned to account in certain branches of industry. In the trial engine exhibited at Vienna, the pressure of carbonic acid was allowed to reach four atmospheres, and the gas on leaving the engine was led by means of an indiarubber tube into an ice safe, in which were placed bottles and vases of water to be frozen. This engine with a few modifications may perhaps have a future before it; in any case, it depends on an ingenious principle, and therefore deserves attention.

* From a communication by Herr Rittershaus, to the German Society of Civil Engineers.

THE EXPORT TRADE OF FRANCE.

The French Minister of Agriculture and of Commerce has lately concluded his abstract of the information furnished by the inquiry before the chambers of commerce and the consultative chambers of arts and manufactures, with a view to arrive at the best means of aiding the development of the French export trade. The work may be divided into two principal portions: one consists of a table of the exports by districts; the other is a *résumé* of general questions relating to the export trade. Lastly, the report concludes with an abstract of the views expressed by the chambers of commerce.

The first portion, or table of exports by districts, comprises the nine following:—Paris, the north, the north-west, the west, the south-west, the Mediterranean, Lyons, the centre, and the east.

Agriculture constitutes a valuable source of wealth not only as regards the cultivation of cereals, but also as regards the exports of all kinds of agricultural produce. The northern countries, England, Belgium, Holland, Sweden, and Norway absorb nearly the whole of the produce available for exportation.

The chief of the export trades is that connected with the textile manufacture of silk, wool, cotton, linen, &c. The trade in linen threads and fabrics takes place chiefly at Lille, Cambrai, Douai, St. Omer, and Abbeville, with England, Germany, Italy, Spain, Holland, Belgium, Switzerland, America, and the colonies. In the case of cotton fabrics, Russia must be added to the above-named countries; and, in the case of the woollen stuffs of Roubaix, Sweden, Norway, Turkey, and Japan. Roubaix is even beginning to enter into business relations with the East, China, and the Sclave countries.

In the north-west, Rouen is the chief seat of the trade in cotton goods, which continue to make their way into Italy, and are finding an important market in Algeria, while in other countries they experience a sharp competition on the part of the English, Swiss, and Germans. The principal centres of the woollen trade in the north-west are, Elbeuf, Louviers, and Lisieux, the products of which are exported to America, Germany, Switzerland, and Spain, but most frequently through English [illegible].

Notwithstanding the loss of Alsace and Lorraine, the textile industry is rapidly recovering; Epinal sends linen and cotton goods into Italy, Spain, America, and the French colonies; and she also makes [illegible] adapted to the taste of the consumers, for the Antilles, Bourbon, South America, and Egypt. [illegible] makes for home consumption. Troyes turns out [illegible] kinds of hosiery: woollen for America, and cotton for England. These products have to contend with English goods in Italy, and find but little sale in Spain, [illegible] and Turkey.

The manufacture of silks has its seat in the district round Lyons, extending on the north to the boundaries of the Saône-et-Loire, on the west to [illegible], and on the south and east nearly to the frontier.

Metallurgy comes next in order. The departments of the North of France take first rank for wrought and pig iron and zinc. The great centre of manufacture, Lille, exports engines to South America, Spain, and Portugal; Douai has also sent some consignments to the Indies. At Sedan pig iron is run; at [illegible]

wrought iron and plates are made for Alsace, Switzerland, and Italy, and castings for Russia and Germany. Douai rolls zinc for England and Holland. The locks of Abbeville and its neighbourhood penetrate as far as South America. A certain number of engines are exported from France by way of Havre and Nantes, but it is in the centre and east that the iron manufacture is concentrated. In the central district, St. Etienne, Montluçon, and Châlon-sur-Saône, are engaged in the manufacture of the most varied iron products, such as hardware, arms, merchant irons, rails, rolling-stock, and iron tubes. All countries are more or less dependent on the blast furnaces and iron-works of France. In the eastern districts, St. Dizier, Joinville, Montbéliard, Moret, and Besançon deal with iron in all its forms, but principally made up into sewing machines, parts of locks, iron wire, nails, &c. As with the silk trade, that of iron is in a languid state, especially in the East.

TRADE STATISTICS OF GUADELOUPE.*

In 1871 the population of this colony reached the figure of 133,037 souls, exclusive of functionaries and their families 800, soldiers 1,000, emigrants 15,430, and the floating population 10,000, which bring the total up to 160,317.

The area of land cultivated or capable of being cultivated reached the extent of 121,197 hectares (299,489 acres). Out of the 34,044 hectares (84,126 acres) actually under cultivation, 18,769 were planted with the sugar cane, 4,128 with the coffee plant, and 1,210 with roots and seeds for food.

The culture of the sugar cane employed 39,815 men, that of the coffee 16,033, that of the food plants 17,208, and the remaining agricultural industries 2,519, making altogether 65,567.

The sugar produced during the year amounted to 43,967,145 kilogrammes (43,087 tons), valued at 41,567,698 frs. (£1,658,708). The production of tafia was 1,817,288 litres (399,803 gallons), valued at 726,815 frs. (£29,072 12s.); that of the coffee did not exceed 637,368 kilogrammes (627½ tons), but reached a value of 1,045,283 frs. (£41,811). The articles of food, including manioc flour, peas, maize, yams, batatas or Spanish potatos, &c., amounted to 9,864,184 kilogrammes (9,704 tons) in quantity, and 1,032,250 frs. (£41,290) in value. Cotton, cocoa, cloves, pepper, vanilla, tobacco, and arnotto, produced together a value of 1,113,886 frs. (£44,555 10s.)

To sum up, it will be seen that the gross value of the agricultural produce is 45,395,932 frs. As the expenses of working amounted to 24,040,672 frs., there remains a profit of 21,355,260 frs., which, added to that from the cattle and animals, 7,106,652 frs., brings up the total to 95,728,312 frs. (£3,829,132 10s. If this figure be compared with that of the net profit from agriculture, it will be seen that the capital engaged by the latter does not bring in less than 22 per cent.

There exist in the colony 426 sugar works, of which number 60 possess steam-mills, 82 water-mills, and 82 wind-mills.

Lastly, out of 56,129 head of cattle, there are 9,635 horses, asses, and mules; 10,783 bulls, oxen, and cows; 12,116 rams and sheep; 11,410 goats; and 12,194 pigs.

The imports amount to 23,735,734 frs., and the exports to 25,950,175 frs., making a total of 49,685,909 frs. (£1,987,436) to represent the general commerce. The chief article of export is sugar; next in order come coffee, dye-woods, arnotto, and brandy.

A proposal has been made for securing to New York a supply of salt water for the extinction of fires. This is to be done by building conduits, to be filled with salt water from the East and North rivers.

* From the *Tableaux de Population, de Culture, de Commerce, et de Navigation des Colonies Françaises.*

SPECIFICATIONS OF FRENCH PATENTS.

The French Minister of Agriculture and Commerce, in a letter addressed to the prefects, states that Article 23 of the law of 5th July, 1844, provides that the specification of inventions patented each year, or abstracts of them, be published. Hitherto they have been issued in the form of a volume, comprising branches of industry the most varied, and often having no connection one with with another, so that to obtain any desired information it was necessary to buy each volume as it appeared, and then to make a long and tedious search. In future, however, the patents will be divided into twenty groups, comprising agriculture, hydraulics, railways, textile manufactures, engines, ships and navigation, civil constructions, mining and metallurgy, domestic appliances, carriages, fire-arms and artillery, instruments of precision, fictile art, chemistry, lighting and heating, wearing apparel, industrial arts, paper making, leather and skins, Paris goods, and minor industries.

Each of these groups is again divided into a certain number of classes relating more particularly to branches of trade either of the same nature or having the same object. Thus, agriculture comprises five classes:—1, agricultural machines; 2, manure; 3, works connected with the management of farms (*travaux d'exploitation*); 4, mill work; 5, bread making.

Each of these classes forms the subject of a separate publication, in the form of parts (*fascicules*), containing the text and plates if required. These parts will be sold separately at a price regulated by the number of sheets and plates, at the rate of 40 centimes (4d.) per sheet and per plate. The parts will be collected into volumes, which will be sold, as heretofore, at 15 frs. (12s.) each.

Now that the new method of publication has been adopted, the specifications deposited since 1861 are to be published. As it was thought interesting to bring to the knowledge of the public the most recent patents, it has been decided to publish simultaneously the patents of 1861 and 1871, of 1862 and 1872, of 1863 and 1873, and so on; a certain number of parts relating to the year 1873 are now to be obtained. The sale of the parts and volumes takes place at the Imprimerie Nationale, Rue Vielle-du-Temple, 87.

A table giving the title and the price of the parts that have appeared up to the present time has been prepared, and the titles and prices of future parts will be announced in the *Journal Officiel.*

VENETIAN INDUSTRIES.

A new feature of Venetian industry is started from the rapidly-increasing demand for imitation of antique furniture in ebony and ivory, for which material pearwood and bone are successfully substituted. Mr. Guggenliem, a dealer in antiquities, and now the manufacturer of these imitations of antique furniture, has formed a school of workmen, whom he furnishes with designs and models. The pupils have succeeded in producing such admirable counterfeits that their master has thrown off the mask, priding himself in the avowed imitations of that which would have passed off for the cinque-cento with all but the most experienced connoisseurs. The English are encouraging this trade on a large scale. One of the oldest firms for antiquities, that of Mr. D. Rietto, largely patronised by English amateurs, has also adopted the manufacture of imitations of antique furniture. The ancient brocade tapestry is also being revived by the Fratelli Agnino. This fabric existed before that of Lyons, and was then patronised by the Doges for gifts to Eastern potentates, at which time 14,000 hands were employed. Some of the stuffs were of extraordinary texture and beauty, but the secret of the rarest is lost, and died with the inventors. An endeavour is now being made to recover some of its splendour. Mr. Layard, Her Majesty's Prime Minister

at Madrid, has obtained a successful result in an order executed for him, and members of the Royal House of Savoy are being furnished with some of its richest patterns.

The bronze foundry of Michielli and Co. likewise deserves notice, and is an establishment where not only the fine bronze works of Italy peculiar to the fourteenth, fifteenth, and sixteenth centuries are perfectly re-produced in all sizes, but even works of modern art are cast at the option of the sculptor, after the manner and the time of Michael Angelo and Benvenuto Cellini. Their special way of casting offers the advantage of learning the sculptor's idea in its full character, for after the casting the bronze is only cleansed, and no chisel is employed which could injure the sculptor's original invention. This noble art, nearly lost in Europe, is treated in this foundry with great skill. Samples are to be seen at Kensington Museum, and one of the finest works of art—the altarpiece of the Church St. Giorgio Maggiore, in Venice, a very noble group—was being re-produced for exhibition at the Alexandra Palace in London.

NATIONAL TRAINING SCHOOL FOR MUSIC.

Lord Granville, Lord Warden of the Cinque Ports, presided on Wednesday last, over a meeting held at Sandwich, with the object of promoting the establishment of the National Training School for Music. He was supported by the Mayor of Sandwich, Mr. Coleman, Dr. Carpenter, F.R.S., Mr. Lionel Benson, the Rev. Arthur Chichester, Mr. Page, Deputy for Walmer; Mr. Henry Russell, the Rev. Mr. Hobson, the Rev. Mr. Hilton, Mr. Robert Harrison, and many other leading inhabitants of the town and liberties. The Countess of Granville and Mrs. Carpenter were also present.

The Mayor opened the proceedings by stating that he had received a letter from the Registrar of the Cinque Ports in Dover announcing that scholarships had already been subscribed for in that town in connection with a meeting over which the Lord Warden had presided a few weeks ago, and asking that the other ports in this, the jurisdiction of his Lordship, should co-operate in a movement that would be attended with important national advantages. The Deputy for Ramsgate was, unfortunately, unable to be present, but expressed his entire sympathy with the project, as also did Mr. Brassey, one of the members for Deal, and Mr. Knatchbull-Hugessen.

Lord Granville said the Mayor had written to him saying that he thought it was desirable he should explain to the people of Sandwich the history and the objects of the proposed National Training School of Music, but, to borrow an expression from Mr. Knatchbull-Hugessen's very witty letter in reply to a similar invitation, he considered himself a little too "sharp" to undertake so heavy a responsibility. He would, therefore, respectfully decline to comply with his worship's request. Still, he had no hesitation in stating publicly, for a second time in the Cinque Ports, that he liked music very much, and he believed that nobody appreciated more than he did the elevating tendencies which attended its study, how high an art it was, the intellectual advantages that were enjoyed by those who professed it, and how fitting an occupation it was for the leisure hours of either busy or idle men. At the same time he did not feel himself confident from the knowledge he possessed, either theoretical or practical, to make more than one speech on the subject, and, as they were probably aware, he had already spoken on the claims of the proposed new institution at a public meeting in Dover. Fully alive, therefore, to his own shortcomings as an advocate of the school, he had the pleasure of introducing to them Mr. Lionel Benson, an accomplished musician, who was really acquainted with the subject, and who would, he had no doubt, give them a most lucid description of the history of the new institution, its wants and its objects, and further suggest the way in which the people of Sandwich could assist in promoting them. The principle of the institution was that of free scholarships, in order that those young people in the country who displayed any exceptional proficiency in music, and who were likely, if properly trained, to distinguish themselves in that capacity, might be able to have the benefit of a thorough musical training in a national institution. Having consented to attend that meeting, he had ventured to press into the good service, even at midnight, the well-known Dr. Carpenter, a distinguished Fellow of the Royal Society, and one of the most eminent scientific men in the country. Dr. Carpenter was, indeed, a gentleman who, notwithstanding his absorbing scientific work, and the great attention he had paid to the advancement of education in general, had learnt music as a recreation since he had attained his majority, and he had no doubt that he would be able that afternoon to advocate the cause of music with his usual happiness of expression. Mr. Benson would tell them how the institute was being supported in London, Birmingham, Manchester, and Liverpool, and other great towns that had promised their support, and he sincerely trusted that because Sandwich was a small town its inhabitants would not come to the conclusion that they should be apathetic in what he believed would be a very good work. The town of Sandwich was certainly a small one, and its inhabitants were not ostentatious; they were, however, [illegible] proud both of the past and present. They were proud of having been some centuries ago described as the most famous port, not only of the Cinque Ports, but the most distinguished of the ports of Great Britain; they were proud of their ancient and historical associations which went back to the earliest periods of English history; they were proud of the visit of Sovereigns to that place; and they were also proud of having been at one time the great centre of the shipbuilding interest, and of having been visited by thousands of seamen of all nations. It was, however, no longer their privilege to boast of these advantages; whatever command they might have had over the sea in the olden time, they did not possess it now. But that was not their own fault, but rather the fault of the sea, which apparently considered the power of the town to be growing dangerous and likely to interfere with its own; whereupon it ran away two miles or so, and only left a river in its place. It had happened that a friend of his own—a gentleman who at one time charmed the House of Commons with his eloquence, but who, like many others of his friends, failed at the last general election to be returned to Parliament, visited Sandwich and was much struck with its quiet, if not altogether deserted appearance. He must also confess that he found grass growing in some of the streets, but he was pleased to state that there was none in the market-place, none in their counting-houses, and that, although the sea had receded from the town, it was still well-known for its excellent ship-building. Turning to the object the meeting had in view, he would observe that the Cinque Ports had begun the movement in this part of the country, and it was started in Dover. On the installation of Lord Palmerston as Lord Warden of the Cinque Ports there was some difficulty about precedence between Dover and Hastings, but that difficulty had since been settled by antiquaries in favour of Dover. Not only antiquaries, however, but poets also had spoken of the position of Sandwich in the Cinque Ports; Longfellow, one of the most charming of versifiers, having written—

> "Sandwich and Romney, Hastings, Hythe, and Dover,
> Were all alert that day."

So that their ancient town was given the first position by a great poet. There was no doubt that a semi-national spirit was identified with the Cinque Ports, because they had been honourably identified with

the history of the past. He therefore trusted that they would not be backward in supporting a project that would be of lasting benefit to the country.

Mr. Lionel Benson then gave, at some length, the history of the National Training School for Music, describing Mr. Freake's generosity in giving a building to the nation, and referring to the assistance rendered by foreign Governments to similar undertakings. In France the Conservatoire was supported entirely by the Government, at a cost of £40,000 a-year; in Brussels the Government gave £12,000, and the rest was supplied by the municipalities; and in other countries music was encouraged to a great extent by Governmental aid. The scholarships of the English school were to be worth £40 a-year each for five years, and at Birmingham they had already subscribed for ten scholarships. At Manchester the movement had been well supported. Sir Titus Salt had given given £1,000 for a perpetual scholarship, and Her Majesty and several members of the Royal Family had liberally supported the scheme.

Dr. Carpenter, F.R.S., next spoke, and said that the movement was one of great value, because the cultivation of music would give them one of the highest and purest of pleasures—a pleasure more completely without alloy than almost any other that could be named, and in these days of intellectual work it was necessary that those who laboured hard in whatever sphere should be enabled to enjoy healthy and elevating recreation. He dwelt upon the fact that in England, owing to the printing of music by type, the most popular songs, ballads, and other compositions were placed within the reach of the multitude at a very trifling cost, a copy of Handel's *Messiah*, which formerly cost 30s., being now procurable for 1s., and attributed the increasing culture of music in this country to the fact that the printing press had been so largely utilised in the production of pieces of the most varied description at a price which placed them within the reach of every class. When further it was remembered that, however great a sensation a foreign artist might achieve elsewhere, it was absolutely necessary that he should submit himself to the verdict of the English people, it could not be doubted that England had some claim to be considered a musical nation, and its reputation in this respect would be greatly enhanced by the establishment of a National Training School for Music.

In reply to Mr. J. H. Russell, the well-known composer, who mentioned that he received his musical education free of cost at the Conservatoire at Bologna,

Mr. Benson said that the scholarships would be open to all young people possessing musical talent, whatever their social position might be, and the cost of their maintenance in London would, in some cases,—at Birmingham, for instance,—be defrayed by private subscription. It was also proposed to erect an institution in London where the pupils could live at a moderate rate.

Resolutions having been passed to promote the objects of the meeting, a vote of thanks was unanimously accorded to the Lord Warden for presiding.

TESTING METALS.

The following circular has been issued from the United States Board, appointed to test iron, steel, and other metals:—

The committee on corrosion of metals of the United States Board, appointed to test iron, steel, and other metals, is instructed "to investigate the subject of the corrosion of metals under the conditions of actual use." Its labours must necessarily consist largely in observing the corrosion that has taken place under these conditions, and in collecting the results of observations and experiments made by others.

In this important part of its labours it asks the assistance of all whose tastes, interests, or occupations have induced them to note the rate and mode of destruction (by corrosion) of the metals used in construction.

Full and clear statements are asked of all cases observed, which show a remarkably rapid state of corrosion or the reverse. It is very desirable, whenever practicable in these cases, to get a sample of the metal and of the scale or crust formed, for the purpose of chemical analysis. These samples you are respectfully requested to forward to Col. T. T. S. Laidley, president of the Board, at Watertown Arsenal, Watertown, Mass., accompanied by a full statement of all the conditions within your knowledge which have influenced the rate of corrosion in the particular case observed. The samples so forwarded will be carefully analysed.

Important as the subject of the corrosion of metals is, the information touching it is so meagre and indefinite, that the rate of destruction cannot be predicted with certainty in any given case. You will confer a favour upon the committee by referring to such sources of information as you may deem valuable: such as reports of engineers, architects, and scientists, or articles touching this subject contained in scientific publications.

Proper acknowledgments will be made of all assistance rendered.

CORRESPONDENCE.

HALL-MARKS.

SIR,—Workmanship in jewellery is a very different thing to workmanship in the generality of other articles, for the value of the material from which jewellery is manufactured holds a very different relation to the labour expended upon its working than would be the case in any other instance. The general notion amongst the public respecting jewellery is, that the intrinsic value of the material from which it is made represents a very great part of its price. It is very different to the value of a work of art where the material goes for nothing, even if it were pure gold, and where alone the skill and inspiration of the artist gives it value, sometimes to an enormous extent. Of such works it would be ridiculous to speak when treating merely of jewellery generally, for as I shall endeavour to show further on, the proportion of value in an ordinary article to the workmanship, or the fashion as it is called, as compared to the metal is so very small, that the public notion that a jewel really represents an intrinsic value for the material of which it is made, ought to a certain extent to hold good.

When we consider that jewellery is manufactured wholesale in large factories by thousands of hands, by endless devices and combinations of machinery, we cannot help admitting that the value of the labour expended upon its make is quite insignificant when compared to the value of the material. In many cases it holds about the same relationship as would the cost of the cutting of iron nails to the iron they are cut from, or the dipping of candles to the tallow, the drawing of copper wire to the metal, or any such like simile we may please to introduce. Let us take, for instance, a gold Albert chain of simple pattern. Such chains a skilled workman, earning say £3 per week, will turn out half a dozen in one day, well finished, and ready for the waistcoat of the wearer. Now, what comparison can there be between the weight of the gold and its value to the workmanship expended upon it? These chains are made, not only by the yard, but by the mile. But should

any reader have the slightest doubt of the veracity of this assertion, let him look into the shop window of any vendor of mock jewellery, and he will see handsome-looking chains, brooches, earrings, bracelets, studs, lockets, &c., marked at from 1s. to 3s. 6d., answering every purpose of ornamentation, satisfying every craving of vanity; in fact, having every requirement excepting the one which is demanded of genuine jewellery, viz., the intrinsic value. Here the whole of the value, small as it is, falls entirely upon the workmanship, the material being, for our purpose, absolutely worthless.

One of your late correspondents says that "to limit the alloys to some definite ratio, seems to interfere with a natural right." I should be glad if he would explain what that natural right is. Is it the natural right of persuasion which, in so many cases, succeeds so well? He must understand that in a small organised and civilised community, for the safety and well-being of the whole, natural right, and even justice must be put aside and give way to law, which being fixed and written, sways the entire nation, and moulds the actions of the people to a given form. Thus the arguments which are brought forward in favour of free trade, cannot with the same degree of reason be applied to the manufacture of articles of gold. We might as well say freedom of deception. When we receive in payment for our chattels, coin, we know that coin represents a certain value, because the metal is of a certain purity; and in the reign of Henry III. it was decreed that articles of gold and silver should be of such fineness that they might be considered equivalent, weight for weight, with the coin of the realm. For the value of an article of trade can only be measured by a fixed standard or expression of value in a given coin, which in England is gold of 22-carats.

In former times, it must be admitted that things were more satisfactory than they are now, where some jewellers advertise that they will sell gold articles for their weight in sovereigns, thereby silently implying that they are giving gold for gold. But if the metal of the jewels they sell is in greater part copper (I do not wish here to allude offensively to *bona fide* 18-carat gold, which is not overpaid by an equal weight of 22-carat gold to cover fashion and profit), the buyer is deceived, and the jeweller obtains money by false pretences, for as I have already said, by weighing sovereigns against the manufactured articles, he at once wishes the purchaser to understand that he lays stress upon the value of the material.

The same correspondent further observes with great truth, "that an object partly hall-marked is doubly treacherous," and he also says, "the English manufacturer sometimes alloys his gold largely." He then says again, "the French jeweller strengthens his tinsel fabrics with cement, but even then they are too frail for the bulk of the English population." Now why should the bulk of the English population require that the tinsel fabric should be more strengthened still with cement? Is the English wearer such a clumsy animal as compared with the French, that anything not exactly manufactured with a sledge hammer will do? I consider our English population quite as refined, elegant, delicate, and civilised as any other nation in the world. Your intelligent correspondent goes on to say, "compulsory hall-marking has too many objections to be admitted." This is a very pretty assertion, especially after he has said that the English manufacturer sometimes alloys his gold largely. Again he says, "to check frauds in trade none are so competent as those in the trade." Very well, let us hear what the trade has to propose in order to check these frauds.

It is generally admitted that reform of some sort in the manufacture of jewellery is urgently called for, and what we want are suggestions as to the best means of effecting these reforms, and not apologies for the existing evil.—I am, &c.,

Alfred Lutschaunig.

GENERAL NOTES.

Japanese Damasked Metal Plates.—Professor [illegible] gives some details of the method by which these plates are manufactured. From thirty to forty thin sheets of gold, silver, copper, and different alloys are placed one upon another in a certain order and welded together by the edges so that the whole forms a single thick plate. By the aid of awls of different forms, conical or pyramidal, this plate is then pierced with holes the sides of which appear, in consequence of the difference in the colours of the sheets, formed of circles, triangles, squares, or hexagons. The plate is then submitted alternately to hammering and rolling until it becomes very fine and the holes have completely disappeared. The concentric figures are thus stretched, at the same time that their parallelism is preserved; and the result is an almost innumerable quantity of straight, broken, and oblique lines, which do not cross one another, and are distinguished by a variety of colours—a variety which can be still further increased by steeping in certain acids.

Sulphur in Coal-gas.—At the recent meeting of the British Association, Mr. Vernon Harcourt, president of the chemical section, described an apparatus for the estimation of sulphur in coal-gas. By the present system of gas making it seems impossible for gas manufacturers altogether to prevent sulphur, in the form of bi-sulphide of carbon, from contaminating the gas, and as Parliament has fixed for the metropolitan companies a limit for the impurity beyond which they may not go, it is a desideratum to have a simple and approximately correct process for the estimation of the amount of this impurity. Especially is this the case in large works, where the nature of the gas is constantly changing, and where it is desirable to have a constant check upon the manufacture. By the present process this estimation takes about twenty hours. Mr. Harcourt has, however, succeeded in devising a process which much facilitates the operation. It is founded upon the following facts:—When bi-sulphide of carbon is heated in presence of hydrogen, it is decomposed into sulphuretted hydrogen, and this sulphuretted hydrogen has the property of converting a lead salt into the black sulphide of lead. The estimation is made in the following manner:—A volume of coal-gas is passed through a flask filled with small pebbles, kept at a low red heat, when the above reaction takes place; the gas is then passed through a solution containing a lead salt, until a definite brown or black tint is produced. This tint is compared with a standard colour, and the amount of sulphur in the gas is calculated from this.

Telegraphs in Russia.—The telegraphs of Russia may be divided into four classes:—The State lines; those worked by the railway companies; the Anglo-Indian line, and those worked by private individuals. On the 1st January, 1873, the extent of the system owned by the State was 53,448 versts,* with 103,330½ versts of wires, and [illegible] stations. At the end of the year, the extent of the lines had increased by 2,196½ versts, that of the wires by [illegible] versts, and the number of stations by 30. The system connected with the railways carrying private messages had, at the commencement of 1873, an extent of 10,73[illegible] versts, with 24,606 versts of wires, and 681 stations; in the course of the year the length of the lines was increased by [illegible] versts, and that of the wires by 4,464 versts, and the number of stations by 112. On the 1st January, 1874, the Anglo-Indian line had an extent of 3,407 versts, with 7,083 versts of wires, and 53 stations. At the same period the lines worked by private individuals had an extent of [illegible] versts, with 325½ versts of wires, and 20 stations. These figures united, give a total of 72,348¾ versts for the lines, 143,069¾ versts of wires, and 1,556 stations. There were besides, at the beginning of 1874, 127 post-offices forwarding telegrams. The countries with which Russia exchanges the largest number of telegrams are:—Germany, then England, Austria-Hungary, and France. In 1873, the receipts from the telegraphs were 4,630,029 roubles (£740,804), exceeding by 10·6 per cent. the return of the preceding year, which was only 4,189,280 roubles. The outgoings amounted to 3,613,820 roubles (£578,211). Out of the available balance of 1,016,209 roubles (£162,593), 448,220 roubles have been devoted to the establishment of new lines.

* A verst = 0·66 mile.

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communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

COMMERCIAL EXAMINATIONS.

The programme of these Examinations, for 76, is now ready, and may be had *gratis*, on plication to the Secretary.

EXTINCTION OF FIRE IN SHIPS.

The Fothergill Gold Medal is offered for an ective means of preventing or of extinguishing on board ship. Communications, illustrated ded be by models or working drawings, must sent in to the Society not later than the 31st of ember, 1875.

The Council will take into consideration, with a w to reward, the best written paper containing ggestions fitted to secure prevention of fire, or means to be adopted for the safety of life and perty when fire breaks out on board ship.

The Council reserve to themselves the right of hholding the medal or reward offered, if, in opinion of the Judges, none of the communica- s sent in are deserving.

MISCELLANEOUS.

FOOD PRESERVATION.

od preservation is a subject both interesting and ortant; interesting itself on account of the great unt of scientific ingenuity already expended on it, the wide field still open for improvement in the ous processes employed, and the discovery of new and important as part of the question of our food ly. In the International Exhibition of 1873, the ay of preserved food formed a considerable part of Food Section, and it may be remembered that in one he reports dealing with this section the writer ed somewhat fully into the different methods which been or are still practised in the preservation od, and especially of animal food. Great interest been taken in the subject for some years previous to Exhibition, and probably in no direction had more riments been made than that of food preservation. interest has been sustained, and hardly a week s without one or more patents for preserving being taken out in this or some other country. Unfortunately the success attending the various inventions has not been commensurate with the enterprise expended, and though many articles of preserved food are now presented to us in a most acceptable form, the great desideratum, namely, beef and mutton preserved in receptacles in a fresh state, or in a cooked state, and in a manner such as to be thoroughly palatable to the consumer, cannot be said to have been attained. At least it must be owned that, notwithstanding the wholesomeness and nutritive value of the tinned beef and mutton sent to this country from the Australian colonies and elsewhere, the overcooked state in which these articles are still presented militates against their popularity, their comparative insipidity contrasting unfavourably with ordinary fresh-cooked meat. Hence a brief glance at the chief methods of food preservation, and the results hitherto attained, may not prove unacceptable to some of the readers of the *Journal*. Taking, then, preservation by means of desiccation or drying, refrigeration, or, to use an unscientific term, the application of cold, the use of chemical antiseptics, and the application of heat, as the leading principles in the food preserver's art, let us see what they have effected for us, and what prospect there may be of improved results in each or all of them.

The process of drying or desiccating is in one sense hardly a scientific process at all. It certainly has a respectable antiquity to recommend it, being probably almost coeval with man, either as a herbivorous or carnivorous animal. From the earliest times fish, flesh, and vegetables, have been dried by simple exposure to the sun; and when previous to this, or in conjunction with this, the expression of water from animal and vegetable substance is effected to a considerable extent, and artificial heat used, then the fibre and a great part of these dried pieces assume such a condition that they are almost incapable of destruction by the natural process of decomposition, and are only affected by time like inorganic matter. The simple process of drying, or rather partially drying, fish and certain meats with or without the further use of smoke or chemical antiseptics, is by no means to be despised, as by it we are enabled to utilise a large quantity of food which would otherwise be wasted. Charqui, or South American dried beef, is an example of fairly successful preservation. Before eating it requires to be well soaked in water, and then to be cut small and cooked by prolonged boiling, but though largely used in South America, it will not "go down" among ourselves. We all know what Hamburg beef is, and other forms of semi-desiccated meat, many of which are very tasteful if not very nutritious, but they hardly come within the scope of this article. Some years ago the Food Committee of the Society of Arts tested some desiccated or "powdered" beef from Queensland, and after testifying to its keeping qualities and nutritious value, expressed an opinion that it was likely to become a very valuable article of commerce, and a cheap addition to our food resources. Unfortunately, as has been the case with many articles of food preservation submitted from time to time to the public generally, and gastronomic critics in particular, and spoken highly of, we seem to have heard little more of this "powdered" beef. The truth is, animal matter preserved by desiccation loses its flavour and becomes tough and indigestible, the fat becomes rancid, and in damp weather the meat absorbs moisture and turns mouldy and sour. The above difficulties in connection with desiccation are to some extent obviated by mixing absorbent substances with fatty food, as in "pemmican," where sugar and spice are mixed with dry powdered meat. A large quantity of this preparation was manufactured for the Arctic Expedition which recently left our shores. Meat biscuits, such as those produced by the well-known firm of Messrs. Peek, Frean, and Co. and others, are made on the same principle of farinaceous meal, absorbing meat essences. Altogether there are in existence more than thirty patents in this country alone for the preservation of various articles of

food by the processes we are treating of, but the result has not been commensurate with the labour and ingenuity expended on them. Among others who have worked in this direction is Dr. Hassall, who has applied a method by which meat may be preserved for a lengthened period in a dry state. He thoroughly dries lean meat by gentle heat, and then grinds it into coarse powder, which may be used for soup or biscuit making. The late Dr. Edward Smith, an authority on many points of dietetics, says that this powder has the nutritive qualities of lean meat, though the aromas have vanished under the influence of heat; but he adds that for "separate use" the cost of preparation would prevent its sale in the market. He further states that the drying of meat by artificial means may be more quickly effected over burning coals. M. Tellier, of Paris, adopts the following method:—He first rarifies the contained air by an air-pump to a tension of two or three centimetres of mercury, and then fills the vessel with carbonic acid gas from a gas-holder, so that the atmosphere will only consist of about three per cent. of air. This he removes by the air-pump to the same tension, and the remaining air is almost entirely carbonic acid gas. Once more, however, he fills the vessel with carbonic acid, and again removes it as before. Afterwards he absorbs the carbonic acid by the use of a concentrated solution of potash, by which a very near approach to a vacuum occurs. After leaving the meat thus treated for three days, it is removed, and may be kept sound without any further trouble, but it will have lost from eighteen to twenty per cent. in weight. The process of desiccation is far better adapted to the preservation of vegetable substances than it is to that of meat; indeed, as applied to the former, it has achieved a very considerable success, and it may be added that housekeepers would do well to experimentalise on dried vegetables much more often than is now the case. In this country the first recorded patent for the preservation of vegetables by desiccation was granted in 1780, to John Graefer, who dipped his articles in boiling salt and water before drying them. Several other patents have been granted, some for vegetables in general, and some for potatoes. In November, 1850, Masson obtained his patent for drying and forcibly compressing vegetables, so that they were reduced to one-seventh their original bulk, a cubic yard containing rations for 16,000 men. The French, with M. Chollet at their head, have been very successful in this line of preservation, but many English houses now produce them in the form of "chips," or of compressed cakes, such as Messrs. Whitehead and Co., of Lime-street-square, Messrs. J. Gillon and Co., of Leith (London agent, Mr. House, 76, Minories, E.). From America, also, dried vegetables are being imported at 1s. 6d. per pound, half an ounce being sufficient to add to a pint of soup. Considering the high price charged by greengrocers for vegetables, and the waste in utilising them in almost every household, all housekeepers, even the very poor, would do well to turn their attention to these dried vegetables, and experimentalise upon them. When soaked and well boiled, they will be found not only economical in their use but excellent in soups, and even for eating with meat in lieu of ordinary fresh vegetables. The process of drying eliminates little else but the water which forms so large a part of the constituents of all vegetables, and takes from them little, if any, of their flavour. Vegetables dried in their natural form, according to Mr. Buchanan's patent, are also most excellent. It may be remembered that compressed vegetables, combined with dried meat, were largely used by the French and English armies in the Crimea; and still more recently the well-known house of Ferré and Co., of 10, Glasshouse-street, Regent-street, supplied large quantities of the best compressed vegetables to the troops in the Ashantee expedition. Soup squares or tablets, which, though not strictly speaking, as above said, "desiccated" articles of preserved food, may fairly claim notice here. Most of them are compressed, but some are in the form of flour or grains, being composed of various substances combined with powdered meat, or meat extracts. Among the first houses for these productions stands that of Messrs. Whitehead and Co., of Lime-street-square, E.C., which offers an almost endless variety of soup squares, such as carrot, pea, chestnut, mulligatawny, &c.; also large cubes called "gargantua," after the name of the mythical giant celebrated by Rabelais, one of which dissolved in three pints of water makes a most delicious pot-pourri of four pounds weight of nutritious food. This firm has also recently produced the squares of "army food," weighing one quarter of a pound each, cased in waterproof but edible covering, and making an almost impromptu quart of excellent soup, meat and drink combined. Another prepared soup—pea soup in packets—worthy of commendation is that produced by Messrs. Symington and Co., of the Bowden Steam Mills, Market Harborough. Its flavour is all that can be desired, and its nutritive value undeniable, being prepared with the pea flour for which this firm is celebrated, and which is produced by a patented operation unequalled in its result. Perhaps we cannot expect much new in the way of preservation by desiccation, nor indeed is it required. What has been done in this line is, perhaps, sufficient for our needs, and it would be better if the efforts of food preservers were mainly turned in another direction.

The preservation of meat by refrigeration or the application of cold is very effective, but it can hardly be called a scientific process, nor can meat temporarily preserved by it be strictly called preserved meat. Still, as in the opinion of many it will be by this means that ultimately large supplies of dead meat will be brought to our markets, this branch of the subject is well worthy of notice. The first patent for the preservation of food by refrigeration was taken out in 1845, and since then a variety of expedients have been adopted by the use of ice, and by artificial processes of lowering the temperature by evaporation, in order to safely import fresh meat from Australia, the American continent, and elsewhere, into this country. Space would be wanting to enumerate these different expedients, nor would there be any purpose gained in so doing, the object of all being the same, viz., to ensure a sufficiently low degree of temperature for the preservation of the meat during the voyage, and to produce this result at such a cost as would repay the importers.

Experiments have been made in almost all parts of the world, *i.e.*, in the large meat producing countries, in connection with refrigeration, and shipments of refrigerated meats have been made to this country from a number of ports with more or less success. One of the most interesting and, as far as it went, most successful experiments was made by Mr. James Harrison at the Melbourne Exhibition, 1872-73. Under the supervision of the officials, and in accordance with certain principles of his own, he constructed an "ice-house" in the building, in which he placed quarters of beef, and halves of sheep. The ice-house was sealed by the commissioners, and at the end of forty days, when opened, the meat was found perfectly good, and when cooked and tasted by a number of competent judges, was not distinguishable from ordinary fresh-killed butchers' meat. Moreover, the meat, after being taken from the ice-chamber, kept perfectly good for 75 hours in a temperature of between [illegible] and 68 degrees, a fact which is contrary to the generally received opinion, in this country at least, that meat which has been subjected to refrigeration decomposes more rapidly than that which has not. This may be the case with meat which has only been covered with ice, and when the temperature of the mass of the meat has only been as low as barely 32 degrees, *i.e.*, just a little above freezing point. Decomposition is apt to go on at this temperature, though slowly, as the pieces of meat are still in a liquid condition. By Mr. Harrison's system, any particle of moisture in the meat is converted into ice, and the little spicules of

crystallised water can be seen scattered through it when it is cut with a knife, nor is there any desintegration or rupture of the elastic fibres of the meat by the freezing and thawing. The statement also that Mr. Harrison's meat has not lost anything in flavour by the process to which it has been subjected, a statement also made in reference to the meat which has been on another occasion frozen according to his method for eighty-five days, is also somewhat contrary to the general belief among ourselves in reference to refrigerated meat, many good judges holding that the effect of cold is to lesson, if not to change the flavour of the substance, so that whilst it may be really good food, it does not fully equal recent fresh meat. Though perhaps game and poultry and certain fish deteriorate by being packed in ice, as anyone can tell by comparing an iced mackerel with one which has not been iced, the probability seems to be that meat undergoes no perceptible deterioration from refrigeration, at least to ordinary taste. So confident was Mr. Harrison of the ultimate success of his method, and of its applicability to the importation of meat from Australia into this country at a remunerative price to the importers, that he undertook in 1873 to bring a sample of his iced meat to this country. For this purpose he had an ice-chamber constructed in the ship *Norfolk*, several tons of meat were stored within it, and he himself sailed with his experiment. Unfortunately, the construction of the ice-chamber by the workmen employed was imperfect, and the ice supply failed before the voyage was little more than half over; and consequently Mr. Harrison arrived in this country without his meat, and very much to the disappointment of all interested in the matter and anxiously expecting the result of his experiment. The success, however, of his experiment in Australia cannot be doubted; but it is a very different thing to conduct an experiment on land and on board ship. As far as is known, nothing further has been done in the matter, partly owing, perhaps, to the increase of the price of meat, especially beef, in Australia. Last year, however, successful attempts were made to bring iced meat to this country from Canada, under the supervision of Mr. James Whyte, and some beef, mutton, and turkeys, shipped at Quebec, were all that could be desired when brought to Liverpool. Some time before this, several gentlemen in New Orleans, interested in the subject, chartered a steamer, fitted with a cooling machine, and despatched her to Texas for a cargo of fresh meat, which meat was reported to have arrived at New Orleans in a perfectly sound condition, after a voyage of five days in the tropical climate of the Mexican Gulf. Then, again, we have M. Tellier's method, by which he proposes to place (on ship-board or elsewhere) joints of meat in a chamber, through which a current of air, charged with ether or other volatile substance, may be passed, with a view to reduce the temperature to about [illegible]° Fahr. Thus, he would not freeze the juices of the meat, but, by a low temperature, keep the chemical and vital actions at their lowest point. Again, not very long ago, M. Poggiale, of Paris, brought this subject of preservation by cold alone before the Paris Academy of Medicine, and from his report it may be gathered that, in a chamber contrived on somewhat similar principles to that of M. Tellier, all kinds of butchers' meat and poultry had been hung for ten weeks, and at the end of that time presented themselves almost in the same state as if fresh from the butcher or poulterer. The whole question of refrigeration, in reference to the transport of meat, resolves itself into one of cost, *i.e.*, the cost of producing and continuing the required low temperature for a given time. Hence all attempts to construct ice-making machines, which shall produce ice at a lower cost per ton, and of all machines or inventions whereby a low temperature can be maintained in a meat-chamber, at a moderate cost, are to be watched with interest. In his address at the opening of the session of this Society, nearly three years ago, General Eardley-Wilmot stated that the Council and Food Committee of the Society still looked forward to the early solution of the question of a fresh-meat supply from Australia and elsewhere, by the adoption of some form of refrigeration. It is still to be hoped that the expectation will ultimately be fulfilled.

Chemical antiseptics have been employed in a variety of ways for the preservation of fresh meat. Chloride of sodium or common salt has been used for this purpose for centuries, and is likely to hold its own; but on this head there is no need to dwell, as what we want is not salted but fresh meat. Much ingenuity has been displayed in the use of antiseptics, and numerous patents have been taken out in reference to them. Inventors and patentees have from time to time been most enthusiastic as to their methods, and the good news that the question of the preservation of fresh meat has been solved has frequently been promulgated. The fumes of burning sulphur (sulphurous acid) are powerfully antiseptic, and many patents have been taken out for their employment; among which may be especially mentioned that of Laury in 1854. Later in the same year, Bellford received a provisional protection for the use of sulphurous acid with about one-hundredth of its volume of hydrochloric acid, the object being to prevent the sulphurous acid combining with the alkaline salts of the meat, and so giving it an unpleasant flavour. Other patents followed for the use of the acid in a gaseous form, and in the specification of Demait it was directed that the substance should be preserved by hanging it up in a chamber and exposing it to the action of the gas. Professor Gamgee renewed this process more recently with certain modifications. In M. George's process the meat is partially dried, and then steeped in successive waters containing hydrochloric acid and sulphate of soda. Instead of covering the meat with the chemical solution it may be injected into it, as in the patents of Long (1834), Horsley (1847), Murdoch (1851), and others. Perhaps the most valuable chemical antiseptic yet employed is the bisulphite of lime as manufactured by Messrs. Bailey and Son, of Wolverhampton. This is very efficacious in the temporary preservation of meat, and several small consignments of meat treated by it, and sent to this country from South America were, when tested in London, considered very satisfactory. A variety of other experiments have been made in the antiseptic line, and various have been the trials held on the results during the last three or four years. We have had M. Sacchi's method of the use of acetate of potash; the chloralum process; M. Pierre Kock's method, and those of Mr. A. J. Goulstone and Mr. Leowy, with many others, of which there was a hope in each instance that a valuable and practical process had been discovered. Unfortunately, however, the results have not come up to the expectations formed, and after years of most diligent chemical experiments we have as yet no fresh meat, at least, brought to our markets in the way of trade, preserved by means of antiseptics other than salt. Without wishing to dishearten those who are labouring in this direction, it must be confessed there is no great hope that the question of food preservation will be solved by the use of chemicals, for after meat has been subjected to their action for any considerable time it more or less develops an unpleasant or at least an unnatural flavour when cooked.

The expulsion of atmospheric air from vessels containing the meat by means of heat is certainly the most successful method of preservation yet adopted. There are three processes employed, known as (1) the ordinary Aberdeen process, (2) the steam retort process, and (3) the chloride of calcium process. These have been so often described in these columns that it is not necessary to enter into them, or to point out how they differ from one another. The main principle is the same in all, and the meats and other articles in tins so familiar to all in the shop windows are preserved by one or other of these processes. The name of M. Appert, who in 1810 gained the first reward of 12,000 francs offered by the

French Government for the best method of preserving food, will always be connected with the application of heat to that purpose. But while the application of heat effects a perfect preservation, this preservation, as far as the present processes go, can only be thoroughly depended on when a very high temperature is used, and the substance to be preserved is subjected to it for a much longer period than is necessary in ordinary cooking. Hence, as above said, the meat is overdone, and rendered soft, fibrous, and comparatively insipid. The process known as Jones's vacuum process partly obviated these objections, but for various reasons its use has not been persevered in. Some improvement has also been effected by the use of tins of large circumference, and only four or five inches in depth, introduced by Mr. Anderson, now preserver to the Melbourne Meat Company, whose agents are Messrs. J. McCall and Co., of Houndsditch. The tins of this shape do not require to be subjected to the "hot bath" for so long a period as those of the ordinary model, as the centre of the meat is sooner acted upon by the heat. Whether by any modification of the existing processes, or by some other method of applying heat for the purpose of meat preserving, an effectual preservation will be secured without the meat being over cooked, it is impossible to say. Unfortunately, we cannot congratulate ourselves on any material progress having been made in this direction since meat was first put up by one or other of the heat processes. However, the soups, stews, and similar articles preserved by these processes at the large establishments of the Aberdeen food preservers, such as J. Moir and Son, J. T. Morton, and others, and by Messrs. J. McCall and Messrs. Crosse and Blackwell, of London, are most excellent in every respect, and deserve far more attention at the hands of housekeepers than they now receive. Fresh vegetables, also, especially those put up by Messrs. J. McCall and Co., are very good, as preserved by the heat process, and might be more extensively used in private houses than they are.

Among a variety of specialities in the way of food preservation, the tinned curries of Mr. J. Halford, of 12, Upper St. Martin's-lane, W.C., are particularly deserving of mention, as being, perhaps, the most successful specimens of the preserver's art yet offered to the public. They were exhibited in the Food Section of the International Exhibition of 1873, and in the report on that section the writer spoke of them as "one of the best forms of preserved food which had come under our notice." This commendation was certainly deserved, and it may be added that in addition to curried fowl, Mr. Halford now puts up rabbit, the flesh of which, being firmer than that of fowl, seems even better adapted for preserving in the form of a curry. The popularity attained by the curried fowl is likely, therefore, to be exceeded by the curried rabbit, especially as the latter is to be obtained at the retail price of three shillings per 2 lbs., as contrasted with four shillings, the retail price of 2 lbs. of the former. The excellence of these curries is attributable partly to the extreme care used in the process of preservation, but partly to the flavour and quality of the curry powder used in their preparation. Mr. Halford was formerly *chef* to Lord Dalhousie, Governor-General of India, in which country he mastered the art of curry making in its several forms; and the ingredients he now uses are, he states, specially prepared for him in India according to his own recipes, and sent to him in hermetically-sealed tins, by which means they preserve a freshness not to be found in the ordinary curry powders of trade. The value of Mr. Halford's curries as a nutritive food and excellent stomachics was so well recognised by the caterers for the Arctic Expedition, that a large supply was obtained for the use of the crews, and within a few hours of the sailing of the ships an additional order was given, the tins opened and tested, commanding unqualified approbation. The only difficulty experienced by Mr. Halford is supplying his curries fast enough to meet the demand.

Another equally successful attempt at presenting a luxury to the public in the form of a preserved food has resulted in the tinned Paysandu ox tongues, which are to be found at almost all grocers and provision dealers' shops. These are put up by Messrs. McCall and Co., of Houndsditch, at their manufactory established for this purpose, at Paysandu, in Uruguay, where the whole process of preserving them is carried out from beginning to end with extreme care and cleanliness. They are unusually firm for this kind of preserved food, and their flavour is most acceptable, while the low price at which they are retailed makes them compare very favourably with an ordinary English ox tongue. The demand for them is now so great that Messrs. McCall and Co. will put out about 200,000 of these tongues in the first six months of next year. It should be mentioned, also, that among the variety of preserved food which comes from Australia, the preserved rabbits put up by the Western Company (Colac), for which, as well as the Melbourne Company, Messrs. McCall are agents, deserve special mention. They are put up in various forms, stewed, boiled, curried, and fricasseed; and considering how excellent they are, a 2lb. tin at about 1s. 6d. is a very cheap dish.

If in any of the above remarks the writer seems to discourage those who are endeavouring to discover some new or improve some existing method for food preservation, or to take too desponding a view of the future prospects of the enterprises, it can only be said that with others interested in it he cannot but regret that food preservation has made so little progress during the last few years, though so much attention has been given to it, and the desirability of bringing to this country the cheap meat of other lands is so great. At the same time it is to be hoped that there will be no relaxation in the efforts made to solve the question satisfactorily, which is one in which the Society has always taken a deep interest.

THE PARIS MARITIME EXHIBITION.

(FROM AN OCCASIONAL CORRESPONDENT.)

Opened more than two months since, on the 10th of July, with a species of formal quasi-official ceremonial, and having now endured about half its time as originally fixed, the Maritime and Fluviatile Exhibition has advanced by slow degrees to a stage of completeness and perfection which is doubtless interesting and adequate, from the general point of view of exhibitions, but falling lamentably short of the ideal suggested by the ostensible objects of its title. With one or two important, and a few unimportant, exceptions, the whole of the exhibits contained in the Palais de l' Industrie, numerous, and in many cases excellent, as they are, hang on to the merest outer fringe of "maritime and fluviatile" industries, pursuits, or requirements; the thread of connection being so slender as to a large extent to appeal merely to imagination and faith. Ship-building is represented only by a few models sent by the British Admiralty—costly and admirable of their kind, it is true—but of types which are not only well-known, but even now fast becoming obsolete in presence of the rapid march, and still more of the potentialities, of discovery in such matters as offensive weapons, rams, torpedoes, stationary and projectile, submarine cannon, 81-ton and 100-ton guns, and the like. Small wager-boats become important items in such an inventory, and a canoe hollowed out of a log of mahogany constitutes a whole category to itself. In the large and important class of marine-engines, the palm and place of honour must be awarded to a small 3-cylinder engine of Messrs. Brotherhood and Hardingham's patent, exhibited by Messrs. Manlove and Alliott, of Nottingham and Rouen: this is designed and adapted for a small steam-yacht or screw-launch, and is little more than

excellent miniature or toy-engine; but such as it is, is the only representative of an industry which in rmer years, and under different auspices, has sent— to South Kensington in 1862—one of the most magficent displays the world ever saw.

I cannot therefore agree with the Paris correspondent the *Times* in his estimate that England, as a maritime untry is, here and now, worthily represented: in fact, rusing the numerous and influential names of the ondon committee, under the presidence of the Lord ayor, including such men as Bessemer, Reed, Samuda, Vhitworth, &c., I feel rather inclined to wonder at the tiful nature of the result, *i.e.*, be it understood from the rely maritime point of view. The fact is—and it is of use blinking the matter—exhibitions are played out, least in the Old World, whatever lessons may be served for us from the New World in 1876. They worn sufficiently threadbare as Government underkings, national and international; but when they generate into purely private and personal speculations, ncealed beneath the lacquer or veneer of an ostensible asi-official aspect, the unadulterated predominance of e "huge bazaar" elements is inevitable. This, I take , is quite sufficient to account for the fact that on the casion of the so-called "official visit to the British tion" last Friday week, the Hon. Sec., or *Commissaire légué*, Mr. Edmund Johnson, and Mr. Edward Jenns, M.P., were the sole representatives of the English mmittee, which consists of several hundred members: d it is not less significant that the honours of the casion, so far as the French were concerned, were ne by M. Nicole, the manager and promoter of the dertaking; while there was not a single official or her gentleman of any position and standing in this untry present on the occasion. It is yet more curious d instructive to note that from first to last, hitherto, ere has been no such thing as an official visit of spection to this "Maritime Exhibition:" neither the resident of the Republic, nor the Ministers of Marine d the Colonies, of War, or of Commerce, have as yet peared, in that character, in the Palace of Industry, this occasion; nor do they seem likely to do so: d although the Marshal de Mac-Mahon and his lady, e Maréchale, as well as General de Cissey, have paid ore than one individual and entirely unofficial visit, is not a little singular that they have not once set t within the English section. I mention this parularly, because the English exhibitors as a rule are tremely sore and indignant on this point, regarding as a national slight, and stating that it is comparable th the treatment which they have experienced from e outset. As a faithful chronicler I thus record at I find; and, making due allowance for the constitional privilege of an Englishman, to grumble, it ust be admitted that smoke does not come without fire. At the same time, judging by what I have seen the delays and apathy of exhibitors, in occupying eir sites, forwarding their exhibits, and completing eir installation, I do not hesitate to affirm that, as race, exhibitors are not the persons who can afford to row stones, without apprehension that their own uses should be demolished about their ears.

Nevertheless, and be all that how it may—sinking "maritime" aspect—the exhibition is noteworthy d interesting, as a general display, mostly free from notony, and frequently rewarding careful and detailed dy and analysis. In one such respect, for example, mely, with reference to the means of saving life on ats, and from wrecks, it stands pre-eminently high, presenting to view all that is known and practised to the present time, and showing side by side, in trast and comparison, the various systems most ective for the humane objects in view.

Under this head I notice, firstly, a very complete set exhibits by the Board of Trade, or rather the Marine partment of that Board, comprising also illustrations the International Signal Code, and the examinations of masters and mates for certificates of competency, as well as of the life-saving apparatus now in use. It is now more than 60 years since the mode of communicating with wrecks on the coasts of the United Kingdom, by means of a line sent over them by a shot fired from a mortar, was brought into use by the establishment of mortar stations, which were mostly connected with the Coastguard Service. Twenty years ago the existing stations were placed specially under a Government Department, and at that time comprised both mortar and rocket stations. Captain Manby's mortar apparatus has since then been entirely superseded by the rocket apparatus, worked in connection with the travelling or sling life buoy of Commander Kisbee, R.N. There are now 289 such stations on the coasts of Great Britain and Ireland, each fitted up with the four-wheeled waggon, or cart, and apparatus; and during the five years 1870-4, there were 1,740 lives saved thereby, or about 350 shipwrecked mariners yearly. Sets of the apparatus, it appears, have been supplied to the Russian and Turkish governments, for stations on the shores of the Black Sea, also to Spain, Denmark, and Italy, while it is also in use in various British colonies, Heligoland, Gibraltar, Canada, Cape of Good Hope, Queensland, and Victoria, while it is about to be introduced in South Australia and on the Indian coasts.

Of much more recent origin, the French Société Centrale de Sauvetage des Naufragés has now been in operation ten years, and saved about 1,000 lives. This organisation is somewhat different to our own. The society, though ostensibly a private enterprise, nevertheless has official standing and Government recognition and support, all its life-saving apparatus on the coasts of France, Corsica, Algeria, and Terre Neuve, being entrusted to the Customs' officers in Government service. Their stations are in all 354 in number, whereof 47 are life-boat stations, 235 are provided with guns and life-saving apparatus of various kinds, and 72 are third-class minor posts, fitted out only with lifebelts, Torres-lines, and heaving-sticks.

The society exhibit on their stand, which is one of the most completely fitted up and interesting displays in the whole exhibition, one of their life-boats, mounted on its carriage, complete with every accessory and appliance, forming a very prominent object; its dimensions being, in metres, 9·78 long, by 2·24 wide (32 feet by 7½), and depth 0·74; the weight being 2,140 kilogrammes, and with crew and all on board, 2,560 kilogrammes, or 2½ tons. This society, therefore, unites the functions which, in England, are divided between a Government department and a private institution, viz., the Board of Trade and the Royal National Life-boat Institution. The latter, I may remark, is not in any way represented at the Palace of Industry, but that is of the less consequence, inasmuch as the French life-boat is confessedly constructed on the same plan and principles as the now well-known English life-boats.

In regard to their other life-saving apparatus, the system is exactly similar to our own, *i.e.*, by throwing a single line over the wreck, then hauling out a "whipline" and a hawser, and thus establishing the to-and-fro communication—called the *va-et-vient*—by means of the travelling or sling life-buoy. But their system differs in the nature of the means employed to throw the line. The merit of the original conception of the rope communication, claimed independently by Manby, in 1807, notwithstanding the priority of Bell in 1791, is assigned by the French society to their compatriot, M. Ducarne de Blangy in 1790. When they took up the question in 1865, they state that England was no further advanced than the Manby-mortar and the Carte-rocket, which did not give satisfactory results; and they adopted the system of M. Gustave Delvigne, who set aside the rockets on account of their great cost and the uncertainty of their direction, and further considered the mortar as of too large a calibre, the frequent rupture of the lines being attributable to the heavy

powder charge; he therefore introduced the system of the bolt or dart, fired from small cannons, swivel-guns, blunderbusses, and muskets, such as are here exhibited. The ranges obtained by these different weapons and projectiles, are stated to be as follows:—Eighty metres for the musket, 120 to 150 metres for the larger shoulder guns, 300 metres for the small cannon, throwing a bolt of five kilogrammes, and 450 metres for the larger one, with a rocket missile, weighing 10 kilogrammes. The length of the hawser and whip-line supplied is 240 metres, or about the same as used by the Board of Trade.

Both the English system and the French improvement thereon, as above described, rely, it will be observed, on a single line for the original effort at communication: at the stand of Messrs. Rogers and Anderson, in the immediate vicinity, may be examined the still more modern system of the double-line or "rove-rope" communication, which is the patented invention of Mr. John Banting Rogers. The fire-arm employed in this system is a small mortar, with a light powder-charge; the projectile is a cone-block shot, *i.e*, an ogival headed cylinder with a sheave or pully recessed into its rear-end; and the double line is passed or rove through this block-shot, the free ends uncoiling easily, during flight, from two tubs or pin-boxes, placed at a little distance on each side of the gun. In this manner the subsequent operations are simplified and made more easy, and the life-saving party on shore are enabled to effect the work—when once the block is made fast to the wreck—of hauling out the hawser and establishing the communication by means of the travelling or sling life-buoy, which is is common to this as well as to the other two systems. The inventor also contemplates and recommends the use of his double-line system, as a means of hauling out life-boats from the shore, to gain an offing in the teeth of storm and surf; and for this purpose substitutes, in lieu of the cone-block shot, a heavier or tri-fluked grapnel or anchor-shot, likewise provided with a sheave in its rear-end. A further important application of this system arises as a part of the outfit of all ships, enabling their crews, in case of wreck on a coast line, to obtain and establish a communication for themselves, thereby increasing their chances of safety. This employment of such an apparatus has been too much overlooked, and among the many improvements demanded in the mercantile marine, there are few which are more needed than the compulsory provision of some such appliances, as part of the ordinary sea-going equipment.

The life-saving apparatus, to which I have referred, constitute almost the most interesting feature of this exhibition, not only on account of their humanitarian objects and importance, but also because they are solely and peculiarly maritime and international in their character and aims.

Another class of appliances having a similar object comprises swimming and floating dresses, life-belts, cinctures, and the like, which are here very well represented, and are of two kinds, viz., of india-rubber inflated with air, and of cork, covered or uncovered; such as the Natateur Gosselin, the life-belt and safety mattress of M. Gay-Hilaire, the Boyton dress, Forster jacket, Goudie coat, and the cork life-belts, buoys, mattresses, &c., of Messrs. Rogers, Birt, the Royal Humane Society, Board of Trade, and French Société Centrale de Sauvetage des Naufragés. Of these various apparatus and apparel the general character is sufficiently well known to render particular description needless; but the palm of novelty and efficiency may perhaps be fairly awarded to the Gay safety mattress, which has been recently introduced to the notice of the French Marine, and of seafaring interests generally, by its inventor and patentee at Marseilles. A special commission of naval officers appointed by the Admiral Marquis de Montaignac, Minister of Marine and the Colonies, has subjected this appliance to a series of experimental trials at Toulon, and they award to it the merit of superiority over all the like means at present used in the service. This result has been confirmed by similar tests, organised and carried out on the River Seine during the past week, and attended by official representatives of various public departments, ministerial and other functionaries interested in the subject. M. Gay-Hilaire's mattress doubles up longitudinally so as to form a life-belt, which can be rapidly fastened on: it is adapted for use in the ordinary sailors' hammocks, &c., without inconvenience, being neither hard nor inelastic; and as the occupant, when suddenly aroused by any signal of alarm, can take out the safety mattress, and attach it as a cincture, within the time of one minute, and as, moreover, its buoyancy and power of flotation are adequate to the support of three or four adults, while allowing perfect freedom to the movements of the wearer, there can be no doubt that this is a most valuable addition to the means for saving life in all casualties on sea or inland waters. Being so constructed that the cork is in detached masses, contained within impermeable envelopes, and therefore impenetrable to wet, immersion or partial injury have no damaging effect on its serviceable character. The importance of every individual member of a ship's crew and passengers having thus at hand an efficient and readily available means of adding to the chances of success and safety in a time of peril, can hardly be exaggerated; and records of recent maritime disasters are not wanting to make manifest the universal interest which all such inventions possess, not only for seafaring men, but for all members of every community.

In this connection I may also give brief notice to two kindred exhibits, designed and adapted to promote the same objects, viz., the safety of life at sea; I refer to boats and boat-lowering apparatus. Under the former head I find here the insubmergible deck-seat life-raft, of Mr. George Frederick Parratt, with which, as your readers will doubtless remember, some successful trials were made on the Thames some three or four months ago, and the collapsible life-boat of the Rev. E. L. Berthon, of which several have been supplied to the latest British Arctic Expedition, the centre of so much hope and interest at the present moment. Under the latter head I observe also two representatives, namely, Hill and Clarke's disengaging apparatus, for hooking and unhooking ships' boats, which have met with much favour in the British Navy, having been fitted, among other vessels, to the *Serapis*, *Alert* and *Discovery*, *Challenger*, Royal yacht *Osborne*, *Bellerophon*, *Raleigh*, &c., besides most of the ships employed for laying submarine cables, such as the *Great Eastern*, *Faraday*, &c., and the ironclads and other vessels of minor foreign navies, Chili, Mexico, Argentine Confederation, &c. The other, and more recently introduced exemplar of this useful appliance is Messrs. Roger and Anderson's slip and catch-hook boat-lowering tackle, a very simple, ingenious, and effective apparatus, specially adapted to the capacity and comprehension of the ordinary seaman. These two boat-lowering hooks are characteristic representatives of two different systems, the former of the automatic action, by which the result, in launching and letting go the boat, is entirely independent of human agency, and secured *ipso facto* by the boat's being fairly water-borne; while the latter secures simultaneous detachment at both ends, solely at the will and discretion of one individual, the officer or coxswain in command or entrusted with the duty. I may add, in regard to the Rogers hook, that one special application for which it is particularly adapted is as a mooring hook or attachment for ships in a stream or tideway, and also as a towing-hook for steam-tugs, the attachment and detachment being singularly rapid, simple, and under control.

Those who recall to mind the *Northfleet* Fund Exhibition at the "London Tavern," will recognise many of the exhibits and names above referred to as old friends, re-appearing with the additional and valuable stamp of the test of use and experience in practice, mostly, however, of English origin, which is not, perhaps, to be wondered at. What may not unnaturally excite surprise

and comment is, as I have already pointed out, the fact that objects and articles of this secondary and subordinatt nature—excellent and serviceable of their kind though they may be—should be the most important illustrative exhibits, entitled to claim the attribute of "maritime," in the British section.

Throughout all the rest of the building there is but one important exception to the same rule, and, warned by the exigencies of your space, I must close my notice with the details thereof—I allude to the stand of M. Bazin, naval contractor and marine engineer, of Angers. Here alone, according to my estimate, is to be found a series of objects justifying the name, and fulfilling the objects implied in the terms "maritime and fluviatile." In mitigation of my comments, I feel bound in justice to make known, that in the scheme or programme of the undertaking, everything contributing in any way to fabrication, alimentation, and exportation, as raw and manufactured articles and materials, was specified as admissible. That explanation it is competent to every-one to assess the value of, for himself; but there can be no doubt of its comprehensiveness, of the wideness of the field opened, or of the elasticity of the margin indicated thereby.

It is not too much to say that, for variety and practical ingenuity of invention, the extensive stand and numerous exhibits by M. Bazin may claim to rank with any that are now memorials of the past and records of the palmy days of the Exhibitions of 1851, 1855, 1862, 1867, and 1873; they go far to redeem the character of the present enterprise, and concentrate the major part of the attention of the visitors, more especially at such times as the inventor gives his frequent *conférences* in explanation thereof, illustrated by experimental demonstrations; for large tanks are prominent features on the stand, and enable the principles of the *Extracteur* and *Navire Express* to be fairly understood and estimated. But probably that portion of the display which is of most general interest, and of most exceptional curiosity, is the "Musée de Vigo," comprising all or most of the objects brought up from the depths of the sea in the bay of that name, as relics of the famous Spanish galleons, or treasure-ships, of historical renown, which were sunk to avoid capture by the English in 1702. As these sub-marine explorations—which were executed by M. Bazin, commencing in 1869, during several years, interrupted by the Franco-Prussian war, ending in 1872—were the actual field wherein many of his inventions for sub-aqueous engineering received their baptism and development in practice and experience, a few brief preliminary particulars of their occasion, associated as it is with a notable event in British history in very stirring times, may not be deemed uninteresting or out of place.

The Spanish convoy, bringing the half-yearly tribute from Mexico, consisted of 13 or 14 galleons, with treasure stated at 450 million francs (18 millions sterling), was escorted by a fleet of three Spanish and 15 French men-of-war. Their destination was Cadiz, but that port being closely blocked they coasted Portugal, and took refuge from the pursuit of the British and Dutch fleets, under Admirals Hobson and Rooke, and Sir Cloudsley Shovel, in the Bay of Vigo. Being there attacked, 14 ships were sunk, and the rest either burnt or captured; none of the treasure, however, fell into the captors' hands, part having been transferred to the shore and saved by the Spaniards, while the remainder, estimated at one-half the entire amount, was either sunk in the ships or thrown overboard, and has been submerged for 173 years; as nothing is more certain than that nothing has, down to the present time, ever been discovered. A French company was formed, about six or seven years ago, for the exploration of the bay, under the presidency of the Duke de Fitz-James. The results were the discovery of 12 wrecks, and the recovery of a large number of miscellaneous objects belonging to armament and cargo, indicating the character of the sunken vessels as galleons and men-of-war. Guns, powder and shot, mahogany logs in a perfect state of preservation, dye woods, indigo and cochineal, together with a vast number of articles belonging to a ship's outfit, were the sole reward of the active and difficult researches carried on at depths varying from shallow water to 20 metres (about 11 fathoms), and buried in from one to six yards of sand. Traces of the precious metals have been found in several of the metallic masses raised, and it is stated that five silver ingots, of which one weighed 77 lbs., were recovered from one of the galleons. There remain several wrecks unexplored, lying in considerably deeper water, in what is known as the Bay of St. Simon. Under all these circumstances, notwithstanding the enticing character of the speculative possibilities of further and more extended research, it is not to be wondered at that, like the galleons, and from the same causes, though in a different sense—pecuniary causes—the company itself foundered, failing funds; and, in fact, I believe the enterprise is at present in the hands of an English association.

Nevertheless, though in point of financial results, the undertaking was a disastrous failure, it may yet be regarded as a great success, as regards the means and capability of conducting such subaqueous operations, under circumstances of incertitude and difficulty. For such work, it is obvious, special appliances are requisite, and these M. Bazin has supplied, and now exhibits.

We see, for example, his submarine observatory, in which descents have been made to the depth of 80 metres, or 44 fathoms, or over 250 feet. This resembles in appearance the captain or pilot's tower on board a monitor, and consists of a stout iron cylinder, closed top and bottom, and fitted with a man-hole suitably made secure, and also with strong plate-glass lights, permitting inspection of surrounding objects. It is, in fact, a kind of closed diving bell, capable of accommodating one or two men, provided with the necessary air-pipes for maintaining the constant essential supply for respiration from an air-pump at the service, and having also a speaking tube for communication with the attendants above, and all other requisite appliances for a descent of some duration in deep water.

Next may be enumerated M. Bazin's submarine electric lantern, a most efficient and valuable aid, indispensable for such operations as those in question. Of course the electric apparatus and illuminating points are hermetically enclosed in a suitable metallic case, mainly spherical in shape, and fitted with thick "eyes" of plate-glass, whence the rays may issue. Not by any means the least curious of the interesting collection of drawings exhibited by M. Bazin, are the paintings and photographs representing work being carried out at the bottom of the sea, by the light of the electric lantern. These were all taken from the actual operation itself.

Much of the exploration really executed was carried on by divers, suitably attired in divers' dresses of the well-known existing types; these, however, not being displayed here by M. Bazin himself. But when the nature and conditions of the work are considered, it is obvious that for the removal of the accumulated deposits of 170 years something more than, and very different to, the ordinary dredging-machine, or even the improved types developed by M. de Lesseps at the Suez Canal, was requisite. This M. Bazin supplied in his "extracteur," the technical description of which would prolong this account too much. Briefly, it is a steam-vessel, with special machinery and appliances also actuated by steam, only that the actual dredging is automatic and effected by the pressure of water outside the hull, due to the head or height from the bottom of the hold to the surface water-level. By making openings in the bottom of the hull, and establishing a communication by suitable pipes with the bed of the sea or river whence accumulations of deposit have to be removed, a strong upward current or

flow of water is established in the pipe, which, thus acting by suction or extraction, sweeps away and carries up with it all sand and mud and such other solid matters as are capable of passing through the mouths, orifices, or pipes, delivering the whole mass of mixed fluids and solids at the bottom of the ship's hold, whence it is excavated and discharged, by powerful centrifugal pumps, into lighters lying alongside, for removal and delivery elsewhere. This application and utilisation of hydrostatic pressure and the resulting hydraulic force are not more ingenious and effective than they are novel and beautiful; and the most convincing practical testimony to their worth is given daily by working models of the Extracteur Bazin and the apparatus, in the tanks provided here for the purpose. Suffice it to say that such a steam-dredger of 80-horse power will remove about 320 cubic yards of material per hour, at an estimated cost of 2½d. per yard cube. It will of course be understood that the work done will vary according to the circumstances of the case, and the nature of the bottom, there being definite limiting conditions of depth and hardness. I may add that provision is made by a revolving forked appliance, called a "désaggrégateur," to break up and loosen an indurated bed of materials.

I pass by the two models of express steamships for ocean and river service, as based on scientific principles of too recondite a nature to be briefly set forth; and moreover, as being subjects for a future, more or less remote, rather than examples of a past or present. Meriting passing notice are the Bazin logs for registering and determining a vessel's speed; one of these is hydraulic, and the other electric, in its action; the latter is an adaptation of the anemometer of Robinson, with its four cups, and sound and ingenious principles, being also provided with a thoroughly effective method of isolating the electric currents and contacts from the action of salt water, otherwise fatal. As a current-meter, and *pari-passu* velocity measurer, this apparatus, as the French say, leaves nothing to be desired.

On the subject of his submarine cannon—adapted for broadside or end-on fire, and throwing, or stated to throw, with accuracy, a projectile of 750 lbs. weight to a range of several hundred yards—the inventor is strikingly reticent, being understood to be in treaty with the French Government, and I am unable, therefore, to dilate thereon. This also is an offensive weapon of the future rather than an accomplished achievement, nevertheless, possibly big with the fate of massive monitors and ironclads generally, as gunpowder was with the fate of body-armour for combatants by land.

A brief enumeration of M. Bazin's remaining exhibits, the monitor, buoy-ship for raising wrecks, rope-spinning, safety collar, and projectiles with prolonged trajectory, comprising one rifled shot within another, must suffice for the rest.

The foregoing constitute the bulk of the essentially maritime objects displayed at this Exhibition. Of all the others there are many, especially in the machinery section, which are noteworthy in themselves, but the limits of space at command preclude my giving them their due.

During the month of July the progress at the St. Gothard tunnel was as follows:—Length driven from north side, 113·40 metres; length from south side, 127·20 metres; total length driven during July, 240·60 metres. The position of these works on the 31st July was as follows:—North side (Goeschenen), 2,330·90 metres; south side (Airolo), 2,103·70 metres; total length driven, 4,434·60 metres; length remaining to be driven, 10,485·40 metres. Total length of tunnel, 14,920·00 metres.

At the Champs Elysées in July, 1876, will be held an exhibition of the applications of electricity to industrial and domestic purposes. Information will be given on application at the offices of the exhibition, rue de la Victoire, 86. A special exhibition of improvements in railway appliances has also been proposed to be opened in Paris next year.

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the months of July and August, 1875. When they are counted by sight the words "by sight" are used, when by turnstile the word "machine":—

	Amounts voted in 1875.	Number of Visitors in July.	Number of Visitors in August.	How counted.
	£			
1. British Museum	17,471	42,043[1]	52,353	(by sight).
2. National Gallery[2]	6,346	98,634	105,536	"
3. Kew Gardens and Museum	4,273	67,895	166,778	"
4. South Kensington Museum	39,019	79,182	...	(by machine).
5. Bethnal-green	7,325	42,390	...	"
6. National Portrait Gallery	1,956	...[3]	...	"
7. Geological Museum, Jermyn-street	9,070	2,510	...	"
8. Patent Office Museum	...	20,553	24,510	"
9. Edinburgh National Gallery	2,100	20,966	19,619	"
10. Edinburgh Museum of Antiquities	...	22,542	18,660	"
11. Edinburgh Museum of Science and Art	10,509	48,879	41,139	"
12. Edinburgh Botanic Gardens	1,750	15,426[4]	14,731	"
13. Dublin Museum of National History	1,717	5,774[5]	6,954	"
14. Glasnevin Botanical Gardens and Museum	2,224	18,873[6]	34,782	"
15. National Gallery of Ireland	2,339	7,358	8,911	"
16. Museum of Royal Irish Academy, Dublin	200	...	...	"
17. Zoological Gardens, Dublin	500	11,867[7]	...	"
18. Tower of London	1,500	37,524	46,414	(by sight).
19. Royal Naval College, including Greenwich Painted Hall	...	30,166[8]	...	"
20. Royal Naval Museum, Greenwich	...	7,290	...	"
21. East India Museum[9]	5,883	...	...	(by machine).
22. Hampton Court Palace[10]	...	...	...	"

[1] Return refused; number given is for corresponding months last year in the Museum Report.

[2] Open from 10.0 a.m. to 6 0 p.m., Monday, August 2nd (Bank Holiday), number of visitors 8,440. Total, eight months, 470,917.

[3] Return refused.

[4] Return for June received late, 15,196.

[5] Returns for May and June received late, 5,673 and 6,0[illegible] respectively.

[6] Returns for May and June received late, 26,786 and 15,5[illegible] respectively.

[7] Sundays, 7,922; week days, 3,945.

[8] Open on Sundays.

[9] Paid for by Indian Government. Admission daily by payment of 1d., except Thursday and Friday, 6d.

[10] Open on Sundays.

Pencils have lately appeared, the writing of which is capable of being copied, more or less perfectly, in the press. They are said to be made of a mixture of graphite, kaolin, and blue violet aniline. The graphite is used in the form of a thick paste, the kaoline in a finely pulverised state, and the aniline in the form of a very concentrated aqueous solution. The whole when well mixed is moulded under the press with cylinders about four inches long, and of the required diameter. Gum arabic may be substituted for the kaolin.

The annual import of Bath bricks into the United States is about 10,000 boxes, 24 bricks in a box. Formerly they went in bulk; but so many got broken that it was deemed advisable to have them securely packed. These bricks are manufactured from the deposits of the river Parrett, Bridgewater, Somerset, where millions are made annually. Nowhere else is this deposit found, so that Bridgewater supplies the world, and Bath bricks are as well known in America, China, and India, as in England.

Extensive deposits of iron have been discovered in the San Gabilan range of mountains in California. Vast iron fields are also known to exist in other parts of the state. It is considered possible, then, that Californian metallurgical industry may now acquire some development.

PRIZES IN INDUSTRY AND AGRICULTURE.

The Société d'Encouragement of Paris has recently published its list of prizes offered from 1876 to 1881 both inclusive. It may be mentioned that this Society bestows annually a gold medal bearing the likeness of some man who has achieved a high reputation in art or science, or is the originator, whether French or foreign, of works which have exercised the greatest influence on French industry during the six preceding years; in 1873 this grand medal of the Society was awarded to our countryman, Sir Charles Wheatstone.

Although all the subjects are open to foreigners as well as natives of France, many would of necessity be confined to the latter. The following items from the long list are likely to have an interest in this country.

A prize of 200 francs in offered in 1880 to the author of the most important improvements in the material and processes employed in civil engineering, architecture, and public works.

Next year a prize of 3,000 francs is offered to the inventor of a motor, of 25 to 100 steam horse-power, not consuming more in regular work than 700 grammes of good coal per horse-power per hour, weighing less than 100 kilogrammes, and costing less than 300 to 400 francs per horse-power.

A prize of 100 francs for a small motor for the use of a home workshop; it must have a revolving arbor, and yield at small cost a power equal from 6 to 20 kilogrames per second; to be awarded in 1878.

In the last-named year also will be awarded a prize of 2,000 francs to the first spinner who shall produce mechanically, and in commercial quantities, linen yarns surpassing 100,000 mètres to the kilogramme, and hempen yarns of 15,000 mètres.

A prize of 2,000 francs is offered in 1879 to the inventor of a machine for combing short staple cotton which has been brought into practical use.

A prize of the same amount is offered for 1880, for a machine for cutting files of all kinds automatically, and which shall have worked for at least three months.

A prize of the same amount is proposed to be awarded in 1877 for the invention of any efficient means of stopping the vibrations caused by steam hammers, and other tools acting by percussion, from being propagated beyond the works in which they are employed.

Prizes of the same amount are offered in 1878 and 1880 for the industrial application of oxygenated water, and for the economic preparation and application of ozone; and in 1876 for fixing the nitrogen of the atmosphere in the form of nitric acid, ammonia, or cyanogene, the object being to obtain practically some compound of nitrogen cheap enough to use in making manure from the nitrogen of the atmosphere, to the exclusion of animal matter.

The Society having been made aware of the resistance of arsenic in sulphuric acid gas, offers for 1879 a prize of 3,000 francs to the first manufacturer who shall produce the acid from pyrites entirely exempt from arsenic.

A prize of 1,000 francs is offered for any new practical application of any cheap, common, mineral substance, and another of the same amount for the utilisation of blast furnace slag, soda ashes, the magnesium salts from chloride of lime, the water of salt marshes; both in 1878.

Prizes of 1,000 francs are also offered, next year, for the useful application of any newly-discovered metal; the same of any non-metallic body; and for any new alloy useful in the arts.

A prize of 3,000 francs is proposed, in 1877, for the artificial production of graphite for making lead pencils. The same sum is offered for the artificial production of the compact black diamond.

The sum of 4,000 francs is offered as a prize, to remain open until 1878, to any one who may discover or invent the means of producing, by chemical transformation, such organic matters as quinine, cane sugar, &c.

The same sum is offered for 1881, for the artificial preparation of the fatty acids or waxes.

A prize of 6,000 francs is proposed for 1878 for a theory respecting steel, founded on actual experiments, and resulting in improved means of directing the manufacture of steel.

A prize of 3,000 francs, set down for 1880, for the disinfection of the residues from gas works.

Three prizes of 1,500, 1,000, and 500 francs respectively, for modes of employing borax and boracic acid in the ceramic arts, 1881.

A prize of 1,000 francs is offered in 1876 for the traction of iodine, contained in the nitrates of soda South America, and the mineral borates and phosphates.

A prize of 3,000 francs is offered, also next year, for the production of cast steel rails from common ores containing from 0·50 to 1·50 per cent of phosphoric acid.

In the economic arts, prizes of 1,000 francs are offered, in 1876, for an industrial application of the endosmose of liquids; in 1877 for the application of the endosmose of gas; and in 1879 for the preservation of fish, flesh, or fowl raw, for at least a month, by a new process.

A prize of 3,000 francs is offered, in 1881, for a process for permanently disinfecting water closets, &c.

A prize of 2,000 francs, in 1876, for the rapid and cheap desiccation of wood without altering its physical qualities.

One thousand francs are offered, in 1880, for an apparatus capable of producing high temperature in home workshops rapidly and economically.

The same sum is proposed, in 1879, for a new application of spectrum analysis to industrial purposes.

A prize of 2,000 francs is announced for a method of preventing soot adhering to chimneys so that they may be completely and easily cleansed.

In agriculture, the following prizes are offered:—2,000 and 500 francs, in 1876, for the cultivation of slopes in mountainous countries; 3,000 and 2,000 francs, in 1876, for irrigation; 1,000 francs, in 1877, for the best study of the agricultural and rural economy of a province or a department; 2,000 francs, in 1876, for works of drainage or embankment; 1,000 francs, in 1880, for the planting of poor lands with a kind of trees not hitherto used for that purpose, and of equal industrial value to those now employed; 1,000 francs, in the same year, for a simple method of stopping the invasions of the phylloxera.

In applied art, 2,000 francs are offered, in 1880, for a good photographic paper, and 2,000, in 1877, for the opening up of new quarries of lithographic stone, at least equal in quality to the best German stone, or for the production of a composition, whether metallic or of any other nature, to replace such stones.

All memoirs, models, &c., must be lodged with the secretary of the Society before the 1st of January of the year in which the prize is to be awarded. Full particulars will be found in the August number of the Bulletin of the Society, which is in the reading-room of the Society of Arts.

M. Degen, of Kriens, has lately used a new description of saw for cutting free-stone into slabs for window mouldings, plinths, cornices, &c., with, it is said, excellent results. The speciality of M. Degen's invention is, that the saw itself remains stationary, the work being performed by drawing the stone to and fro beneath it. Several saws are mounted side by side, at various heights, each admitting of a certain amount of vertical displacement and adjustment.

According to the statistical report of the Swedish Chamber of Commerce, there were in Sweden, in 1873, in all, 31 glass-making establishments. These gave employment to 1,671 hands. The declared value of their manufacture during the year was 2,833,183 kr.

THE RESOURCES AND CONDITION OF SERVIA.

Among the provinces of European Turkey, Servia holds a position that is well-nigh independent of the Sultan's authority at Constantinople. It is bordered on the north by the Danube, which separates it from Hungary, on the east lies Wallachia and Bulgaria, on the south Macedonia, and on the west Bosnia and Albania. The area is 12,600 square miles, and the population in 1854 was 985,000 persons, mostly of Sclavonic descent, and professing the faith of the Greek Church. The ferment that prevails at the present time amongst the Sclav population in the vicinity of the Danube makes it desirable to acquire some knowledge of the countries that are actually affected or lie contiguous to the scene of excitement. It seems that no information with regard to the commerce of the principality has appeared since the year 1869, when a review of the trade to 1865 only was published. The Finance Minister is, however, engaged in the collection of reliable data, and intends shortly to take a general census of the cattle as well as the inhabitants of Servia. The series of consular reports furnishes an appropriate idea of the description and extent of its commerce, with a general outline of the productive features of the country.

It appears that the exports had risen from a value of £842,891 in 1864 to their maximum amount of £1,576,006 in 1868, when they decreased again to £1,410,988 in 1869, to £1,274,809 in 1870, £1,151,140 in 1871, and £1,415,871 in 1872. The great preponderance in the exports of agricultural productions reveals the character and capabilities of the soil of Servia. Animals and skins form always from between three-fourths and four-fifths of the total, and of the animals three-fourths are pigs. The corn that is exported is generally 3 per cent. of the whole exports. A good harvest has generally little effect on the exports of corn, the surplus being consumed by the pigs before leaving the country, thus enhancing the value of the animal exports. The exports of grain during 1872 amounted only to a third of the total exports; but importation, strange to say, was three times larger, and this, in a country three-fourths of the surface of which is uncultivated, would seem an unaccountable anomaly. Of the imports of corn and flour, four-fifths are flour, which has been sent to be ground in the mills on the Austrian bank of the Danube. Three or four small flour mills have lately, however, been built in Servia, which, working by steam, will most likely soon do away with the primitive water-mill still in use. The next greatest export is wool, which averages £60,000 worth a year. It is of very middling quality and unwashed. Then follows tallow for about £10,000. The other items, such as honey, sheep, cheese, dried plums, leeches, &c., are for very small amounts. Silkworms' eggs, which were tried in 1864 and 1865, not having returned any profit to the Italians who introduced them, the culture has been discontinued. Between 2 and 3 per cent. of the exports are spirits made from the plum. This goes into Austria to be rectified. A very prominent article are the staves of casks collected from the forests, £13,000 worth being exported yearly. Amongst the minerals, salt is the greatest article, being more than all the others put together. It is not, however, produced in the country, but passes from Wallachia, through Servia, into Austria, by the process of smuggling. It should, therefore, be deemed as appertaining to the transit trade. The copper mines of Maidanpek, belonging to an English company, are now producing about £13,000 worth of copper yearly. This quantity, however, could be very greatly increased. The copper is principally sold in this state at Pesth and Vienna for about £5 the cwt. Under the head of imports it appears that the quantity of wine, beer, and rum imported is only to the value of £20,000 a-year. The half of this amount is in beer, which comes from Austria, and is consumed in Belgrade and the two or three towns on the banks of the Saxe and the Danube. It is seldom to be found in the interior of the country, the peasant drinking bad native wine and plum brandy. Small quantities of tobacco of an inferior kind are grown in Servia, but this does not amount as yet to a quarter of what is used. Timber for building purposes is mostly brought from Bosnia. Cotton goods and yarns are the only imports that interest England directly. The trade in these goods has very largely increased of late years. In 1864 it was only £2,060, and now it reaches £30,000 worth yearly. There are several Belgrade merchants who have direct trade with Manchester. Leather, to the amount of £15,000 worth, is used annually. The skins go in a raw state to Austria, and are then returned tanned. Dried fish is brought from Trieste. Though Servia is very rich in minerals, much more metal is imported than exported. There are besides, ordinary colonials, such as coffee, sugar, rice, and oil, dried fruits, pepper, almonds, &c. Manufactured goods, as men's and women's ready-made clothing, silks, ribbons, &c., from Switzerland; linen from Bohemia; cloth, mostly from Austria; and other articles from Nuremburg.

The pig trade, which amounts to nearly one-half of the value of the whole exports of the country, deserves some special mention. In 1864 the number of pigs exported was 158,745; in 1865 it was 251,777; in 1870 it reached 368,313. Compared with former years, the exportation of 1872, in this the chief industry of the country, shows much improvement, the number exported being 472,70[illegible], valued at £636,702. The value of these exports, it appears, may vary with the condition in which the animal, whether fat or lean, may reach the depôt at Steinbrück, near Pesth, in Hungary, where more than [illegible] pigs from various parts are fattened yearly. According to a report published by the Hungarian Company, to whom the feeding-place belongs, there were fattened there in 1870 a total of 526,730, of which 256,320 were from Upper Hungary, 55,340 from Transylvania, [illegible] from Servia, the whole valued, when killed, at [illegible] Austrian paper florins, or about £3,000,000 sterling. All these pigs were melted down for their fat. They are not what is called a flesh race, and so are useless for salt pork for the navy. The sort of pigs, such as the Russian, Polish, and English races, do not seem to be appreciated in these countries, the pigs being simply valued for the quantity of lard they can be converted into. Most of this fat is consumed in the Austrian Empire, as of [illegible] pigs sold in 1870 from Steinbrück, only 88,260 were exported into Prussia. The Servian pig seems to hold its place well, as though there is more bone and offal comparatively than with finer breeds, still it seems to fatten better, taking into consideration the weight and quality of the food. Age also may have something to do with it, as the pigs are generally two years old when exported from Servia. During September, October, and November the pigs are fed on acorns, but the chief food when a scarcity occurs is such pasture as the fields and forests afford during the remaining nine months. They are also fattened upon maize when the season is favourable.

The soil of Servia is fertile and productive, but three-fourths of its surface are uncultivated. There is coal and no lack of mineral resources beneath, but the mines have only just began to be worked, concessions having been made to two English companies. Worst of all, perhaps, is the almost total absence of native skill and industry. What the people most indulge in since the Turks have been dispossessed of this fine province is an exemption from labour, which, as it was formerly for the sole benefit of their task masters, was naturally considered as an unmitigated hardship. It might, under these circumstances, have been a wise policy to have encouraged immigration from more civilised countries in their neighbourhood, by which land in thinly populated districts would have acquired a more than nominal value, and the Servians themselves have been

stimulated to exertion by salutary example and competition. So far, however, the only encouragement of the kind is extended to swarms of itinerant artisans (courlatgees), a class of rough, unskilled architects, masons and carpenters, who flock thither every year from the adjacent Turkish provinces of Albania and Macedonia. To these the rural population, consisting of nine-tenths of the inhabitants, is entirely indebted for the construction of their houses and cottages, their earnings being, at a moderate computation, estimated at £200 000 a year. To this annual drain may be added the loss arising from neglect of agriculture, three-fourths of the land lying uncultivated from the unwillingness of the free Servians to work either as servants or farm labourers. Nor is this all, by the wasteful extravagance of these peasant lords of the soil, the fine forests of the country have been to a great extent devastated, and that at a time when the slender capital of the merchants has been devoted to speculative schemes of forest exploration in Hungary.

There is no doubt that the internal trade of the principality suffers much from the want of communication. Consul-General Longworth has endeavoured to make as exhaustive a review of the national resources as possible, believing it may interest railway contractors and financial companies who are at this moment occupied with projects of railroads, by which facilities of communication and transport to connect them with the network of the Ottoman Empire could, as well as the internal prosperity of Servia, be so materially promoted. The success of enterprises of this nature must, in great measure, depend on the confidence felt in the credit and the guarantee the Government can offer. It would, however, he thinks, be idle to look to sound financial views in a country like Servia. The peasant parliament (Shapechtina), by whom the Government is, to a certain extent, controlled, have very narrow and superficial notions of the public interest, though some few of its members, and among these officials educated abroad, may be more enlightened; but the serious reverses—agricultural and commercial—consequent on a failure of crops for three successive years, have awakened more attention to these matters. They began to see the only effectual remedy will be the establishment of a national bank (a bank of issue in notes and of discount) by which the credit of the country may, through the responsibility of the Government, be placed on a satisfactory footing, and foreign capitalists, by the security thus offered, be led to contribute to a more intelligent development of its ways and means. These must by this time have been more or less appreciated by the agents of European financial companies who have lately visited Belgrade in quest of railway concessions. They must have seen on what abnormal foundations the national credit reposed, these being almost entirely of a negative kind. The Government, it is true, has no debt, neither has it, on the other hand, the slightest financial experience, nor has foreign enterprise, by investments to any extent, yet acquired an interest in its prosperity.

Experiments have lately been made upon a small private line of tramway leading to the quarries at the foot of Mount Avron, near Neuilly-sur-Marne, with a new noiseless and smokeless locomotive, worked with a mixture of hot compressed air and steam. It was found that 800 litres of atmospheric air, compressed and heated, sufficed to move a car containing twenty-five persons, and itself weighing 4,500 kilogs., over a distance of 3 kilometres.

The space of 45,000 square feet has been allotted to Great Britain and her colonies in the Centennial Industrial Hall, but the mother country alone has made applications covering 60,000 square feet, and Canada wants 30,000 more. This is double the original allowance. In addition to this, the carpet industries have asked for 27,000 square feet of hanging room.

THE PROGRESS OF INDIA.

For several years the authorities at the India Office have laid before Parliament reports showing in a compact and tabulated form the moral and material progress and condition of India. The one printed last year dealing with 1872-3, to which the name of Mr. Clements Markham is attached, was a most valuable compilation, presenting a complete synopsis of the moral and material condition of India at the date of which it refers. It would, of course, be not requisite, and indeed not advisable, to re-issue a bulky report of 200 pages year by year, which would necessarily be in great part a mere repetition of statements already published. It will be quite sufficient if a new addition be forthcoming at intervals of five or six years, the intermediate numbers bearing the character of a supplement or appendix bringing the information augmented and corrected down to the latest accessible date. In accordance with this view, we are now presented with a modest paper of 30 pages, in which we can, at a glance, satisfy ourselves as to the progress made during the past year in any of the 15 sections into which the statement is divided.

The most important subject connected with our administration in India is the Land Revenue. After nearly two years' deliberation, the Revenue and Rent Acts for the North-West Provinces have at length been passed, a measure much needed, not only to introduce valuable reforms, but also to codify and define the practice previously existing. It is greatly to the credit of the Indian Government that it has for some years past been compiling, arranging, and sifting the heterogeneous materials on which depend the present state of the law on almost every subject. If there be a subject on which it is important that the law should be clear, concise, and admit of no dispute, it is this which regulates the daily life of the great mass of the people. Among the changes introduced by the present Act the most important empowers the tenant to obtain a lease for a term of years. It has hitherto been in the power of the landlord to sue for enhancement of rent every year; and if he could show sufficient cause he was entitled to claim the enhancement. This perpetual vexation and annoyance to the tenant are now checked, and an enhancement once granted cannot be further increased for a term of ten years. Another important change is the distinguishing between the rights in the land held by a proprietor as such and those which he can claim as the cultivator of his field. In case of legal sale of his proprietary rights on account of failure to satisfy the Government demand, he may still retain the rights of occupancy as tenant, of which under the previous law the sale would have deprived him. The question of the compulsory sale of their proprietary rights on account of the debts of the cultivating classes has been attracting much attention, and has a special interest now as being the assigned cause of the recent outbreak in the Bombay Presidency. It has been said that various circumstances, but mainly their own improvidence, bring them into the power of the money-lenders, whose usurious demands it is impossible for them to satisfy; and they sink deeper and deeper into difficulties until their ancestral estates are brought to the hammer. Considerable difference of opinion exists both as to the amount of the hardship and its remedy.

The notice of the land tenure naturally leads us to the subject of the Bengal Famine. Without here entering on any of the vexed questions relating to the mode in which the difficulty was met, we remark with satisfaction that the fears which had been expressed lest the administration of relief on a large scale should tend to demoralise the people, have proved to be groundless. To improvements in agriculture, to better means of irrigation, and to increased facility of intercommunication, we must look for the preventives of future scarcity, and everywhere we find that the Government is giving its attention to these matters. The irrigation works in Orissa, so lately ravaged by famine, are rapidly advancing. Sir Richard Temple

considers that the completion of the present system of canals will entirely protect that province in the future. It is estimated that the value of the grain saved by the Soane and Midnapore canals, incomplete as they were, must have been at least £600,000. Canals, however, are not an unmixed blessing, for we find that the Madras Government has determined to assign an annual sum of £10,000 for works of drainage, in order to check the malarious fever, which is directly attributable to the Government irrigation works. Nor are other means for checking malarious fever neglected. Good accounts are given of the state of the Government plantations of chinchona. In the Nilgherries they had passed through a trying season, but their condition was satisfactory. In Burmah 86 per cent. of the plants set out were well established, and in Sikkim the plantations are said to have passed beyond the experimental stage, and to offer a good return for the care and expenditure bestowed on them. In Sikkim alone the Government has 2,000 acres under cultivation, and the anticipated annual supply of dry bark will, after 1877, be 150,000lb. The example set by Government in well-conducted model farms and plantations is of the greatest value, and we are glad to hear of the establishment of an experimental farm at Bangalore under the superintendence of a graduate of the Royal Agricultural College at Cirencester. The first of a series of Agricultural Exhibitions in the Madras Presidency was held on the Sydapet farm in February, 1874, with satisfactory results. Cattle fairs were established in various parts of the Punjab, and in Burmah agricultural shows were held in several districts. As a matter of course, the people supposed these gatherings to be preliminary to the imposition of new taxes, but with proper explanations the feeling passed away. From Bombay it is reported that no marked improvement in agriculture is visible, and that the native processes, though rude, are generally better suited to the country; and, again, that English ploughs have been tried, but that the native instrument appears the best adapted for the soil. We confess it hard to concur in the latter assertion. That the native processes and instruments best suit the prejudices of the people we are willing to admit; but even though it be neither possible nor desirable, as stated, to plough deeply, it is difficult to acquiesce in the opinion that the country implements cannot be improved upon. Another singular statement comes from the same source—namely, that "as the great bulk of the people do not use animal food, cattle are maintained only in such numbers as are necessary for cultivation and carrying purposes, and are too few for properly manuring the land." It is not the paucity of animals, but the almost universal use of the manure for fuel, which tends to impoverish the land in this respect.

It is not only in the rural districts that the necessity of a good supply of water has been recognised. Throughout the country the working of the various Municipal Acts has been watched with much interest; and in the Presidency towns we find that the municipalities have been chiefly engaged in improving the water supply, one of the principal, and at the same time one of the most neglected, necessities of Oriental cities. In Calcutta, pipes from the water-works had been carried into 7,160 houses, an advance in civilisation only to be appreciated by those who can remember how but a short time ago every drop required for domestic purposes was brought in leather bags on the backs of men. In Madras, 39 miles of piping have been laid, communicating with 133 public fountains and 55 private houses. In Bombay the water is supplied by pipes communicating with the Vehar and Tulsi lakes. A natural concomitant of the supply of good water is an efficient scheme of drainage, and in carrying out this the municipal authorities appear to have been equally energetic. Great efforts have been made to introduce the system of local self-government wherever practicable throughout the country, and the Acts directed to this object are said to be working well. Another experiment in local taxation has proved equally satisfactory. The Road Cess of Eastern Bengal, which at one time threatened to meet with some difficulties, has proved a complete success. Its introduction has been accomplished with great facility, and it affords rich districts the means, often urgently wanted, of making and repairing their roads, and opening and maintaining their waterways. Improvement in the means of intercommunication is the most crying necessity in many parts of the country, and it is reassuring to learn that effective measures have been devised for overcoming the evil. Improvement in water communication has not been confined to the inland channel. The important work of shortening the route for vessels proceeding to the East coast of India, and avoiding the necessity of rounding Ceylon, by deepening the Pamban Channel between the island of Rameswar and the mainland in Palk Strait, which has been in progress for fifty years, has been so far carried out that the main channel is navigable at neap tides for vessels drawing 11 ft. It is proposed to deepen it to 14 ft., beyond which labour would be thrown away, inasmuch as the approaches on either side are too shallow to admit of vessels of greater draught making use of this passage. Another important work is a canal to connect the Pegu and Sittang rivers, rendering practicable throughout the year water communication between Rangoon and Toungoo, which will lead to a gseat development of the agricultural industry of the province.

We may remark, in conclusion, that the preceding number contained several useful maps. In general more may be learnt in a few minutes from a well-constructed map than from a protracted poring over figures of statistics. It would be well if in future the use of maps were freely resorted to in representing the moral and material as well as the physical, condition of the country. Many subjects, such as religion, education, trade, crime, &c., admit of chartographic treatment with as much facility and benefit as the rainfall, thermal lines, and prevailing winds of a country.—*Times.*

NOTE ON THE MANUFACTURE OF ANTHRACITE COKE IN SOUTH WALES.*

The high calorific power of anthracite, consisting as it does of nearly pure carbon, and the low percentage of sulphur and ash contained in most varieties, naturally render it of great value as a fuel in the cupola and blast furnace, while from its abundance in many districts, and the cheapness with which it may generally be worked, it should at once be the best and the cheapest fuel that could be used. The practical drawbacks to its use, which diminish its value, and to a great extent restrict its employment, are the difficulty of utilising the slack, or small anthracite, of which a good deal is made in mining and handling, and in breaking the large pieces, and the tendency of many anthracites to split up into small particles if suddenly heated. In the blast furnace this decrepitation is especially injurious, as the fine dust is apt to form, together with the cinder, pasty masses that can neither be melted nor burned away, and may choke the furnace up or seriously derange its working.

These difficulties in the way of using anthracite generally, in its natural or raw state, have led to many attempts to make it into a serviceable coke, by using it in admixture with greater or less proportion of binding coal, pitch, or other bituminous substances. None of these attempts, until very recently, appear, however, to have been commercially successful; none, at least, of those made in South Wales, have been carried out largely or continuously; as though coherent coke was made, it was friable and of inferior quality.

The samples exhibited would appear, however, to show

* Paper read by Mr. W. Hackney, B.Sc., A.I.C.E., before the Iron and Steel Institute.

that the production, on a working, of a hard and sound anthracite coke, is not at all impossible.

They are fair specimens of the coke now being made by the process of Messrs. Penrose and Richards, of Swansea, to whom the writer is indebted for them, as well as for the information as to the mode of manufacture, and the characters of the coke obtained, on which the present note is based.

The materials used are anthracite, or semi-anthracite, if free from shale or stones, good bituminous or binding coal and pitch, in the following proportions:—

Anthracite....................	60
Bituminous coal	35
Pitch	5
	100

Specimens are on the table of coke made of Messrs. Brock and Sons' anthracite, from Cwmllynfell colliery near Cwm Amman; of a mixture of this with Yniscedwyn anthracite; and of culm or semi-anthracite from Birch Rock colliery, near Pontardulias. The bituminous coal used in making all the samples is that from Tyrissa colliery, near Swansea.

The materials are passed, together, through a Carr's disintegrator, to crush and mix them; the proportions in which they are mixed being regulated by supplying the feeding hopper of the disintegrator by the elevators, one carrying up each constituent, and each provided with buckets of such size and number as to bring up the relative quantity required. Samples are shown of the anthracite, bituminous coal, and pitch, in the condition in which they are supplied to the disintegrator, and of the crushed mixture produced.

The ovens used are of the oblong shape, generally employed in South Wales; 15 feet long, by 5 ft. 7 in. wide at the back, and 6 ft. 2 in. in front, and 4 ft. 4 in. high to the under side of the arch. Each oven is charged, through a hole in the roof, with about four tons of the crushed mixture; this is levelled by a rabble put in through the door at the end, and a small quantity of bituminous coal, sufficient to form a layer about two inches thick, is thrown in and spread uniformly over the surface. The oven is then lighted, by throwing a few shovelsful of hot embers on the top of the charge immediately inside of the door, and the coking is managed as in working an ordinary charge of bituminous coal. The object of covering the charge with a layer of bituminous coal is to prevent the burning away of the pitch, and its use appears to be essential for the production of a hard and strong coke. Ordinary slack, of the same quality as that in the mixture, is used for the covering; this is mostly very small, but is not specially crushed.

Rather more than two charges per week are made in each oven; the coke is watered in the oven, and is then drawn out in one mass, by a chain and hand winch.

The yield of coke is 80 per cent. of the weight of the charge. The coke is steel-grey in colour, and very much harder than the anthracite from which it is made; so hard, indeed, that it scratches glass with comparative ease. In a common fire, or under the action of a blast, it burns away without showing any tendency to crumble or decrepitate. It is about 23 per cent. heavier than the best coke made from Welsh bituminous coal; so that in sending a cargo abroad recently, a vessel that could not carry more than 240 tons of ordinary coke was able to take in as much as 310 tons of anthracite coke. Another valuable consequence of the dense compact character of the coke, in addition to the saving in cost of carriage, is that even if soaked in water it takes up very little, only from 1·5 to 2 per cent. of its weight; while many kinds of ordinary coke absorb readily 10 per cent. or more. The coke is harder and more dense, the finer the materials are crushed and the more intimately they are mixed.

In practical use, both in the cupola and in the blast furnace, the coke, so far as it has been tried, has given remarkably good results. These are probably due in part to its hardness and density, or rather to the high temperature required to set it on fire, which brings the zone of combustion closer to the tuyeres, and diminishes the waste of fuel in the upper part of the furnace, caused by the transformation of CO into CO_2; and in part to its freedom from water, and the small amount of ash that it contains.

In a small foundry cupola, in which 1 lb. of good Welsh coke, that from Bryndu, near Bridgend, melts 10 lbs. of iron, 1 lb. of anthracite coke melts 16 lbs., and the metal is hotter when tapped out; and in a trial carried out at Messrs. Tangye's Works, near Birmingham, anthracite coke melted well with 25 per cent. more burden than that placed on ordinary coke, and would probably have done more, but the managers were unwilling to run any risk of deranging the working of the cupola, and did not push the experiment further.

In a trial made in one of the blast furnaces at Landore, working on spiegeleisen, the burden, in using anthracite coke, was increased 28½ per cent., and the economy might probably have been raised to 30 per cent. or more, but the stock of coke in hand was not sufficient to admit of carrying on the experiment. The Landore company are, however, so satisfied of the value of the coke, that they have nearly completed preparations for making it in all their ovens, and using nothing else in their two blast furnaces.

The cost of the anthracite coke is about the same as that of the best ordinary coke made in the district. Anthracite in Wales is about 2s. a ton cheaper than bituminous coal, an economy in one constituent that balances the extra cost of the pitch; and in making best ordinary coke, the coal used is ground, at a cost of about 6d. a ton, just as in the case of coke from anthracite. The yield of 80 per cent. in coking anthracite, against 70 per cent. or less in coking bituminous coal, is again in favour of the former.

The cost of the crushing and mixing arrangements, to grind 1,000 tons a day, is estimated by the inventors at from £2,000 to £2,500. This would include a 6ft. 3in. disintegrator, with driving power, elevators, and shed.

The process has been carried on near Swansea for about nine months, and though it was suspended for some time during last winter on account of the colliers' strike, between 2,000 and 3,000 tons have in all been made.

The field for the application of any practical method of utilising small anthracite is very great; the quantity available in Wales and in America is almost unlimited, and very much of that raised is now unsaleable, merely because it is too small to be used. In Pennsylvania, according to Mr. Bell, from one fifth to one half of the material brought to the surface in the anthracite collieries is thus thrown aside; partly shale and stones, but chiefly small and dust coal, perfectly clean and bright.

M. Lecocq de Boisbaudran has announced the discovery, by means of the spectroscope, of a new chemical element, which he calls "gallium," and which he affirms to be closely allied to zinc. The spectroscopic character of gallium is two violet lines, one corresponding to wave length 417, and the other to 404, but fainter. A commission of the French Academy has been appointed to report on the discovery. Gallium is said to be found in a special blende from Pierrefite mining works, in the Argeles Valley.

It is reported that Mahmoud Pacha, a member of the Council of State, obtained authorisation some time ago to conduct mineral explorations in the districts of Lom and Belgradjik, district of the Danube. The engineers employed by his Highness have returned to Constantinople, bringing with them specimens of iron ores and of bitumen, and are said, besides, to have discovered coal of first-rate quality.

NOTES ON DIAMONDS FROM THE CAPE.*

The first diamond was found in March, 1867, and on examining its physical character, it was pronounced by Dr. Atherstone to be genuine. When this stone was received in London it created a good deal of interest, and also of suspicion, some persons having asserted that it was brought forward for mercenary purposes; letters even appeared in the public papers implying that it was impossible it could have been found near Cape Town. As Dr. W. G. Atherstone, F.G.S., who in March, 1867, examined and pronounced the stone to be a diamond, is now in Bristol, I beg to offer a few general remarks on the Cape diamonds, and to express in public my thanks to him.

The late Mr. Mawe, who wrote on diamonds, and described their mode of occurrence in his travels in Brazil (London, 1812), often told me of the probability of their existence in South Africa, and said that if people only knew them in the natural state he felt confident they would be found. He died in 1829, but I took every opportunity to try to make the subject known by means of short papers, accompanied by figures showing the crystallization form.

The number and quality of diamonds from the Cape are equal to those from the Brazils, which have chiefly supplied Europe during the last eighty years.

About ten per cent. of the Cape diamonds may be taken as those of the first quality, fifteen per cent. of the second, twenty per cent. of the third; the remainder, under the name of *boot*, are employed for cutting diamonds, and for the numerous applications to which this valuable substance is applied on the part of the glazier, the engineer for drilling rocks, the lapidary, and others. Many diamonds contain specks and cavities; these are placed in the hands of skilled workmen who are acquainted with the cleavage, and by careful manipulation they often get out portions of the first quality for making small "brilliants," "roses," and "tables."

The cutting and polishing of diamonds was carried on in London with great success 200 years ago; after this it was carried on chiefly in Holland. Attempts have been made to re-establish the trade in this country.

In 1874 the Turners' Company offered prizes in the form of medals and the freedom of the City of London. The Baroness Burdett-Coutts has supplemented this by the addition of money prizes, and has offered to contribute the further sum of £50 for prizes in the year 1876.

It is estimated that the value of the diamonds found at the Cape from March, 1867, to the present time, exceeds twelve millions of pounds sterling.

* Read by Professor James Tennant, F.G.S., before the Geological Section of the British Association.

GENERAL NOTES.

Coffee in Queensland.—The coffee plant has been grown in Queensland for some years, but it is only of late that its cultivation has been attempted with a view to its exportation as a commercial article, and we now learn that the plants have become attacked by blight, or fungus, which has given rise to some anxiety and inquiry as to whether the disease is identical with the *Hemileia vastatrix*, which has proved so destructive to coffee plants in Ceylon. We shall probably soon hear more about this, as the subject of the extension of coffee culture in Queensland is about to be taken up by Mr. L. A. Bernays, F.L.S., clerk of the Legislative Assembly of Queensland, and a vice-president of the Queensland Acclimatisation Society, and who moreover is known as the author of a little work on the cultivation and propagation of the olive in Australia.—*Nature.*

Hardening of Glass and China.—Amongst recent French patents appear the following:—Heinson-Huch—A method of hardening glass by heating in a muffle to a temperature of about 400° C., and afterwards plunging in a bath of soot or melted butter. Boistel and Leger—A process by which liquefied metals or alloys having fusing points below that of glass, as copper, lead, antimony, &c., are used for the same purpose. An addition to the patent provides for the employment of currents of gas or of heated or super-heated vapours of suitable temperature for the like object. The same patent a process of "tempering" ceramic wares of all sorts, with a view to increasing their power of resisting fracture.

Instruction in Cookery.—*Nature*, commenting on a letter in the *Morning Post*, signed "W. S. M.," in which attention is drawn to the provision in the New Code of the Privy Council Committee of Education for instruction in cooking, house management, &c., in elementary schools—remarks that a very happy suggestion is made. The writer can see no reason why some portions at least of the subject should not at once be introduced into all schools which are in connection with the Science and Art Department. He then shows how very large a number of students attend the classes for Animal Physiology, Organic and Inorganic Chemistry, and Heat, and says:—"There is thus already given, though scattered over four subjects, much of the instruction which would belong properly to the special subject of 'Food and its Preparation.' To make the subject an efficient one, all that is needed is to select certain portions from the subjects already taught, 'Physiology,' 'Acoustics, Light, Heat,' 'Inorganic Chemistry,' 'Organic Chemistry,' to group these portions as one subject, and to add to it some additional instruction that is not at all more difficult than much that is already given." *Nature* commends "W. S. M.'s" suggestion, indeed the whole of his letter, to the notice of the South Kensington authorities.

The Patent-office Publications.—In our notice of the Commissioners of Patents' Report a few weeks ago, says *Engineering*, we alluded to the great regularity with which the printing of the specifications had been carried on. We stated that since the present law came into operation (which was in 1852) not a week had passed without being marked by the issue of a bulky parcel of printed specifications. To give some idea of the extent of the work we will take the issue of Saturday last as an example. The total number of specifications was 130, which together comprised no less than 858 pages of letterpress of large octavo size. There were 149 sheets of drawings appertaining to these 130 specifications, a very large portion being of "imperial" size. The cost of a set would be £5 15s. Few persons, we think, are aware of the number of patents which are applied for, or at all events they do not take the trouble to think of it. The figures we have given above are in our opinion very significant, and furnished indications of immense activity on the part of the community of inventors. The number of patents applied for last year was 4,492, the highest ever known, but judging from the present rate of increase the applications during 1875 will not fall far short of 4,600. The Lord Chancellor's Bill had no doubt the effect of stimulating applications, as inventors were somewhat alarmed at the prospect of the impediments which it was proposed to throw in their way. We must also include, amongst the Patent-office publications of the day which we have selected as a typical example, the *Commissioners of Patents' Journal* and the *Chronological and Descriptive Index*. The Journal of that day consists of 36 octavo pages of list of applications and grants of patents in this country and in America, together with a translation of the German law of trade-marks. The Index contains, in 76 pages, an abridgment of all the specifications thrown open to public inspection during the previous week, together with indexes of names and subjects.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Society of Engineers, 6, Westminster-chambers, Victoria-street, S.W., 7½. 1. Mr. Thomas Maude on "The Government Brake Trials." 2. Adjourned discussion on Mr. St. John V. Day's paper upon "Continuous Railway Brakes."

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, OCTOBER 8, 1875.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

COMMERCIAL EXAMINATIONS.

The programme of these Examinations, for 1876, is now ready, and may be had *gratis*, on application to the Secretary.

EXTINCTION OF FIRE IN SHIPS.

The Fothergill Gold Medal is offered for an effective means of preventing or of extinguishing fire on board ship. Communications, illustrated if need be by models or working drawings, must be sent in to the Society not later than the 31st of December, 1875.

The Council will take into consideration, with a view to reward, the best written paper containing suggestions fitted to secure prevention of fire, or the means to be adopted for the safety of life and property when fire breaks out on board ship.

The Council reserve to themselves the right of withholding the medal or reward offered, if, in the opinion of the Judges, none of the communications sent in are deserving.

MISCELLANEOUS.

TRADE-MARKS.

As the new Act for the registration of trade-marks will shortly come into force, it may be interesting to note what is the practice of foreign countries in this respect, and how far a system has been established similar to that which will, presumably, after the end of the present year, obtain in our own country. What will be the actual provisions of our new system it is not yet possible to say, for the Act, while establishing a registry for trade-marks, leaves it to the Commissioners of Patents to frame such a code of regulations as may seem advisable. At present no notices on the subject have been issued.

Pending, however, the publication of the new regulations—which will, doubtless, appear in due course between now and next January—it may, perhaps, be serviceable to those interested in the subject to have a slight outline presented to them of the rules in force in other countries. To the large export manufacturer it is of scarcely less importance that his special mark should be protected in other countries than in his own, and as the possibility of registering trade-marks officially will doubtless greatly increase their value, and thus lead to an extended use of them, it is probable that many manufacturers will be inclined to turn their attention to the question of protection for trade-marks in foreign countries, who have hitherto paid but little attention to the subject.

It may be convenient to commence with a *résumé* of the laws of the two countries with which we are most nearly connected, France and the United States, while the newest system, that of Germany, which is just coming into effect, may fitly be reserved till the conclusion of this article.

The most recent French legislation respecting trade-marks bears date in 1857, the "Regulation of Public Administration" for the execution of the law being dated 1858. The law was not passed till after long and careful discussion, the subject having been brought forward in 1841, 1845, 1846, and 1850. A chief point in the discussion was the question of compulsion, whether or no it should be obligatory on the manufacturer to affix his mark on all his goods. It was determined that the mark should be optional—unless any special manufacture should be considered to require a compulsory mark—and so the law stands.

In order to establish a right to a mark, the proprietor must deposit two copies of it at the Registry of the Tribunal of Commerce of the locality where he resides. One of these is preserved by the Registrar, the other is transmitted to the Ministry of Agriculture, Commerce, and Public Works, to be deposited in the Conservatoire des Arts et Metiers. The depositor receives a copy of the official entry certifying the registration. The fees are one franc for the statement of deposit and "the amount of the stamp and registering duties." The stamp is 35 centimes. The copy of the mark was, by the original law, to be in the centre of a sheet of paper 18 centimetres (7¼ inches) square, with certain spaces reserved at each side for the statements of the depositor and remarks of the Registrar. By a recent alteration, the size of the paper has been slightly augmented. A list of the marks he has registered is drawn up by each Registrar annually, and transmitted to the Ministry of Commerce. All registers are open free to public inspection. Foreigners resident in France or in countries having reciprocal treaties are entitled to equal privileges. The mark holds good for fifteen years, when it may be again registered. Trade-marks include "the names under a distinctive form, appellations, emblems, engraved marks, stamps, seals, illustrations, cameos, letters, cyphers, wrappers, and all other signs, used to distinguish the products of a manufacture or the articles of a trade."

In the United States any rightful proprietor, domiciled in the country, or in another country having a reciprocal treaty, may obtain protection for a trade-mark by recording at the Patent-office the name of the owner, class of merchandise, &c., depositing a description and fac-simile, filing a sworn declaration that the depositor has a sole right to the mark, and paying a fee of 25 dols. (£5). There are also certain office regulations to be complied with. The mark remains in force for 30 years, and may be renewed. The protection lapses with the lapse of any foreign protection. The mark must not be a name merely. Applications are referred to a special examiner with an appeal to the commissioner, the practice generally following that for the grant of a patent. The rules as to the number of copies to be supplied are the same as in the case of designs.

In Austria the mark must be registered at the local Chamber of Commerce and Industry. Two copies are delivered, of which one is returned to the depositor. The fee for registration is 5 florins (10s.) The register is open to public inspection. Trade-marks may not consist of letters, words, or numbers only, or of the arms of

states or countries. The right in marks continues with the trade undertaking for which the marks are intended, but under certain circumstances a new owner is compelled to register again.

The Belgian law of trade-marks dates from the beginning of the century, and it is stated that the Government have had under their consideration the advisability of a revision of the law. Under it, articles of hardware, cutlery, &c., have a certain manufacturers stamp fixed to them, each manufacturer who desires it depositing a certified copy of his mark. Other articles have also special marks. A comprehensive scheme of trade-marks is yet to be formed.

In Russia trade-marks are registered at the Department of Commerce and Manufactures, St. Petersburgh, British trade-marks being available for registration.

In Spain the persons desirous of obtaining the right to a trade-mark must apply to the governor of their province for a certificate. The petition must be accompanied by a statement setting forth the nature of the mark, the class of goods it is to cover, the owner's name, &c. On a favourable report from the Director of the Conservatoiro de Artes, a certificate is granted to the petitioner, subject to a fee of 100 reals (£1 1s.) Any mark may be used, except the Spanish royal arms, and orders and decorations. A register is kept in the Conservatorio de Artes, and a list is published every quarter in the "Gazette," of marks granted during the quarter. A similar annual list is also published.

In Switzerland, in certain cantons, protection is granted to foreign trade-marks on specimens being deposited with the respective Governments. The Federal Legislature provides no protection to foreign marks.

In Turkey, there was practically no legislation on the subject till 1870. In that year a set of rules was drawn up for the registration of trade-marks. Two specimens of the mark are to be deposited at the central civil court of the province of the depositor. One of the copies is transmitted to the Supreme Council of Justice, by whom a certificate is returned, a provisional certificate being in the meantime given to the proprietor of the mark. The second specimen is preserved at the office where it is deposited. The fee is one gold medjidié. Foreigners and natives are placed on the same footing. The use of a trade-mark is optional, but the Government reserves the right of ordering the use of a trade-mark for any manufacture.

Denmark has enactments making forgery of trade-marks penal, but it appears that the legislation hardly affects foreigners. There is no registration.

In the Netherlands there has been no legislation more recent than the Penal Code of Napoleon. By this, imitation of trade-marks is a punishable offence, but no person can bring an action against another for such a cause "unless he has previously made it known in legal form by depositing a model with the 'greffier' of the commercial court of the district." It is believed that this law would not extend to foreigners.

In Portugal the imitation of a trade-mark is a punishable offence. There is no registration.

In Sweden the criminal code makes the illegal use of a mark punishable with fine and imprisonment. There is no registration.

We now come to Germany, which has produced the most recent legislation on the subject. The text of the law is given in a Foreign-office Blue-book, together with some remarks by Mr. White, Her Majesty's Consul at Dantzic.

The German Penal Code of 1870 enacted a penalty for the counterfeiting the name of any manufacturer, &c., but this was found insufficient, as no protection was given to marks. It is suggested by Mr. White that one principal cause of recent dissatisfaction with the law was the addition to the empire of Alsace-Lorraine, where the protection enjoyed by manufacturers for their marks was felt to be a very great advantage.

The new law came into force on May 1st and the period allowed for the registration of existing marks expired on the 30th ult. The marks may not contain "numerals, letters, words, armorial bearings or scandalous designs." The exact method of application is not detailed in the law. The marks are to be registered at the district court of the owner, or in the case of foreigners at the Commercial Court at Leipzig. The fee is fifty marks (£2 10s.). All entries and cancelling of a claim to trade-marks are to be published in the *Deutsche Reichs-Anzeiger*, or Official Gazette, at the expense of the parties. The registration holds good for ten years, and then a fresh claim must be made. With regard to foreigners there are certain special clauses, requiring reciprocity, and proof that the mark is entitled to recognition in its own country.

The treaty stipulations between Great Britain and foreign Powers on the subject of trade-marks were printed in a return to the House of Commons in 1872. In Austria, Belgium, Colombia, France, and Italy, British subjects have the same rights as natives. In Russia, as noted above, British trade-marks registered at St. Petersburg are entitled to protection, and it is stipulated that similar rights shall be granted to Russians in Great Britain should the latter country adopt a system of registration. The two countries also bind themselves to take all due measures for the protection of the marks of manufacturers of the other from piracy or fraudulent imitation. The treaty with the Zollverein obtains equal rights for foreigners and natives, but the necessity for its provisions would seem to be done away with by the recent German law.

TOBACCO CULTIVATION IN JAMAICA.

The old saying, "It is an ill wind that blows nobody any good," has lately received a good illustration in the West Indies. As a consequence of the native insurrection and troubles which have been going on in Cuba for the last eight years, there has sprung up in Jamaica a new industry which bids fair to rival in time the staple island productions of sugar, rum, and coffee. Although termed a new industry, it would be more correctly called a renewed one; for in the old chronicles of the colony we find tobacco set down as an article of exportation, and even now, Clarendon and certain other districts of the island have a vague reputation of having formerly produced good tobacco. For nearly a century, however, but very little progress has been made in this direction, so that, four or five years ago, there was not a regular tobacco plantation in the island. The coarse native variety of the plant has, indeed, always been cultivated —or, rather, allowed to grow—by the negroes, and sometimes by the white settlers of the country parts; but there have been, until lately, but few attempts at systematic planting or subsequent curing. The leaves were merely dried and rolled up into the so-called "donkey rope," an article, if its tensile strength were a little greater, probably as well adapted for tying up donkeys as for smoking.

There is nothing in the various conditions of soil, climate, &c., to prevent the growth of tobacco on a large scale in Jamaica. But although this fact is pretty well understood, and generally admitted, no one in the island has for a long time endeavoured to do anything in the matter, nor, as is most likely, has known how to do so. Among the many political refugees from Cuba, who came to Jamaica in 1870 and subsequently, there were some who had been engaged in this branch of agriculture in their own island. These either went in themselves in a small way, or induced certain enterprising Jamaica capitalists to assist or join them. They were the first to draw attention to a subject which is expected to become one of great importance to the colony.

Last year there were about 1,000 bales of tobacco pro-uced; this season, from the ten plantations which are nder culture, the out-put will probably amount to 000 bales of 100lbs. each. This is a small quantity as mpared with the produce from the large established bacco districts of Cuba and elsewhere. But, apart om the consideration that the whole thing is in its fancy in Jamaica, it must be remembered that the ex-nt of land actually under cultivation, although nually increasing, has not yet exceeded 300 acres, or ereabouts. These figures are, however, sufficient to ow that tobacco culture has really taken root in amaica.

As an economic production, tobacco would appear to most profitable. In order to start a sugar estate, a rge outlay of capital is necessary for the numerous e stock and to lay down the complicated machinery d substantial buildings; and while there must be a con-derable lapse of time before a crop can be obtained. A ffee planter, too, has to wait for four or five years fore realising any return for the money expended in e field, in building barbicues, and in erecting buildings d machinery. In these respects the tobacco grower s a great advantage. Beyond the expense of a few ht and airy closed sheds, and rooms for curing and rage—costing, when substantially built, not more an £200—a dozen head of oxen for ploughing, and few mules and carts, representing together another 00, little further in the way of outlay is required. n most properties in Jamaica the substantial walls are nding of old buildings, which can be easily converted to sheds at a small expenditure.) The development, o, is so rapid, that a plantation can be settled and the op reaped in the course of one year. In such a case, wever, the profits could scarcely be expected to com-ence until the second year, for the first season's ex-nses would necessarily be exceptionally heavy, and e value of the yield would do but little more than just ver them.

The quantity of tobacco producible per acre, in one op, ranges from five to ten bales, varying with the vourableness of the season, richness of soil, method of ltivation, &c. From what has already been actually ne on some of the present plantations in Jamaica, it y be estimated that upon a well established and properly naged place, the cost of production, per bale, should t exceed £4. The market value will of course depend on the quality, care in selection, and other circum-nces. It will be safe to put it down, upon an average, £7 to £8 per bale. Some tobacco from Retreat Plan-tion, in the parish of Clarendon, was estimated in the ropean markets to be worth 3s. 6d. per lb., *i.e.*, 7 10s. per bale. Some from that plantation and from other in the same parish has been sold in the island at 0. Supposing a plantation in working order to pro-ce 300 bales in the season, the total cost of production y be represented at £1,200; and, taking the low esti-te of value, the return at £2,100, giving a clear profit £900. A high price cannot be looked for at first. As all new or young undertakings, considerable ignorant ejudice must be expected, and much opposition must met on the part of the European dealers. There is immense business done in Havannah tobacco. People e accustomed to give a high price for that, but for no her kind from the West Indies. (It is true that most the latter has been, hitherto, undoubtedly inferior.) e result is that many unscrupulous merchants send acco from Germany and other places to Cuba, and re-p it as Havannah. It is to be hoped that the Jamaica nters will not stoop to such practices. Their tobacco s been pronounced by competent judges to be really od, and equal to most of the Cuban brands. In time will assuredly make its way by honourable means rough its own merits.

Were the reputation of Jamaica tobacco established, e profits of a plantation would be just trebled, by king up its tobacco into cigars, instead of selling it in the raw state. This naturally would entail a further outlay of capital. It would, moreover, be hardly safe to commence this just yet, for although dealers in Europe will buy the Jamaica tobacco, in order to make from it their so-called "Havannahs," there is at present neither sale nor demand for Jamaica cigars under that name. When they are known and properly introduced over here, we have no doubt that things will be very different. Samples which were sent to the Vienna Exhibition were highly approved of, and were awarded a medal; and since then cigars from the above-mentioned Retreat have acquired a high local reputation, and are admitted by all who have smoked them to be really superior to many of the Havannah brands.

For the benefit of intending planters, it may be per-missible to make some remarks upon the points which should be considered in choosing a suitable plantation, and to give a short outline of the method of planting and curing ordinarily adopted by the Cubans.

An attentive observer will perceive that the best tobacco in Cuba comes from the low lands lying west-ward of the mountains, and, in fact, principally from the western districts of the island. There is a good physical reason for this. The prevailing winds in the West Indies blow from an easterly or south-easterly direction. These are laden with moisture, taken up from the Atlantic, most of which falls in the form of rain upon the slopes and valleys immediately to the east of the mountains, rendering those districts far too humid for the production of good tobacco. For, when it is once transplanted, nothing more than an occasional shower is required. If grown in wet localities, the leaves become very large, but are devoid of strength and flavour; and, consequently, they lose much of their value. It is, however, essential that the neighbourhood should not be too dry, and that rains may be relied on at the times of planting, viz., in the autumn and in the spring. And it is further important that there should be, through the property, a running stream, from which, in the absence of rain, water may be obtained to supply the young transplanted plants while they are taking root.

The celebrated "vuelta abajo," or low-lying districts in the neighbourhood of Havannah, are yearly flooded during the autumnal seasons, just before the tobacco is is transplanted. The alluvial deposit which is left when the water recedes, greatly enriches the land; and it is probably owing to this circumstance, that the tobacco grown upon it has maintained its quality and reputation for so many years. Similar conditions exist in many of the Jamaica villages. Several sugar estates have been thrown up, because the standing cane-fields were now and then washed away, or buried by the sediment left by the occasional overflowings of streams. Such places would be highly suitable for tobacco plantations.

Tobacco grows best on perfectly flat land, or in shallow hollows, sheltered as much as possible by sur-rounding hills. These not only enrich the ground by their drainage, but ward off strong winds, *e.g.*, the "January norths," which sometimes prove very de-structive to the leaves. The soil should consist of a light, sandy, but rich loam. A clayey soil becomes, during the long spells of dry weather which often prevail in the West Indies, too much caked and too dry for so quick-growing a plant. The more the ground is tilled and broken up, the better, in quantity and quality, is the resulting yield. It is partly on account of this that the first crop from a new plantation is seldom so good as the succeeding ones. Dried tobacco leaves contain an unusually large proportion of mineral ingredients, rarely less than 17 per cent of their weight, as well as a large amount of ammoniacal and other nitrogenous matters. Hence the plant is found to be very exhaustive to the soil. Unless the fields be re-plenished by floods, in the manner mentioned above, after four or five years it will be, therefore, advantageous to employ manure. Considerable care and judgment

have to be exercised in its use; for if too much, or an unsuitable kind be mingled with the soil, the tobacco becomes rank in growth and flavour. Manures of a calcareous nature are generally the safest.

The method of planting ordinarily adopted by the Cubans is as follows:—Towards the end of July, or in August, the dust-like seed, mixed or not with wood ashes, is thrown broadcast upon land, preferably on the top or side of a hill, which has been recently cleared and burnt over, set out in beds, and drained by gutters at intervals. Virgin forest is desirable for this purpose, both because it is richer, and because in such places the young tobacco will not be smothered by the grass and weeds, which would be sure to spring up in old land. The frequent light afternoon showers of this period of the year are very beneficial. When they are absent, as occasionally occurs, it is well to water the seed-beds artificially. In the course of seven or eight weeks many of the young plants are three or four inches high, and are fit to be transferred to the field, which has by this time been well ploughed, harrowed, and prepared. They are planted at intervals of about fourteen inches in rows, which are three to four feet apart, and running in an east and west direction, so that the crop may the better get the benefit of the northern showers which fall after Christmas. The rough cultivation is 10,000 plants to the acre. This transplanting should be done in wet weather, which, fortunately, is nearly always prevalent in the planting months of October and November. If the ground be dry, the plants must be watered for two or three days until they strike root. From time to time the rows have to be resupplied from the seed-beds, to replace those roots which may not have become established, or which may have been killed by caterpillars. There is a kind of the latter, somewhat resembling the European "wire worm," which sometimes in dry weather does much damage by gnawing through the stalks above the roots. These worms remain buried during the day in the earth in the immediate neighbourhood; they are usually searched for by children. To keep down these pests and the other caterpillars which feed upon the growing tobacco, flocks of turkeys are very useful upon a plantation. It is necessary to keep the rows clean from grass and weeds, and after a time it is advisable to bed up the plants, in order to keep their roots cool and moist. In six or seven weeks they will have attained a height of about eighteen inches, and there will be from eight to fourteen leaves upon each; then the terminal flower-bud usually appears. This, together with an inch or two of stalk, must be clipped off, so that the whole growth of the plant may be concentrated in the leaves. For the same reason, all the suckers or buds between the leaves and the stalk must be removed as soon as they appear. It will now be understood why a tobacco field requires so much labour and careful supervision. In three to four months from the time of transplanting, the leaves will have a slightly mottled appearance, will be gummy to the touch, and their midribs will have become brittle; in short, they will have attained their full size and development. The stalk has also by that time acquired a certain rigidity. For the sake of the quality and colour of the resulting tobacco, it is of the highest importance to gather in the leaves immediately they are ripe. If all the leaves be not equally advanced, it is well to take in those which are fit. In order to save time and trouble, it is usual, however, to cut the whole plant an inch or two above the root, when the majority of its leaves are ripe. If rain now fall upon the leaves, a quantity of the gummy resin is washed away, and their quality greatly injured. Hence the gathering in should take place on a warm day, while the sun is out. As soon as cut, the plants are exposed to the sun for some hours. They are then tied in pairs by strips of palmetto straw, and slung over bamboos or lathes, which are arranged in horizontal rows, from the rafters down, in the drying houses. It is supposed to be an improvement to cut up the stalks, so that a pair of leaves may depend from each piece, and to hang these instead of the whole plants across the lathes. Here they remain until the stalks as well as the leaves are quite dry and brown—often for seven weeks or longer—the time depending upon the state of the weather. When ready, they are taken down in the morning, or on a moist day, when not too brittle, and placed one upon another, in large heaps, under a weight. The plants are kept in this "press" for from ten days to a month, until fermentation has set up, and the whole heap has become tangibly and uniformly warm. After this the leaves are stripped off, sorted into "cappa" or "wrappers," or those which are large, perfect, and of good colour; and into "tripa" or "fillers," which are the smaller, broken, or discoloured ones. They are then tied up into hanks. Not until now will the leaves have gained the smell, flavour, and properties of tobacco. But the curing is not yet complete. The hanks are either dipped in, or sprinkled with, a mixture formed by steeping dried tobacco stalks in water until they decompose, and sometimes containing a little rum. The Cubans affect to make a great secret of this, which they call "betun," and of the quantity they use of it. After this treatment the tobacco is again placed in heaps, to undergo a second longer and more thorough fermentation, which brings out the proper flavour and aroma. It requires skill and experience to know exactly how long these fermentations should be allowed to last, and with regard to the use of the curing liquid. Hence it is advisable, for the first few years, to have the services of a competent Cuban planter. When cured, the hanks are tied together in threes by means of palmetto straw, to form the so-called "minojos." These are tightly packed and pressed into bales, weighing a little over 100lbs., which are closely covered in by sheets of the bark surrounding the growing shoot of the cabbage palm, and securely tied. The tobacco is now ready for shipment. From the roots which are left in the ground, after the first cutting, spring up secondary shoots, called "rattoons" in Jamaica, "hijos" or *sons* in Cuba. One or two of the most vigorous of these are allowed to come up. Their first growth gives tobacco good enough for "cappa." Leaves from the later rattoons go to form "tripa." As a rule, the proportion of "cappa" to "tripa" produced on a plantation is as one to two. By due care the increased quantity of "cappa" can, in good seasons, be obtained on well sheltered properties.

It will be seen that the whole period of growth, from the time of planting the seed, does not exceed six months, so that it is possible to raise two crops in the year. On account, however, of the difficulty of getting a sufficient number of small plants to set out in the field in April and May, and from other considerations, it is customary to take off a crop of Indian corn and peas during the spring months. The bulky stalks of the former, together with the old tobacco roots, are ploughed in, and the land thereby is much improved. Seed for the next crop is obtained from plants in the seed beds, some of which have been permitted to develop themselves normally, or from those rattoons which have gone to seed.

Before concluding this paper, some allusion should be made to the question of labour in Jamaica. To whatever straits sugar and coffee estate proprietors have been put, for want of hands, no tobacco planter has yet found any difficulty in obtaining as many labourers as he wanted. The work of a tobacco plantation is comparatively light, and is evidently preferred by the negroes and coolies. Added to this, the best tobacco districts are not great sugar or coffee centres; there is, therefore, but little competition for the labour therein existing. Cuban labourers are now easily obtainable in Jamaica; they are useful as "head-men," and for those duties which may require some little exercise of "brains."

It is hoped that enough has now been said to call the attention of those interested in the colonies to the subject of tobacco cultivation in Jamaica, and to indicate to intending emigrants a direction in which their time and

money may be profitably expended. But little time should be lost: in a very few years the tobacco will have established its reputation, and suitable localities, which now may be leased or bought at low rates, will then be expensive and difficult to get hold of. It is safe to anticipate a brilliant future for Jamaica tobacco. The time may yet come when to be the proprietor of a tobacco plantation in that island will mean the possessor of a fortune.

SIR STAFFORD NORTHCOTE ON SCIENCE AND ART INSTRUCTION.

Towards the end of the last Session, Mr. Sullivan brought forward a motion in the House of Commons, recommending that a greater diffusion of technical instruction should be given among the working classes of Ireland than now is afforded. He was cordially supported by Sir A. Guinness, Lord Eslington, Mr. D. Davies, and others. Sir Stafford Northcote made a speech remarkable for its sympathy with the object of the motion. It was not possible in the hurry of the Session to give it the attention it deserved, but it is now reprinted in the *Journal* for the guidance of the Society's Committee on Public Museums:—

The Chancellor of the Exchequer thought that the hon. gentlemen who had brought forward this subject must be satisfied with the general expressions of feeling which had been manifested throughout the House, and he could assure them that the feeling which had been expressed by the Englishmen and Welshmen who had spoken was cordially reciprocated by her Majesty's Government. He hoped the Government would be able to look at the question in a broad and liberal spirit, and that they would not be disposed to treat it merely as an Irish question, but as one of a national character. They took an interest in the welfare of Ireland because she formed an important and integral part of the empire, and because what was good for Ireland must be good for the whole empire. It had been said that they should give this boon because it was demanded by the people of Ireland, without too much considering whether it was or was not the best thing they could do. He did not think that that was a respectful way of treating the Irish people in this matter. They should look at it as if it were brought forward for any other part of the United Kingdom, and, if they did, their conclusions would to a great extent tally with those which had been arrived at by the hon. members. He himself felt a peculiar interest in the question, and had had a large amount of official connection with it. The experience which he had gained had convinced him more and more of its importance and of some of the difficulties attending it. The hon. member for Louth spoke of South Kensington as if it were to be treated as an English institution, and one which was not of great utility to Ireland; and some exception had been taken to the language of officials on this question. He ventured to say that official persons had been actuated by a desire not to magnify this or the other particular institution, but to bring about that system which would be for the general interests of the country. He did not believe they had yet entirely attained to a proper system. There was a great deal of room for more exertion and more assistance on the part of the State for the promotion of education in science and art. He believed that the assistance now given might be given in a more advantageous form. He thought there was a waste of money and of power to some extent. What he wished to call the attention of the hon. member for Louth and the House to was the distinction between the function of the museum and of the great school of art at South Kensington, and how far either was capable of being broken up for the use of other parts of the kingdom, and how far it was desirable to keep certain parts of the institution together. With regard to the system of teaching, he thought it would be a great misfortune if we were to break up the general principles on which the system of teaching was founded. A great deal would be sacrificed if we threw up the advantages of the school of art at South Kensington as the centre and mother of all other art schools in the country. That was one great advantage which took place from what occurred in 1851. Before that time there were schools of art in the different seats of manufacture—in Manchester, Birmingham, Dublin, Belfast, and Cork—but it was not until we were able to bring them under one system, of which South Kensington was made the focus, that we gave the impulse the right direction. He thought it would be a great pity to sacrifice the advantage arising from the school-centre of South Kensington, though he believed that more might be done to improve the various branch schools throughout the country, and that that object ought to be kept in view. He did not know much of the present practical working of the system, but the president and vice-president of the council were thoroughly impressed with the importance of making the South Kensington collection a focus for diffusing throughout the country art education. Beyond the question of education there was another, and that was, what was to be done with the Art Museum? We had a magnificent collection, unparalleled in the world; but the mere accumulation of these treasures at South Kensington was far short of what the country required; and it was desirable that not alone in Ireland, but in various other parts of Great Britain, different neighbourhoods and localities should have collections of their own. He considered it desirable that South Kensington should be brought into relation with other museums by a proper system of loans of articles, and by assisting in the formation of local museums. In that object he thought the Imperial Government and the Imperial treasury might assist if they were met in a corresponding spirit at the seats of industry. It would be one of the great objects of the Government to endeavour to meet in a liberal spirit the efforts that might be made in other parts of the kingdom, and especially in Ireland. He believed that the money spent in Ireland might be supplemented by a little more and better administered. He was not able to bind himself to any exact plan, but he could say that the subject was one which had engaged the attention of the Government, and that there should be no want of attention to it on their part during the recess, and it would not be from any want of desire on their part to meet the claims of Ireland if they did not arrive at a satisfactory result. In saying this he wished to guard himself against undertaking to break up the great central institution at South Kensington, or to diminish the advantages arising from having a centralised system. He believed that the hon. member would be satisfied with the assurance which he now gave on the part of the Government, and not think it necessary to ask the Government to pledge themselves to any particular scheme.

Mr. Sullivan, in reply, explained to the Chancellor of the Exchequer that his wish was not to abolish South Kensington, but to maintain that establishment as a national centre and a subsidiary group in Ireland.

These opinions entirely agree with those expressed by the Society's Committee on Public Museums, and must be highly gratifying to them. With a flourishing revenue Sir Stafford Northcote this year has an opportunity to lay down principles which will enable any locality to have its museum of fine art or science or a museum for both subjects. Let the principles advocated by Nottingham be accepted and made general. A grant from Government proportioned to the local funds, say one-third, would suffice for the maintenance of the museum paid for by a moderate local rate and a penny admission, as now successfully working at the East India Museum.

THE TRUE METHOD OF SCIENTIFIC RESEARCH.

At a time when the methods and the advantages of scientific research have given rise to so much popular research, perhaps the following graphic account of one of the earliest investigations of modern chemistry will be read with interest. It is an extract from an address on "Scientific Culture," recently delivered by Professor Josiah P. Cooke at the Harvard University:—

A still more striking illustration of the same method of questioning nature is to be found in the investigation of Sir Humphry Davy on the composition of water. The voltaic battery which works our telegraphs was invented by Volta in 1800; and later, during the same year, it was discovered in London, by Nicholson and Carlisle, that this remarkable instrument had the power of decomposing water. These physicists at once recognised that the chief products of the action of the battery on water were hydrogen and oxygen gases, thus confirming the results of Cavendish, who in 1781 had obtained water by combining these elementary substances; oxygen having been previously discovered in 1775, and hydrogen at least as early as 1766. It was, also, very soon afterwards observed that there were always formed by the action of the battery on water, besides these aëriform products, an alkali and an acid, the alkali collecting around the negative pole and the acid around the positive pole of the electrical combination. In regard to the nature of this acid and alkali there was the greatest difference of opinion among the early experimenters on this subject. Cruikshank supposed that the acid was nitrous acid, and the alkali ammonia. Desormes, a French chemist, attempted to prove that the acid was muriatic acid; while Brugnatelli asserted that a new and peculiar acid was formed, which he called the electric acid.

It was in this state of the question that Sir Humphry Davy began his investigation. From the analogies of chemical science, as well as from the previous experiments of Cavendish and Lavoisier, he was persuaded that water consisted solely of oxygen and hydrogen gases, and that the acid and alkali were merely adventitious products. This opinion was undoubtedly well founded; but, great disciple of Bacon as he was, Davy felt that his opinion was worth nothing unless substantiated by experimental evidence, and accordingly he set himself to work to obtain the required proof.

In Davy's first experiments the two glass tubes which he used to contain the water were connected together by an animal membrane, and he found, on immersing the poles of his battery in their respective tubes, that besides the now well-known gases, there were really formed muriatic acid in one tube and a fixed alkali in the other. Davy at once, however, suspected that the acid and alkali came from common salt contained in the animal membrane, and he therefore rejected this material and connected the glass tubes by carefully-washed cotton fibre; when, on submitting the water as before to the action of the voltaic current, and continuing the experiment through a great length of time, no muriatic acid appeared; but he still found that the water in one tube was strongly alkaline, and in the other strongly acid, although the acid was, chiefly at least, nitrous acid. A part of the acid evidently came from the animal membrane, but not the whole, and the source of the alkali was as obscure as before. Davy then made another guess. He knew that alkali was used in the manufacture of glass; and it occurred to him that the glass of the tubes, decomposed by the electric current, might be the origin of the alkali in the experiments. He therefore substituted for the glass tubes cups of agate, which contains no alkali, and repeated the experiment, but still the troublesome acid and alkali appeared. Nevertheless, he said, it is possible that these products may be derived from some impurities existing in the agate cups, or adhering to them; and so, in order to make his experiments as refined as possible, he rejected the agate cups, and procured two conical cups of pure gold; but on repeating the experiments the acid and the alkali again appeared.

And now let me ask who is there of us who would not have concluded at this stage of the inquiry that the acid and alkali were essential products of the decomposition of water? But not so with Davy. He knew perfectly well that all the circumstances of his experiments had not been tested, and until this had been done he had no right to draw such a conclusion. He next turned to the water he was using. It was distilled water, which he supposed to be pure, but still, he said, it is possible that the impurities of the spring water may be carried over to a slight extent by the steam in the process of distillation, and may therefore exist in my distilled water in a sufficient amount to have caused the difficulty. Accordingly he evaporated a quart of this water in a silver dish, and obtained seven-tenths of a grain of dry residue. He then added this residue to the small amount of water in the gold cones, and again repeated the experiment. The proportion of alkali and acid was sensibly increased.

You think he has found at last the source of the acid and alkali in the impurities of the water. So thought Davy, but he was too faithful a disciple of Bacon to leave this legitimate inference unverified. Accordingly he repeatedly distilled the water from a silver alembic until it left absolutely no residue on evaporation, and then with water, which he knew to be pure, and contained in vessels of gold from which he knew it could acquire no taint, he still again repeated the already well-tried experiment. He dipped his test-paper into the vessel connected with the positive pole, and the water was still decidedly acid. He dipped the paper into the vessel connected with the negative pole, and the water was still alkaline.

You might well think that Davy would have been discouraged here. But not in the least. The path to the great truths which nature hides often leads through a far denser and a more bewildering forest than this; but then there is not infrequently a blaze on the trees which points out the way, although it may require a sharp eye in a clear head to see the marks. And Davy was well enough trained to observe a circumstance which showed that he was now on the right path and heading straight for the goal. On examining the alkali formed in the last experiment, he found that it was not, as before, a fixed alkali, soda or potash, but the volatile alkali ammonia. Evidently the fixed alkali came from the impurities of the water, and when, on repeating the experiment with pure water in agate cups or glass tubes the same results followed, he felt assured that so much at least had been established. There was still, however, the production of the volatile alkali and of nitrous acid to be accounted for. As these contain only the elements of air and water, Davy thought that possibly they might be formed by the combination of hydrogen at the one pole and of oxygen at the other with the nitrogen of the air, which was necessarily dissolved in the water. In order, therefore, to eliminate the effect of the air, he again repeated the experiment under the receiver of an air-pump from which the atmosphere had been exhausted, but still the acid and alkali appeared in the two cups.

Davy, however, was not discouraged by this, for the blazes on the trees were becoming more numerous, and he now felt sure that he was fast approaching the end. He observed that the quantity of acid and alkali had been greatly exhausted by diminishing the air, and this was all that could be expected, for, as Davy knew perfectly well, the best air-pumps do not remove all the air. He therefore, for the last experiment, not only exhausted the air, but replaced it with pure hydrogen, and then exhausted the hydrogen and refilled the receiver with the same gas several times in succession, until he was perfectly sure that the last traces of air had been, as it were, washed out. In this atmosphere of pure hydrogen

e allowed the battery to act on the water, and not until he end of twenty-four hours did he disconnect the pparatus. He then dips his test-paper into the water onnected with the positive pole, and there is no trace of cid; he dips it into the water at the negative pole, and here is no alkali; and you may judge with what satis-ction he withdraws those slips of test-paper, whose un-ltered surfaces showed that he had been guided at last the truth, and that his perseverance had been rewarded.

The fame of Sir Humphry Davy rests on his discovery f the metals of the alkalies and earths which first re-ealed the wonderful truth that the crust of our globe onsists of metallic cinders; but none of these brilliant esults show so great scientific merit or such eminent ower of investigating nature as the experiments which have just detailed. I have not, however, described hem here for the purpose of glorifying that renowned an. His honoured memory needs no such office at my ands. My only object was to show you what is meant y the Baconian method of science, and to give some idea f the nature of that modern logic which within the last fty years has produced more wonderful transformations human society than the author of Aladdin ever nagined in his wildest dreams. In this short address I an, of course, give you but a very dim and imperfect idea f what I have called the Baconian system of experi-ental reasoning. Indeed, you cannot form any clear onception of it until in some humble way you have ttempted to use the method, each one for himself, and ou have come here in order that you may acquire such xperience. My object, however, will be gained if these lustrations serve to give emphasis to the following atements, which I feel I ought to make at the opening f these courses of instruction—statements which have n especial appropriateness in this place, since I am ad-ressing teachers, who are in a position to exert an im-ortant influence on the system of education in this ountry.

SOLAR TELEGRAPHY.

It is a matter of common observation that the rays of e sun are brilliantly reflected to enormous distances om glass buildings or from polished sufaces. Take, r instance, the Crystal Palace as a familiar illustration; e sun's rays, falling upon the ridged roof at a suitable ngle, are reflected many miles away and are clearly isible even when the building is only dimly discernible rough miles of intervening smoky atmosphere. Con-dering this, it might appear somewhat remarkable that dvantage has not been taken of the circumstance to und a system of telegraphy thereon. Not that such a stem could always be relied upon for use in this and her climates where sunlight is capricious. But in untries where sunshine is not so fitful such a system ould serve the most useful puposes. As a matter of ct, the rays of the sun have been utilised for signalling urposes at intervals for centuries past. The fleet of lexander the Great is said to have been guided along e Persian Gulf by mirrors on his return from invading dia. On the North American prairies, too, the Indians ill carry on signalling by means of sun flashes, and a milar method was adopted by the Russians at the ege of Sebastopol. But the principle appears never have been reduced to a system; arbitrary signs have en hitherto made to work out a perfect code of signals d to devise an instrument or apparatus which shall present them.

Sun-flashing has, however, been of essential service in r Ordinance Survey, although even there it was only ade to convey very limited information—to signal only, fact, and not to converse. Towards the close of the t century General Roy was engaged in connecting the eridians of Paris and Greenwich, and he employed sun-ashing in his operations. Later on, in the earlier years our Trigonometrical Survey, Bengal lights or Argand lamps were burned at night on the distant points the bearings of which it was desired to take. But this gave a very limited range and involved other practical diffi-culties, which led to the invention by Captain Drummond, R.E., of the light which bears his name. This enabled ranges of from 30 to 40 miles to be obtained, but even these distances were soon exceeded when, in 1822, Colonel Colby, R.E., who was then in charge of the survey, designed an apparatus for signalling by flashing the sun's rays, which proved very successful. Sub-sequently Captain Drummond improved upon Colonel Colby's instrument by the invention known as the helio-stat, which was an instrument consisting of an adjustable mirror as a reflector, worked in connection with a com-bination of telescopes. This apparatus, at first somewhat complex, was afterwards greatly simplified. Professor Gauss, who was at this time conducting the survey at Hanover, also introduced a similar instrument, which proved of great service in facilitating the work. The heliostat is now a recognised adjunct of all trigonometrical surveys, and by its aid triangles having sides over 100 miles in length have been formed even in Great Britain—notably that formed by Sca Fell in Cumberland, Slieve Donard in Ireland, and Snowden in Wales, the sides of which are respectively 111, 108, and 102 miles in length.

But the heliostat does no more than permit of an arbi-trary set of signals being exchanged; it does not allow a conversation to be carried on. To bring the beams of the sun into subjection in this respect and to utilise them as a means of freely interchanging ideas was left for Mr. Henry C. Mance, of the Government Persian Gulf Tele-graph Department, to accomplish. This he has suc-ceeded in effecting by means of a very simple apparatus which is known as the Mance Heliograph, or sun-tele-graph, the construction of which we have lately had an opportunity of examining at the chambers of Mr. S. Goode, 5, Gray's-inn-square, that gentleman representing Mr. Mance in this country. The heliograph consists in the first place of a light tripod stand about 4ft. long when folded up for transport. On this tripod is screwed a cir-cular mirror, varying in diameter according to the purpose for which the instrument is designed; that is whether for field or fixed observations. If for the former purpose the mirror is about 4in. in diameter; while if for the latter it is about 9 inches. The mirror is hung in a frame so as to revolve about a horizontal axis, and it is adjusted to the required angle of incidence with the sun by means of a telescopic connecting rod having a screw adjustment, the top end being attached to the upper edge of the mirror at the back. The horizontal circular traverse of the instrument is obtained by means of a tangent screw gearing into a small horizontal worm-wheel, with the centre of which the mirror is connected. By means of the tangent screw and the vertical screwed rod, the rays of the sun can be made to fall upon any given point with the utmost precision. The vertical rod behind the mirror is pivoted at the bottom to a lever, the fulcrum of which is on the horizontal worm-wheel, the lever constantly pressing against the lower end of the rod by means of a spring which is placed under it. It will thus be seen that when the rod is depressed it will depress the top edge of the mirror and draw it slightly backwards, the bottom edge being at the same time slightly raised and thrown forwards. In adjusting the instrument to commence signalling, the rays are directed to a point slightly below the distant observer's level, but upon depressing the connecting rod—for which purpose there is a small finger-piece attached to it—the flash is raised to the level of the observer, and he sees it. If now the lengths of these flashes be varied and grouped, they can be made to represent letters, and so words composing mes-sages can be spelt out. This is precisely what Mr. Mance has done, and by adopting the Morse system of dashes and dots he is able on a fine day to make himself understood by an observer many miles off, as easily as one electric telegraph operator makes himself intelligible to another.

In adjusting the instrument for use, a light wooden rod having two brass sliding sights upon it, is employed. This is set up in the ground in front of the instrument, and the operator looks through a small space in the centre of the mirror, from which the quicksilver has been removed, towards the station with which he desires to communicate. The upper sight on the rod is then moved vertically until the centre of the mirror, the sight, and the distant station are truly aligned. Hence when the flash from the mirror is directed on to the sight it is in true line with the distant station, and can be seen by the observer there. This will, of course, be whenever the angle of the mirror is raised; when depressed, or in its normal position, the flash rests upon a cross piece on the rod, and, according as the sun's horizontal and vertical motions cause the flash to deviate from the true line, the signaller is able to see and to correct the error by means of the adjustments on the instrument. The observer at the distant station having seen the bright star-like appearances, sets his instrument to the point at which they appear, and acknowledges the fact, and the parties being thus placed in communication, the interchange of messages proceeds upon the system we have mentioned—namely, the Morse alphabet.

There are other details to which it is not necessary to refer here further than to observe that they consist in arrangements for signalling with the sun behind the apparatus by means of a reflector; for signalling at night, and for signalling either from fixed or variable positions. It is, however, an important fact that the apparatus has been in use for some time in India, where its working has been attended with every success, the range of the signals being very great and their intelligibility absolute. Official reports are very explicit in both these respects, and fully establish the capabilities of the heliograph. They state that the signals given are perfectly clear and satisfactory, and that they can be easily read in ordinary weather without telescopes up to 50 miles. Captain Collette, D.A.Q.M.G., certifies that under favourable conditions messages can be signalled up to 80 or even 100 miles without recourse being had to telescopes. The heliograph has the recommendations of economy in first cost and portability, as it weighs complete about 5 lbs., and packs up into a very small compass.

Subsequently to examining into the construction of the heliograph we were afforded an opportunity of witnessing its practical working by Mr. Goode. Taking advantage of the sunshine on Monday, Sept. 27th., Mr. Goode stationed himself on the dome of St. Paul's, having previously despatched an electric telegraph operator to the Crystal Palace, where he stationed himself with a heliograph in the gallery of the North Tower. Mr. Goode had a telegraphic operator with him, and there was also present Mr. Sanders, of the Eastern Telegraph Company, who are arranging for the application of the system from Gibraltar across the Straits to Ceuta, in Morocco, thus bringing that country into telegraphic communication with Europe. The weather was not very propitious, the sky being at times overcast, while during the operation a heavy storm cloud was observed to drift over Sydenham. The two operators, moreover, had not previously seen the apparatus, and made no arrangement previously to setting to work as to their course of procedure. Nevertheless, the instruments were duly cited, and a series of brilliant flashes of light from the Palace tower indicated that those from St. Paul's had been seen. Signals in long and short flashes were freely interchanged as the intervals of sunshine permitted, but for reasons stated conversation was not entered upon. In other words, the operators signalled rapidly and readily, but they did not talk, as they might have done by preconcerted arrangement. Sufficient, however, was effected to demonstrate that, given an unclouded sun, the heliograph is a very efficient telegraphic instrument.

The uses to which the heliograph may be applied are very numerous, although it is not pretended that they are numberless. In military operations especially it would prove invaluable; if, for instance, the system had been in use by the French army during the siege of Metz, Marshal Bazaine could have communicated with the forces which were operating for his relief without hindrance, and in all probability France would not have experienced the disaster of Sedan. Looking at our Indian possessions, should another mutiny occur there, lines of telegraph wires would, of course, be cut and railways destroyed. At such a juncture the heliograph would prove invaluable, by maintaining communication between distant points. By its means, too, a detached force operating in hill districts could be connected with the main body of troops, or two forces like Wolseley's and Glover's in the late Ashantee war could be thus united and enabled to operate in concert. For reconnoitring, flanking, and reconnaissance parties, also, it would prove highly advantageous; it would not matter, so far as the operations were concerned, if a reconnaissance party was captured, because, unless surprised, they would have previously flashed their information back to the main army. It is not intended that the heliograph should supersede flag signalling, although in many cases it might be used with advantage in the place of flags, which are invisible at long ranges unless they can be displayed on the horizon. In fact, just at the point where flags fail the heliograph becomes useful.

The applications of the heliograph to civil purposes are not less numerous than those to military use. It would serve as a substitute for wires in countries where the electric telegraph would not pay, and where trunk lines existed they could be fed by the heliograph, which would effect communication with the outlying districts. It could be used for temporary purposes on special occasions inland, while there are countries on the coasts of which it might be substituted for expensive submarine cables. In the event, too, of short submarine cables failing, as they often do, it could be used for maintaining communication, provided the weather permitted. In short, the heliograph would appear to be an admirable adjunct to the electric telegraph in all countries, while in some it would supersede it with advantage. It is, as we have previously observed, already in use in India, and we are informed that our own Government, as well as several foreign powers, are investigating its merits with a view to its adoption.—*Times.*

The *Warehouseman* states, on the authority of a native paper, that the producers of silkworm eggs in Japan have formed themselves into companies, for the purpose of regulating the supply of the present season. The heads of these companies have resolved that the supply of cards for the eggs should be limited to 1, 730,000, one half being for exportation and the other half for home production. This quantity, after some consideration, was reduced to [illegible], but it is thought this intelligence may be somewhat incorrect in detail, and more exact news is expected.

The Board of Machinery of the Philadelphia Exhibition has issued a set of comprehensive rules and regulations for the guidance of exhibitors in the machinery department. All articles for exhibition in the machinery building will be admitted from January 5th to April 10th, 1876; heavy and bulky machinery must be sent up by April 1st, and all other not later than May 1st. Manufacturers of steam boilers, after notifying the Bureau, are required to deliver their exhibits before March, 1876, all of which must be previously subjected to a hydrostatic test in order to be accepted.

It is reported that the dairymen of Ohio are preparing to manufacture a cheese to weigh 29,000 lbs. (nearly 13 tons), the cost of which is expected to be about 18,000 dollars. This is to be shown at the Centennial Exhibition at Philadelphia next year.

According to Wagner's *Technologie Chimique*, 120 tons of bromine are now manufactured annually—[illegible] in Germany, 50 in America, 15 in Scotland, and 5 in France.

THE PIHLADELPHIA EXHIBITION.

The following letter has been received by Mr. T. B. ·tter, M.P., from the Hon. David A. Wells, the ·e United States Revenue Commissioner, and Pre- ·lent of the newly-formed American Social Science ·sociation:—

Thomas Bayley Potter, Esq., M.P., Hon. Sec. Cobden Club.

United States, August, 1875.

DEAR SIR,—It is not necessary for me to inform you ·at an International Exhibition of the products of all ·tions, commemorative of the completion of the first ·ndred years of the United States as a nation, will open ·the city of Philadelphia in May next. To be present ·d contribute to this exhibition, an invitation to the ·ople of all countries has been officially extended by the ·esident of the United States, and from Great Britain ·pecially, by reason of a common blood and close com- ·rcial intercouse, a cordial response has been antici- ·ted. An impression, however, very generally prevails ·the United States that foreign manufacturers, artists, ·d artisans are not disposed to contribute of their pro- ·cts to this exhibition—an impression due, doubtless, ·part to some recent remarks of Mr. Bright, and also ·the circumstance that, in at least one instance, an ·tire class of English manufacturers (English carpets) ·re considered and officially determined not to par- ·ipate. For what inducement, it has been per- ·ently asked, can be offered to citizens of other ·untries to send to the United States specimens ·their skill, excellence, and cheapness in production, ·en the laws and fiscal policy of the United States ·ve for years been specially framed and maintained ·h a view of excluding these same products from their ·rkets, and also from preventing their own citizens ·m taking advantage, through the reciprocal exchange ·their domestic products, of this same skill, excellence, ·cheapness. But, pertinent undoubtedly as is this ·stion, and difficult as it certainly must be for any ·zen of the United States interested in the exhibition ·satisfactorily answer it, it is nevertheless my opinion ·t foreign manufacturers will make a grievous mistake ·withholding their products from the Philadelphia ·hibition of 1876; and that there are in some respects ·re cogent reasons, even, for their contributing to the ·ited States "Centennial" than have existed in the ·e of any of the prior European International Exhibi- ·ns. For what better opportunity can possiby be ·rded to a foreign manufacturer to convince a ·ighted people of the terrible economic blunder com- ·ted in restricting exchanges by an extravagant, pro- ·itory tariff on imports than to publicly contrast the ·es of foreign productions, free of duty, or under ·derate imposts, imposed solely with a view to revenue, ·h the prevailing prices under the existing American ·ff? In short, I have no doubt that by a judicious show ·foreign commodities, bearing placards stating clearly ·conditions and cost of production, more can be accom- ·hed in a single season in educating the American ·ple up to a clear perception of the immense benefits ·tain to result from an unrestricted commercial inter- ·rse with foreign nations, such as now exists between ·separate and industrially diverse states of the Union, ·n has been achieved by all that has been written and ·l on this subject in this country during the last ·rter of a century. Through you, therefore, as secre- ·y of the Cobden Club, I desire to impress upon the ·mbers of the club, and upon all friends of economic ·rm in Europe and elsewhere, the importance of ·ing foreign manufacturers to send to the Philadelphia ·hibition, not only a full and typical assortment of ·ir respective products, but that each exhibitor also ·se to be prepared for exhibition or general distribu- ·n therewith, a clear and succinct statement of the price at which his goods are now sold in the United States under the existing American tariff, and which they could be sold for in gold if allowed importation free of duty, or under a duty of 20 per cent. *ad valorem*. To do this, it will not be necessary, in my opinion, to obtain any official authorisation in advance from the directors of the exhibition. For the fundamental idea involved in all industrial exhibitions, and more especially those of an international character, is education in respect to all the conditions involved in the production and use of the things exhibited. So that it may be confidently asserted that if any attempt should be seriously made at Philadelphia to restrain any exhibitor from properly stating the cost or selling price of his commodities under varying conditions, the motive would be so obviously a desire to prevent, for purely selfish and class interests, the people from obtaining legitimate information, that public opinion would not for one moment tolerate the restriction. In further illustration of this subject, I append the following extract of a letter recently addressed to me by Mr. J. S. Moore, of New York, one of my former official assistants under the Government, whose thorough acquaintance with our American fiscal system enables him most happily to confirm my views in respect to the opportunity now afforded for exposing to the people of the United States, the extravagance and absurdities of their existing tariff:—"As an example of what may be taught at Philadelphia," writes Mr. Moore, "suppose we take the well-known fabric which bears the name of 'Alpaca.' A quality of this article of women's wear, which costs in Bradford, England, from 8d. to 9d. per yard, cannot be sold in New York, owing to a duty of 67 per cent. *ad valorem*, and a premium of from 12 to 15 per cent. on gold, for less than 38 to 40 cents currency. But if an exhibitor of this quality of fabrics should append to them a placard bearing in clear printed letters words to this effect:—'This alpaca, which now sells in New York for 40 cents per yard currency, could, if admitted duty free, be sold for 22 cents per yard gold.' Then 'he who runs may read,' and need no interpreter to tell him the meaning of what he reads; and if a similar course were taken by all foreign exhibitors and a truly great display of foreign goods were made, then every woman, to say nothing of the men, who enters that devoted 'Centennial' will become a free-trader, and I need hardly prophecy to you the influence such an important auxiliary will have on future political platforms and elections. The Centennial 'cactus tariff' may thus blossom for the last time, and then wither under the glass roof of the Philadelphia Exhibition, with no prospect, let us hope, of blossoming again within the coming century."—I am, yours most respectfully, DAVID A. WELLS.

Colonel Forney, the United States Centennial Commissioner for Europe, says that the statement generally published in Europe, and alluded to in several of the London papers, that the people of the United States are not showing sufficient interest in the International Exhibition at Philadelphia in 1876, must create an injurious impression unless authoritatively corrected. A cable telegram from Mr. A. P. Goshorn, Director-General of the Centennial Exhibition, dated Philadelphia, September 25th, informs him that the entire space set apart for the United States in the exhibition buildings has been taken by the American exhibitors; and letters from Philadelphia, dated September 15th, announce that the American representations will be full and varied, and that all the States and territories will furnish specimens of their resources and ingenuity. Europe has already, through her different nationalities, accepted the space allotted by the Commission, and every other country, with a few exceptions, has followed the example.

A report from Lyons states that, on the whole, the French silk crop of this year is about equal to the last. It is therefore believed that the supply will be ample.

CHALET ARCHITECTURE IN SWITZERLAND.

Both socially and artistically there is much that is attractive in the architecture of the Swiss châlet. It is more especially in the German cantons that those wooden buildings are to be met with in their ancient form. Under the influence of their immediate neighbours they are rapidly disappearing from the French and Italian cantons, to be replaced by more economical, if less picturesque, constructions of stone or bricks. Mr. Jenner, Secretary of Legation at Berne, has obtained an account of the châlet architecture of Switzerland from Professor Gladbach, of the Zurich Polytechnic School, which he has embodied in his report upon the production and consumption of timber in that country. Although there is much variety in the plans of châlets, still there are certain great principles which are hardly ever departed from, which demonstrate the affinity between them and the older style of German peasant's houses, of which specimens may still be seen in the Black Forest. This affinity is most evident in the arrangement of the family room, which forms the characteristic feature of the German cottage. As a rule, this room holds such a position in the southern corner of the house, that the sun shines through it diagonally. It is nearly square, and the walls on both sides of the northern corner are pierced with numerous contiguous windows, which throw light upon the large working and eating table in this corner. This is the gathering place of the family, where the light and the warmth of the sun may be enjoyed from morning to evening. Benches are fixed to both of the sunny walls under the windows, and these have small compartments, which can readily be opened by the hand of anyone sitting on the benches.

These windows generally command a beautiful view, whilst a mere turn of the head enables the person enjoying it from the benches to keep a watchful eye upon the proceedings of the other inmates of the room. The windows are mostly latticed, and a projecting roof shelters the interior of the room from the mid-day rays of the summer sun. Not only is the symmetry of the frontage sacrificed to this arrangement of the windows, but not unfrequently in the villages houses will be met with which, with a total disregard of the street line, crane out in front of their neighbours for the sake of a freer view. The lowness of the rooms, the panelling of the walls and ceiling, and the stout boards of the floor, combine to retain in winter the heat radiating from the huge tiled stove, which fills the corner opposite the windows. Close to it are steps, which serve for seats in cold weather, and lead through a trap-door to an upper room, which derives its warmth from the same stove. In a third corner stands the immense dresser or sideboard, provided with open and locked compartments, and a flap which serves as a wash table. A clock, with hanging-weights and some neatly-carved wooden chains, complete the furniture of the family room, which only differs in the poorer and richer dwellings in the lesser or greater amount of carving which adorns the panels and furniture.

From the square shape of the family chamber is evolved the ground-plan of the old buildings. Next to that room is the sleeping apartment, which fills the adjacent space in the frontage, and stretches back the same distance; behind both of them, and completing the ground floor, is the kitchen. The kitchen-range is situated behind the above-mentioned stove, which is the only one in the house. Either one chimney is made to serve for both fires, or the kitchen smoke is left to find its way out of holes in the roof, to which the walls of a portion of the kitchen extend in height. On the south-west and north-east sides of the house are steps leading up to two opposite entrances to the kitchen, which are protected by the projecting roof. The spaces under the landings of those entrances are sometimes enclosed and utilised as pigsties, &c. Flights of stairs lead from the kitchen downwards to the cellars and upwards to the two front rooms underneath the gables, and to the covered-in balconies on the sides. The front of the house is by far the most important portion, and for it are reserved the chief efforts of the wood carver. The back wall is generally left perfectly unornamented. Some of the châlets have only a ground floor, divided in the manner described, into a family room, sleeping room and kitchen. In rare instances there are also more than two floors, but the general plan is the one described. Occasional châlets are, indeed, to be met with here and there, constructed on a totally different system, as, for instance, with a kitchen in the centre of the house, lighted from above; or, as in the Bernese Oberland, where, when two families live in one house, which is often the case, the châlet is divided down the middle, the partition wall subtending the point of meeting of the sloping sides of the roof. It is in such double châlets that the finest specimens of huge gabled fronts, twice the length of the sides, are to be met with, richly and fantastically decorated. The barns and stablings are sometimes attached to the house and sometimes separate. In the interior of Switzerland, and in the mountain districts, the former is usually the case.

With respect to the mode in which the outer walls are put together, Swiss châlets may be said to belong to three styles; two of these are undoubtedly of great antiquity, and are distinguished from the third by the fact that the walls are constructed entirely of wood. To the first belongs the so called block-house châlet which is generally raised considerably above the ground on stone foundations. The walls, projecting one beyond the other, are constructed of stout planks of fir or larch, fastened together by means of wooden pins. The second is the frame-house style, in which the walls, like those in the old German houses, are built of strong oaken posts grooved to receive planking secured by cross-pieces and bolts. The third style of châlet, which may be called the panelled, or trellis-work, mode of building, was introduced into north-east Switzerland about the beginning of the last century in consequence of the increased price of wood. It is related to the frame-house above described, which is has entirely superseded in those districts, and especially in the canton of Zurich. It may be considered as a sort of transition style between the châlet and the ordinary houses in general use in the towns. It is built upon high stone foundations from which a series of light beams, interlaced so as to form a species of trellis-work, rise upwards vertically and diagonally to support a projecting roof of varying character; the spaces between the beams are filled up with rubble and plaster. A distinguished writer holds the opinion that some of the love of home so characteristic of the Swiss may perhaps be due to the carefully devised and cunningly ornamented dwelling with which the feeling is so closely connected.

The consumption of petroleum in Japan is reported to be very large, and shiploads are received from America. Japan, however, possesses naphtha springs in its own territory, and some time since a Japanese engineer was sent to Pennsylvania to obtain information relating to the process of production and preparation. His son is still in the States purchasing the necessary machines and perfecting his studies of the subject.

In 1872, Germany imported pig-iron to the extent of 12·2 million cwt.; forge pig, 1·3; manufactured, 1·1. In 1873, the figures for the same goods were [illegible], 2·7, 1·5; in 1874, 10·9, 0·9, 0·9. The exports were—1872, 2·9, 2·3, 1·2; 1873, 0·3, 1·9, 0·9; 1874, 4·3, 2·7, 1·2.

The receipts of the French railways during the first half of the present year amounted to [illegible] fr., as compared with 370,420,997 fr. in 1874. Part of this increase is atributable to additional lines, but the revenue per kilometre was 20·787 fr. this year against 20·915 fr. last year.

[IM]PROVEMENTS IN THE MANUFACTURE OF SULPHURIC ACID.

Amongst the many improvements which are constantly [to] be met with in industrial manufactures, none are so [im]portant as those which accelerate the speed of produc[tio]n of the raw material, or which bring about the [che]apening or improvement of such material. This is [rec]ognised at once, seeing how much further the influence [of] such improvements is felt. Sulphuric acid, although [no]t in reality a raw material, yet occupies a position in [che]mical manufactures of undoubtedly equal importance, [an]d any true advance in the process of its manufacture [mu]st be recognised as a valuable gain. The statement [oft]en repeated, but nevertheless true, that a nation's in[du]strial position and commercial prosperity may be [jud]ged of by the number of tons of sulphuric acid pro[duc]ed annually, gives an idea of the unique position [wh]ich this substance occupies. This is due to the large [nu]mber of commercial products which are obtainable by [its] aid, and the very wide application which some of [the]se have. The development of the sulphuric acid [ind]ustry has been extraordinary. The first factory [of] any importance for its production in England was [ere]cted less than a century ago, while it was first [ma]de in London in the year 1772. In 1863 the [La]ncashire district, the great centre of the manufac[tur]e, produced above 700 tons weekly, independently [of] the consumption of the acid in the soda trade; [in] 1874 this amount had been increased to more [tha]n 3,000 tons per week. Since the introduction of [Ga]y-Lussac's improvements very little advance has been [ma]de in its manufacture, the process being carried on [wi]th great accuracy and with extremely little loss, so that [bu]t small inducement was offered for its improvement. It [wou]ld appear, however, from statements which may be [tak]en to be accurate, that in a very simple manner the cost [of] production may be very materially reduced, and upon [so] gigantic a manufacture even a comparatively small [red]uction in cost will be of considerable moment; in the [pre]sent case, a difference of one shilling per ton repre[sen]ting about £50,000 with reference to the annual con[su]mption of England.

The process as usually carried out is as follows:—A [su]lphur mineral is burnt upon the hearth of a furnace in [th]e presence of a sufficient supply of air; the sulphurous [ac]id so formed is sent forward into a large leaden [ch]amber, being caused to carry with it in its passage a [qu]antity of nitrous fumes, which fumes, in the chamber, [ac]t as the vehicle or carrier for the transference of the [ox]ygen from the air to the sulphurous acid, the latter, [con]sequently, becoming oxidised to form sulphuric acid. [At] different points of the chamber jets of steam are intro[du]ced for two purposes—first, to supply the proper [am]ount of water for the hydration of the sulphuric acid [co]mpound; and second, to cause the precipitation of the [so]-formed acid on to the floor of the chamber, from [wh]ence it may be run off. For a long time it was con[sid]ered that a certain heat in the chamber should be main[ta]ined, and that the steam thus introduced also effected [th]is result; this has since, however, been proved to be [er]roneous. In every 2,000 tons of acid formed in the [ch]amber there are contained about 1,000 of water, which [wa]ter, seeing that none is introduced in any other [for]m, must have been obtained by the condensation of [ste]am. The improvements referred to consist in the [us]e in the place of this steam of what has been called "[pu]lverised" or "atomised" water or spray, this spray [be]ing injected into the chambers in the place of the steam [jet]s. Dr. Sprengel, whose invention this is, has been [wo]rking at the matter for some considerable time, and [ha]s demonstrated the perfect success of the improved [arr]angement at the Lawes' Chemical Manure Company's [Wo]rks, Barking. It would seem that, beyond the chief [ad]vantage, that of the saving of fuel, there are other [ad]vantages to be obtained by this method of working; [fo]r instance, the chamber is much cooler without the use of the steam, and it is found that the yield of acid is better under such circumstances, while at the same time the chamber can be caused to do more work, as a greater quantity of the gases will be contained in them at a given time, owing to such gases occupying a less volume at the reduced temperature. The water spray is produced by the use of a small quantity of steam, which is made to escape from a platinum jet, under a pressure of about two atmospheres, into the centre of a flow of water.

Twenty pounds of steam used in this way will convert 80 lbs. of water into a fine mist, the actual weight of which issuing from a jet of the above size amounts to about one-third of a ton in twenty-four hours. These jets are placed in the sides of the chambers about 40 feet apart, being supplied with water from a tank above. The saving of coal by this arrangement amounts to about two-thirds of that formerly burnt, and from statements made by Messrs. Lawes, it would appear that they have already saved by this means during the past year upwards of 1,000 tons of coal. The amount of pyrites, and also of nitre used, is also reduced for the production of the same amount of acid. Dr. Sprengel is to be congratulated upon having made this simple and very practicable improvement, which, if it be adopted with uniform success, will mark a great advance in the manufacture of by far our most important chemical product.

FOSSIL RESIN.

A new fossil resin has been discovered in Bukovina, Austria, to which the name of *schraufite* has been given. According to a communication from the Baron de Schröckinger this resin is found in the neighbourhood of the village of Wamma, and presents considerable analogy with the other kinds of the same substance which occur in Gallicia, South Austria, and Bohemia. This schraufite of Wamma is met with in a stratum of schistose sandstone, traversing the beds of petroleum of Ropianka, and the sandstones of Magura; it forms veins the thickness of which vary from 1 to 10 centimetres (0·4 to 4 in.). The largest piece hitherto found is 16 centimetres long, 9 broad, and 8 thick ($6\frac{1}{4} \times 3\frac{1}{2} \times 3$ in.), and is deposited in the mineralogical collection of the Minister of Agriculture, Vienna. The hardness of this substance varies from 1 to 1·12. The fracture is conconchoidal, but often lamellar; though turning in a lathe is out of the question, some pieces are capable of being polished. The colour is purplish, sometimes degenerating to a duller hue. Pieces of the former colour contain $4\frac{1}{2}$ per cent. of hygroscopic water, a circumstance which renders them friable, and consequently unfit for being worked. Pieces of the blood-red colour contain 95 per cent. of water, which they lose on being heated, at the same time assuming a blackish-brown tint. Their structure is more compact, but they will not take a polish. Fusion takes place at 326° Cent. (618·8° Fahr.), with a considerable disengagement of gas and the decomposition of the whole mass; other resins all melt at 270° or 290° Cent. (518° or 554° Fahr.). Schraufite is but slightly soluble in alcohol, benzine, and chloroform, but entirely so in sulphuric acid; with caustic alkalies, it forms reddish-brown soaps, the colour of which is destroyed by chlorine gas. After distillation it leaves, as an ultimate residuum, a reddish-brown colophony, which, like that from meerschaum, yields with turpentine or the fat oils a very brilliant varnish. Quantitative analysis gives the following results:—

Carbon	73·81
Hydrogen	8·82
Oxygen	17·37
	100·

Special experiments lead to the belief that this fossil resin is not similar to meerschaum, but that it is a distinct substance.

THE NEW ADULTERATION ACT.

On the 1st inst., the Act to repeal the former Statutes on adulterations, and to make better provision for the sale of food and drugs in a pure and genuine condition, came into operation. The term "food" includes every article used for food or drink by man other than drugs or water, and "drugs" comprises medicine for internal and external use. The new law has application to the United Kingdom, and makes an important alteration as to offences. Hitherto it was sufficient to show that an article was adulterated, and many shopkeepers have been fined for selling commodities as they receive them. It is now provided that if the defendant in any prosecution prove to the satisfaction of the Court that he had purchased the article in question as the same in nature, substance, and quality as that demanded of him by the prosecutor, "and with a written warranty to that effect," that he had no reason to believe at the time when he sold it that the article was otherwise, and that he sold it in the same state as when he purchased it, he shall be discharged from the prosecution, but shall be liable to pay the costs incurred unless he has given due notice that he would rely on the above defence. The offences under the new law are described, and the Act prohibits the mixing of injurious ingredients, and the selling of the same, under heavy penalties, with exemption in the case of proof of absence of knowledge. It must be shown that such article is injurious to health; but the result is to be different where the ingredient is not injurious to health, and was not used fraudulently to conceal the bulk or the inferior quality of the article. No person is to abstract any part of an article before sale and to sell it without notice. The Act provides for the appointment of analysts in the United Kingdom. Any purchaser of an article of food or a drug can have the same analyzed at the expense of 10s. 6d. Any medical officer of health, inspector of nuisances, or inspector of weights and measures, or any inspector of a market, or any police-constable acting under the direction and at the cost of the local authority, may procure a sample and submit it to be analyzed, and a person refusing to sell the same is to be liable to a penalty not exceeding £10. After an article had been analyzed proceedings may be taken, and every penalty may be reduced or mitigated. Another alteration in the Act is that a defendant may, if he think fit, tender himself and his wife to be examined. Justices, on any complaint before them, may send an article to the Inland Revenue Commissioners to be analyzed. An appeal is given to the Quarter Sessions. For forging a certificate or warranty, the offender is to be liable to two years' imprisonment, with hard labour; and for a wilful misapplication of a warranty, or for a false warranty or false label, to a penalty of £20. From and after the 1st January next tea is to be examined by Customs officers on importation, and if found to be unfit for human food is to be forfeited and destroyed. There are several provisions as to the execution of the Act in England, Scotland, and Ireland.

From some experiments made at Trieste for the purpose of comparing different coloured lights and white light from different oils, it was ascertained:—1. That the white light given by petroleum is much more intense than the white light of paraffin; this last substance is besides liable to give an intermittent light and even to go out, which constitutes a serious drawback. 2. Of all the lights furnished by olive oil, after a white light, the red is the most brilliant and green the next. The experiments were made with hand lanterns provided with glasses of different colours.

The International Congress for the Establishment of a Uniform System of Numbering Yarns will meet in Turin on the 12th inst., under the presidency of the Italian Minister of Commerce. The previous congresses met in Brussels and Vienna.

JUVENILE EDUCATION IN JAPAN.

For the information of the observers of Japanese manners and customs, the *Japan Mail* gives a continuous budget of notes. Amongst other topics it is stated that the education of children at school rarely commences before their seventh year, according to the Japanese mode of reckoning age, and boys and girls in the infant schools receive their instruction together. A lucky day is chosen; the usual time is the beginning of the second month: the scholar takes a present to the teacher, and also cakes for his school-fellows, his parents or relatives providing the usual pencils, paper, desk, inkstand, &c. The first lesson is the *I, Ro, Ra*, in the vulgar *shirakana*, the numerals, the names of persons, countries, cities, &c., of Japan, in the order imparted. This is the introductory *Te nara*, hand learning, or writing school course. To this succeeds the study of the *sho-soku-orai*. The studies of girls generally conclude with the *Onna-Ima-Gawa*, the *Hiaku-Mu-I-Shiu*—a verse from one of a hundred poets. A book of greater pretension prepared for young ladies of more advanced powers and greater capacity follows, and a few kindred works which can hardly be called school-books. Boys are taught to write the Chinese characters; then follows a child's book; next, the volume of Confucius. The Chinese classics follow, and the boy's memory of the eye for Chinese characters is fully exercised, but no more.

School holidays in the olden time, and before the introduction of foreign professors *ad libitum*, were on the 1st, 15th, and 25th of each month. Before the latter day, the pupil brought the monthly contribution to the teacher, and a copy, to show by comparison with the last, the progress made. The half-yearly exhibition is a great event, a day for the display of best clothes, and the enjoyment of good things in the form of cakes, fruit, &c., paid for of course by the friends of the pupils, who have also to make donations to the teacher in winter for providing charcoal to warm the school-room. The boys and girls are separated, the girls remaining near the teacher, while the boys are placed nearer the door; or, if there is an upstairs room, the bigger boys are sent there in charge of the assistant teacher or pupil teacher. School parties and picnics generally demand that the pupils be dressed alike, especially the girls, who, in addition to the writing-school attend singing, dancing, and music teachers. The wealthy alone can afford to have their daughters taught at home.

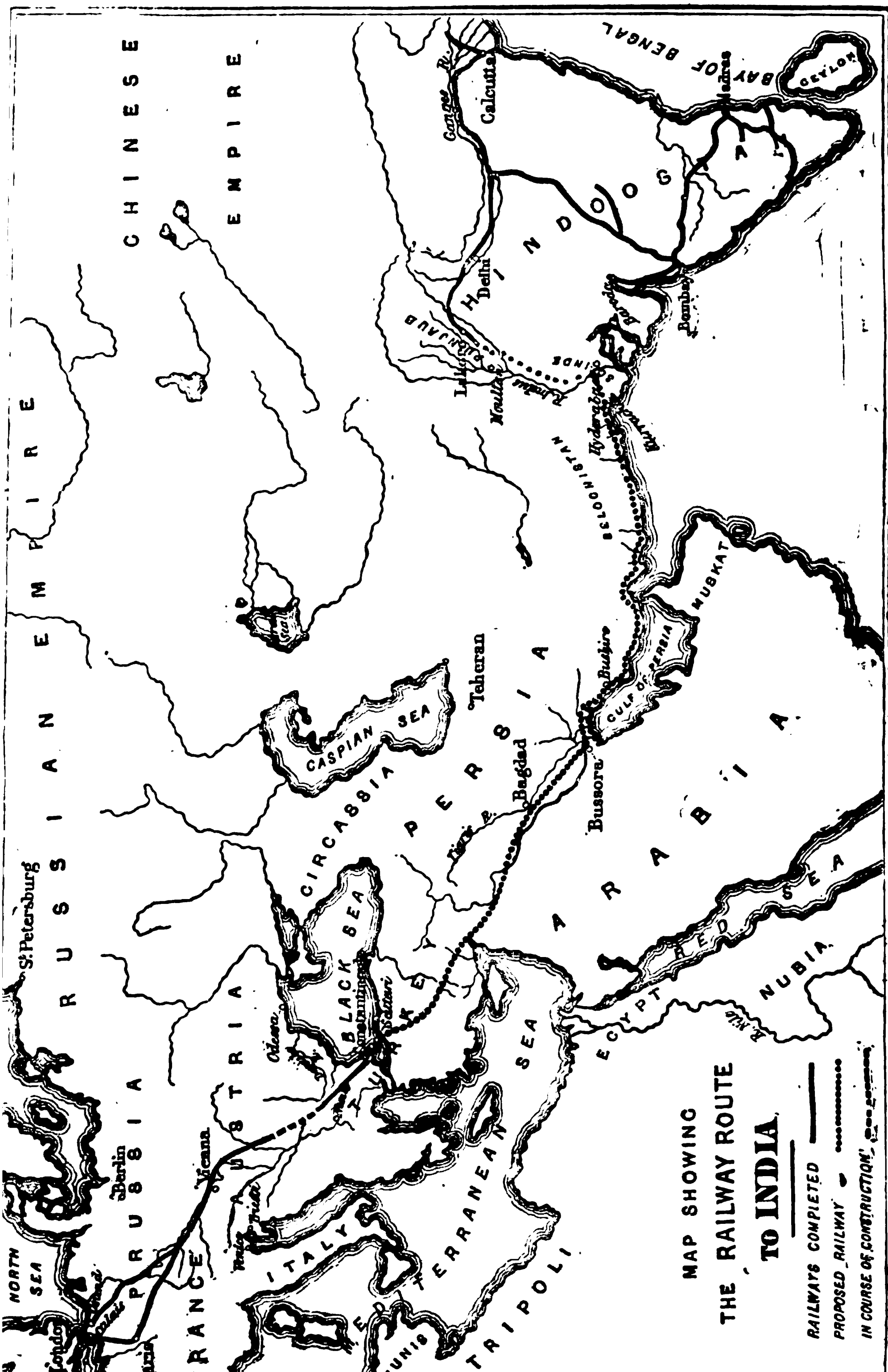
CORRESPONDENCE.

THROUGH RAILWAY TO INDIA.

Sir,—The publication of the Rev. Dr. Long's paper on "The Russian Advance in Central Asia, in its Commercial and Social Aspects towards India and the East," is accompanied by a map, which shows only the Russian projected lines, while it does not exhibit the line which is actually in progress through Turkey, and which commercially and politically is of great importance.

From England the communication exists with the Danube close to the Servian frontier at Belgrade. A mail line to the Black Sea and Constantinople has long been effectually worked from the point on the Danube by river steamers to Ruschuk, and thence by railway 140 miles long to Varna, and by Black Sea steamers to Constantinople. This also affords steam communication to Trebisond, and thereby access to the old route to Persia.

At Belgrade we have a stopping point, as the Servian Government are afraid that the through line will give access to Austrian troops, on the one side, and Turkish troops on the other. They will, however, be compelled to yield, and, if not, the Ottoman Government proposes


MAP SHOWING
THE RAILWAY ROUTE
TO INDIA
RAILWAYS COMPLETED
PROPOSED RAILWAY
IN COURSE OF CONSTRUCTION
CHINESE EMPIRE
RUSSIAN EMPIRE
S^t. Petersburg
PRUSSIA
Berlin
NORTH SEA
London
Paris
FRANCE
AUSTRIA
Vienna
ITALY
MEDITERRANEAN SEA
TUNIS
TRIPOLI
EGYPT
NUBIA
RED SEA
ARABIA
BLACK SEA
Odessa
Constantinople
TURKEY
CIRCASSIA
CASPIAN SEA
PERSIA
Teheran
Bagdad
Bussora
Bushire
GULF OF PERSIA
MUSKAT
BELOOCHISTAN
SCINDE
Hyderabad
Delhi
Calcutta
Bombay
Madras
CEYLON
BAY OF BENGAL
HINDOSTAN
Ganges R.

to carry a line through Bosnia, which has lately been examined by Captain Tyler, of the Board of Trade.

On the Turkish side most of the line is working towards Constantinople, and the rest is in progress. What portion remains unfinished was delayed on account of the exactions of the German financiers, who are considered to have been more intent on making commissions by the issue of bonds than by the execution of works. The Ottoman Government has spent enormous sums without having got what it had provided for. It is, however, determined to persevere, as the political objects are of the greatest importance to it.

Although this line so much concerns the interests of England and India, the Government of the feudal state of Servia, in the creation and protection of which we have so large a share, is allowed to throttle the extension of the whole European railway system in this direction. This is not for want of resources. It is the duty of our Foreign and Indian ministers to see to the completion of the Servian line, when the tide of European commerce and progress will set in through Servia and Turkey, and whereby the prosecution of the through railway in Europe and Asia will be ensured.

This is a matter much more easily to be effected than the protection of Merv or Kashgar.

The completion, indeed, of the remaining portion of the line in Europe gives us access not only to Constantinople, but by a branch line to Salonika on the Archipelago, which if it does not rival Brindisi as asserted, will afford an alternate line, and be particularly valuable for a steam line to Scemderoon or Suedia on the Syrian coast, affording connexion with the heads of the Euphrates and Tigris valleys. The promotion of a Euphrates or Tigris Valley Railway will, it is affirmed, be promoted by the transit with Salonika.

From Constantinople or Skutari, on the other side of the Bosphorus, the railway is open to Ismid, and has been working for a couple of years. The energies of the Government being directed to the European or Rumelian lines, those in Asia Minor have been kept back. The extension from Ismid to Angora is now being surveyed, and the Sultan proposes to appropriate £480,000 yearly from his civil list to ensure its construction.

When the hitch is got over at Belgrade, and the European portion of the through line to India is completed, it is possible measures may be taken to proceed with the Euphrates Valley section, independently of and concurrently with the Asia Minor section.

In the Persian Gulf the steam communication with India has been improved, while Kurrachee has been made more available for shipping, and the connexion of the Indian railways through Scinde is being prosecuted.

Thus, notwithstanding difficulties, and perhaps the greatest difficulty of all, the supineness of our own Government, the line of communication through Turkey proceeds, because it is a matter of local political value to the Ottoman Government, which has found the means for its prosecution, while we have not afforded moral help and co-operation.—I am, &c.,

Hyde Clarke.

32, St. George's-square, S.W.

FOOD PRESERVATION.

Sir,—As a member of the Society, and one who has been engaged for years in researches bearing on the preservation of meat, I must protest against the conclusions drawn in the article published in your issue of the 1st of October. The writer cannot but "regret that food preservation has made so little progress during the last few years." It is my impression that, in this department, the progress of knowledge during the past decade quite equals the advances made in other branches of science and the arts. The contrast in grocers and other shops nowadays (the shelves of which are groaning under the weight of admirably preserved delicacies of all kinds) if compared with only a few years since must strike everyone.

When the cattle disease question induced me to search for trade measures for the prevention of plagues I soon discovered that "the great desideratum" was not "beef and mutton preserved in receptacles in a fresh state," but the preservation and transportation of the carcases of animals in the cheapest and most open manner.

I unhesitatingly affirm that, starting with the original plan adopted by me of slaughtering animals by means of carbonic oxide gas, and then subjecting the meat, while cold, to the action of readily measured quantities of antiseptic gases, no difficulty stands in the way of importing fresh meat.

The prompt abstraction of animal heat after slaughter, especially in hot countries, is an essential part of the system, destined to preserve meat uncooked, [illegible] rapid desiccation set in.

It was owing to the instantaneous decay after death of animals in Texas, that I engaged in my labours of the past five years, directed towards cheapening the production of artificial cold. The preservation of a good colour and absolute freshness of large quantities of meat for any lengthened period necessitates that a moderately low temperature be maintained in the holds of ships.

The two systems to be carefully avoided [illegible] to supply animal food to this country are (1st) the import of live animals, and (2) the import of frozen provisions. Both are wasteful. Live stock imported [illegible] did and always will largely curtail the meat supply by destroying more home-grown animal food than we can possibly import. On the other hand, freezing meat is a troublesome, expensive, and wasteful process which never can find favour unless all other methods are insufficient.

Your remark with reference both to refrigeration and desiccation, that they can hardly be called scientific processes, I cannot endorse. The most simple and the effective means to an end are necessarily the most scientific. We are not independent of either refrigeration or desiccation, any more than we are altogether of the use of antiseptics in transporting cargoes of meat from abroad. The knowledge has been acquired whereby, say Russian or American beef may be hung up fresh in British butchers' shops, and under proper management the combined cost of preservation and transportation should not exceed and indeed should be much less than the cost of transporting live animals. I have always failed with expensive processes and [illegible] coverings or packings. The conditions to be observed are known, and notwithstanding the inertia which always obstructs great reforms, it is quite certain that the imports of fresh meat will soon supersede the [illegible] pernicious importation of fat animals for slaughter.

If the Food Committee of the Society of Arts, [illegible] of acting as a tasting committee, will stimulate the Government and the great Agricultural Societies to defray the expenses of conclusive experiments on the subject, we may the sooner accomplish our purpose. I have offered, without fee or reward, to place my [illegible] information at the disposal of the country, but the work must be done thoroughly, and I could take no part in isolated trials under partial conditions not calculated to settle the question once and for always. I [illegible] to fail, and whereas others have been working [illegible] at the subject, the point of first importance [illegible] against selfish and conflicting interests.

The best means by whomsoever suggested should be tested, but no one can superintend the work without the experience of years to guide him. We might as well trust any any but an expert to lay an Atlantic cable.—I am, &c.,

John Gamgee.

1, Kensington-gardens-square, London, W.,
Oct. 4, 1875.

—In the instructive article on Food Preservation larrison's attempt is alluded to, and his reason for is thus quoted:—"Unfortunately the construc- the ice-chamber by the workmen employed was fect, and the ice supply failed before the voyage tle more than half over." I wish to call atten- real cause of failure.

ugh ice is ice, yet there is so much difference in lue that success or non-success in such matters ls on its prime temperature, for if taken imme- below the freezing point it soon thaws. In the y of the ice-carrying trade from the United States East such great losses occurred that the exporters learnt to take it from places further north than n's Bay, whence it became a most profitable for the loss on a voyage to Calcutta was estimated believe, as not exceeding 5 per cent. on a four ' voyage. That used by Mr. Harrison was either ed American ice or was artificially produced in lony, as to both of which it may be said that its ature on the day of the experimental shipment at little below the freezing point. Our southern l governments should seek for and find some suitable ot far south of them where they could obtain and ips with ice of a low temperature, and it would be a very remunerative business to supply themselves en India, far more so than to depend on Hudson's r Sitka, in the North Pacific, or that from artifi- urces; and such a trade would soon reach large tions, for at present the high price of a very ble ice considerably prevents its sale both there the tropics. South Victoria may roughly be put about 2,000 miles south of Melbourne, or say a ht's distance, and doubtless a surveying vessel soon find a suitable place for shipment of an which at a 1d. a-lb. does look insignificant, but form of £9 6s. 8d. a-ton would be found to leave some profit. In the absence of such information, d think that Mr. Harrison paid nearly 3d. per lb., per ton (nearly double the price of guano in Eng- r this ice, and that, too, when it was not far from at of dissolution.—I am, &c., J. F. D.

, October 4th, 1875.

NOTES ON BOOKS.

h Metric Arithmetic.—By J. Gregory. London: Cassell, Petter and Galpin.

bject of Mr. Gregory in this, as well as in some orks of which he appears to be the author, is to rward a system of weights and measures which may ise with the French system, and yet possess the ges of our existing method. It is well known inion—even in the case of the best informed—is equally divided as to the comparative merits of systems, one permitting an easy division by quarters, &c., and the other preserving a perfect ity, and affording great simplicity in calculation. d be easy to reckon up as many authorities side as the other, while as to the general may safely be said that they are quite apathetic atter, being merely averse to the trouble involved alteration of existing weights and measures. re indeed some points in this question that are d on all hands. There is no gain, but great incon- in having three distinct scales with equivalents ar name but different value, when the pound pois) may consist of 7,000 grains or (troy and aries) 5,760 grains, and may be divided into 12 oz. value, or 16 of another. Nor can anything ctical loss and confusion come from a variety of as between two countries trading together. As commerce, no general attempt has been made to get over this difficulty, though in all branches of science workers in different countries have recognised the absolute necessity for a common language in this respect. Hence we find all recent English scientific books using "grams," "millimetres," the "Centigrade" scale, instead of "grains," "inches," and the "Fahrenheit" scale. The system is not, of course, universal, but it is very nearly so, and will, doubtless, soon quite drive out the older methods. To accomplish a similar reformation in the concerns of daily life, or even in such engineering and architectural works as require much labour of a less highly-educated sort, is a more difficult matter. A change has lately been advocated, but no practical advance towards it has been made. Perhaps one of the principal obstacles is the want of agreement among the advocates of reform as to the reform required. Some—with the late Sir John Herschel—would admit of certain slight internal changes, sufficient to reconcile and convert together our measures (capacity and length) and our weights, while others would have us bodily adopt the French system as it stands. Sir J. Herschel, it will be remembered, suggested a slight alteration in the length of the yard (the addition of a thousandth), which would make it an exact subdivision of the polar axis, while at the same time it brought into connection the measures of capacity and weight, by making a (new) cubic foot of water contain exactly 1,000 oz., or so nearly that amount that a slight change in the ounce (an increase by one part in 8,000) would make such a division absolutely true. Mr. Gregory's proposal so far reminds the reader of Sir J. Herschel's, that he also proposes a slight change in our present standards, though he goes to work in a somewhat more wholesale manner than the late distinguished philosopher. He would make the British inch equivalent to 25 millimetres, and would thus make absolutely correct the present rough and ready method of converting inches to parts of the metre—taking four inches as equal to the decimetre. This means a reduction of our existing standards by one sixty-fourth, a very appreciable change, though not so sweeping an alteration as would be involved by the adoption of the metric system as it stands. As regards weights and measures of capacity, the differences are greater and more complicated, and though they are assimilated to the corresponding denominations of the French system, they certainly do not preserve the same easily appreciable relations to their existing equivalents as do the measures of length.

GENERAL NOTES.

National Penny Bank, Limited.—On Tuesday, September 28th, a meeting was held at 257, Edgware-road, one of the branches of the bank, for the purpose of promoting habits of thrift and of explaining the objects of the above bank. The Hon. E. Stanhope, M.P., was in the chair, and there were also present among others Sir Henry Cole, K.C.B., Major-General F. Eardley-Wilmot, R.A., Hamilton N. Hoare, Esq., and George C. T. Bartley, Esq. It was announced that this branch would be opened on October 9th. The occasion would appear to be opportune, for the Paddington Savings Bank, which held upwards of £120,000, was closed in February last, and less than half the amount has been invested in the Post-office Savings Banks, the remainder having been retained by the depositors. The National Penny Bank, which has been established on a similar basis to the Yorkshire Penny Bank, has already arranged to open branches in all parts of London. Deposits to any amount, from one penny upwards, will be received, and small sums of consols (16s. 8d. worth giving 6d. a-year interest) will be sold to the public. The clergy and ministers of the district were especially invited to the meeting on Tuesday, in order to elicit their co-operation and support, and the establishment of an influential local committee was commenced.

Exhibition of Industrial Art.—The Union Centrale de Beaux Arts appliqués, of Paris, announces its intention of organising for next year a retrospective exhibition on a still larger basis than that which drew crowds to the Palais de l'Industrie last year. The programme of the coming exhibition will not be confined to a collection of artistic productions grouped in classes, but an attempt will be made to give the public as complete an idea as possible of the application of architecture, sculpture, and painting to dwelling houses during past centuries. From the commencement of the eleventh to about the thirteenth, only drawings of public monuments are generally to be obtained. Of such the administration of Beaux Arts has placed at the disposal of the committee for the exhibition, a magnificent collection from the fourteenth to the eighteenth century. Each marked epoch will be illustrated by various rooms decorated in the then style, and furnished with real furniture, hangings, and ornaments of the period. The preliminary plans have been drawn up by MM. Parent and Perthes, and are to be carried out by M. Lorain, architect. As was the case last year, there will be a collection of modern works of ornamental art in conjunction with the retrospective exhibition.

Beer in Tablets or Paste.—In connection with a recent article in the *Journal* on this subject, it may be interesting to note that a method has just been patented in France of fabricating beer concentrated in the shape of tablets or paste. For 1,000 litres of Strasburg beer in this form are required 380 to 400 kilogs. of malt or sprouted barley, 7 or 8 kilogs. of hops, and about half the ordinary quantity of water. The mixture is placed in a caldron with some fermentable sugar, and boiled down. To prepare it for use, 100 kilogs. of the concentrated product are added to 100 litres of drinking water, and after the lapse of 24 hours the ferment is put in. The vessel is filled up with water every 12 hours, and at the end of 5 days the beer is ready for use. The ferment is kept separately, and added a few days only before the beer is required for use. An addition to the patent provides for the preparation of the beer in capsules or packets, each containing enough for 1 litre of beer. The ferment is prepared in separate packets of proportionate size.

Metal-work among the Hindoos.—For several centuries India has enjoyed the reputation of having produced some of the most tasteful, if not the finest quality of armour; and the manufacture of swords, spears, daggers, warlike weapons, elephant goads, state umbrella handles, chain-armour, and insignia of rank, has given employment to skilled workmen all over the country. As in Europe in olden times, the chief encouragement has come from the princes, nobles, and zemindars, or wealthy landowners, who have usually kept in their employ skilled workmen and their families, who have devoted all their time and talents to the perfecting of some particular branch of industry. It is for this reason, says Dr. Hunter, in the *Art Journal* for the present month, that we often see an amount of labour, manipulative skill and taste expended upon single small articles of little intrinsic value, which would not have been produced to meet the requirements of the ordinary market; but where the workmen have been in the employ of some wealthy rajah, upon whose bounty the whole family has been dependent, time and labour were not of so much consequence as manipulative skill and tasteful finish. This principle has been applied to nearly all the best art industries of India, and the result has been that large families have been trained for successive generations to particular industries, which have been carefully retained, fostered, and brought to perfection in particular districts or villages. Caste prejudices have also contributed in no small degree to keep up the practice, which has some good points to recommend it, though there are objections to the system also, the most serious of which has been that an industry has often died out in a village by the death of the rajah who encouraged it, or on the death of the most skilled workmen. The finest coats-of-mail and chain-armour have been produced in Upper India, and the helmets, cuirasses, shields, armlets, and gauntlets, inlaid with gold, are often most tastefully decorated. The localities where these manufactures attained to the greatest perfection were the Punjab, Umritsur, Delhi, Cashmere and Nagpore. Small weapons, as swords, daggers, battle-axes, elephant goads, and insignia of royalty or of wealth or rank, have been made all over India, and the courts of Hyderabad, Tanjore, Vizianagram, Travancore, Poodoocotta, and many others have encouraged these and similar manufactures.

Mining Prizes.—In order to stimulate research, [illegible] periment, and invention, and to promote the advancement [illegible] mining enterprise in Cornwall and Devon, Mr. G. L. [illegible] of Tehidy, offers prizes under the following [illegible] 1. For the discovery of a new mineral, in Cornwall [illegible] which is deemed likely to become commercially [illegible] prize of £50. An accurate annalysis and a [illegible] leading physical properties and distinguishing [illegible] of the mineral to be given, specimens to be [illegible] committee, and the locality and mode of [illegible] distinctly described. 2. For the invention [illegible] mechanical or chemical—of making marketable [illegible] mercial advantage, ores or minerals produced in [illegible] Devon, and hitherto regarded as worthless or of [illegible] The method to be clearly described, and [illegible] product in its several stages to be handed to the [illegible] or, for the discovery of some new application [illegible] substance already known to occur in Cornwall [illegible] either by itself or in combination, to some useful [illegible] as to render it of marketable value, or materially [illegible] its value if already marketable to some [illegible] £100. The prizes to be awarded at the [illegible] according to the judgment of a committee, [illegible] President and Hon. Sec. of the Miners' [illegible] some other gentlemen to be nominated by [illegible] communications on this subject must be [illegible] first instance, to Mr. J. H. Collins, F.G.S., [illegible] Miners' Association of Cornwall and [illegible] street, Truro.

Flax in Russia. — A commission [illegible] Russian Government with the organisation [illegible] of an exhibition of textile plants and [illegible] tention in its report to the extensive [illegible] empire, and the comparative insignificance [illegible] facture, especially when the extent of the [illegible] manufacture is considered. The total [illegible] Russia last year was estimated at 12,000,000 [illegible] cent. of the entire production of Europe. [illegible] mills in Russia engaged in the cotton [illegible] which 122,000 workpeople are employed, [illegible] being valued at 98,000,000 roubles (£14,[illegible] number of spinning and weaving mills in the [illegible] however, is only 111, in which 2,000 [illegible] the annual production being valued at about [illegible] roubles (£1,571,430). The report expresses [illegible] should have been diverted to the cotton [illegible] neglect of linen, as the development of the [illegible] industry would benefit the agricultural as well as the [illegible] classes. An important drawback to the linen [illegible] the distance of the spinning and weaving mills from [illegible] tricts in which flax is grown. The cultivators [illegible] mended to exercise more care in the selection of [illegible] spinners and weavers to substitute perfected [illegible] in harmony with the development of [illegible] ally, for the routine and obsolete methods to [illegible] become accustomed. The formation of [illegible] is also urged, and the Government and [illegible] are asked to take steps for indicating to [illegible] capitalists the best localities for the cultivation [illegible] and the establishment of the works. The [illegible] vised to encourage and stimulate enterprises [illegible] subventions, prizes, and periodical exhibitions.—[illegible] *man.*

THE LIBRARY.

The following works have been [illegible] Library:—

British Metric Arithmetic, by Isaac [illegible] Presented by the Author.

The Free School System of the [illegible] Francis Adams. Presented by the [illegible] Chapman and Hall.

St. James's Magazine. Vol. 1. [illegible] Townshend Mayer. Presented by the [illegible]

Metropolitan Board of Works. [illegible] polis.

Keramic Art of Japan, by G. A. [illegible] Bowes. Part 2. Presented by the [illegible]

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ll communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ESULT OF TECHNOLOGICAL EXAMINATIONS, 1875.

The following candidates having passed in the rescribed subjects at the Examinations of the cience and Art Department, and having been re- orted by the Society's Examiners as having passed n Technology, the Council have awarded them ertificates, as follows:—

Agriculture and Rural Economy.

90989*—Read, James Marsh, 19, City of London College —1st Elementary, with the Prize of £5.

Carriage Building.

0993—Casson, William Thompson, 31, Aspatria, Cumberland — 1st Elementary, with the Prize of £5.

0991—Mullins, Mathew, 21, Cork School of Art—1st Advanced, with the Prize of £7.

Cloth Manufacture.

2427—Heywood, John, 23, Royal Institution, Swansea —2nd Honours.

Cotton Manufacture.

2423—Ashworth, James Edward, 19, Manchester Mechanics' Institution—1st Advanced, with the Prize of £7.

2421—Bickerton, Henry N., 17, Oldham Science School —2nd Elementary.

0500—Firth, William, 18, Huddersfield Mechanics' Institution—2nd Elementary.

2418—Harrison, John Edward, 17, Oldham Science School—1st Elementary, with the Prize of £5.

2424—Mills, Thomas G., 24, Manchester Mechanics' Institution—1st Honours, with the Prize of £10.

2414—Wilby, Richard, 30, Elland Science School—2nd Elementary.

Gas Manufacture.

0985—Akroyd, Benjamin, 32, Elland Science School—1st Elementary.

0984—Hepworth, Reuben A., 21, Elland Science School —1st Elementary, with the Prize of £5.

0982—Strachan, Thomas, 30, Science Classes, Allen-street, Kensington—1st Elementary.

Steel Manufacture.

60492—Bedford, William, 25, Manchester Mechanics' Institution—1st Elementary.

60481—Hutchinson, Christopher Clarke, 21, Leeds Mechanics' Institution—1st Honours, with the Prize of £10.

60489—Needham, Joseph Edward, 18, Oldham Science School—2nd Elementary.

60488—Ogden, Fred, 16, Oldham Science School—1st Elementary, with the Prize of £5.

60494—Pillow, Edward, 22, Crewe Mechanics' Institution—2nd Elementary.

60482—Westmoreland, John, 21, Nottingham Mechanics' Institution—2nd Elementary.

Wool Dyeing.

90990—Wilkinson, J. B., 29, Huddersfield Mechanics' Institution—1st Elementary, with the Prize of £5.

The following have been reported by the Society's Examiners as having passed in Technology, but not having passed the required Examinations of the Science and Art Department, no certificates have been awarded to them:—

Agriculture and Rural Economy.

90988—Brennan, John, 22, Armagh Natural History Society—1st Elementary.

Carriage Manufacture.

32647—Mead, Benjamin, 28, Aylesbury Endowed School —2nd Elementary.

90992—Mercer, John Henry, 17, Oldham Science School —2nd Elementary.

Cloth Manufacture.

90981—Hooson, William, 30, Elland Science School—2nd Honours.

90980—Sykes, Edmund, 32, Elland Science School—2nd Advanced.

Cotton Manufacture.

72416—Beaumont, Albert Edward, 17, Oldham Science School—1st Elementary.

72420—Chadwick, Thomas Henry, 32, Oldham Science School—1st Elementary.

72419—Warrenner, Albert, 18, Oldham Science School—1st Elementary.

Gas Manufacture.

90986—Dronsfield, John, 18, Oldham Science School—2nd Elementary.

90983—Gilcriest, Thomas, 52, St. John's Schools, Sligo —1st Elementary.

90987—Harris, Edward Heane, 23, Gloucester Science School—2nd Elementary.

Steel Manufacture.

60499—Alldred, John, 21, Wolverton Science and Art Institute—2nd Honours.

60496—Dawson, Oliver Samuel, 21, Wolverton Science and Art Institute—2nd Advanced.

60495—Gow, George, 18, Wolverton Science and Art Institute—2nd Elementary.

60490—Hayes, Thomas, 24, Oldham Science School—2nd Elementary.

60486—Sugden, Thomas, 25, Oldham Science School—1st Advanced.

The above candidates, by passing the required Science Examination; in a future year, can obtain certificates.

* The numbers are those given at the Science and Art Examinations of the present year.

COMMERCIAL EXAMINATIONS.

The programme of these Examinations, for 1876, is now ready, and may be had *gratis*, on application to the Secretary.

FOOD COMMITTEE.

On Wednesday last, the 13th inst., some specimens of Australian beef and mutton were submitted to the examination of the Committee. The meat was packed in two tin-lined cases, each containing about 130lbs.; it was in separate joints, each joint wrapped in prepared calico, and the whole packed in charcoal. It was despatched from Melbourne at the end of May. On opening the packages the meat was found to be in an advanced stage of decomposition.

MISCELLANEOUS.

HEALTH AND CIVILISATION.

By Benjamin W. Richardson, M.D., F.R.S.*

We meet in this assembly, a voluntary Parliament of men and women, to study together and to exchange knowledge and thought on works of every-day life and usefulness. Our object, to make the present existence better and happier; to inquire, in this particular section of our Congress—What are the conditions which lead to the pain and penalty of disease; what the means for the removal of those conditions when they are discovered? What are the most ready and convincing methods of making known to the uninformed the facts, that many of the conditions are under our control; that neither mental serenity nor mental development can exist with an unhealthy animal organisation; that poverty is the shadow of disease, and wealth the shadow of health?

These objects relate to ourselves, to our own reliefs from suffering, to our own happiness, to our own riches. We have, I trust and believe, yet another object, one that relates not to ourselves, but to those who have yet to be; those to whom we may become known, but whom we can never know, who are the ourselves, unseen to ourselves, continuing our mission.

We are privileged more than any who have as yet lived on this planet in being able to foresee, and in some measure estimate the results of our wealth of labour as it may be possibly extended over and through the unborn. A few scholars of the past, like him who, writing to the close of his mortal day, sang himself to his immortal rest with the *Gloria in excelsis*, a few scholars might foresee, even as that Bœda did, that their living actual work was but the beginning of their triumphant course through the ages—the momentum. But the masses of the nations, crude and selfish, have had no such prescience, no such intent. "Let us eat and drink, for to-morrow we die." That has been the pass, if not the password, with them and theirs.

We, scholars of modern thought, have the broader, and therefore more solemn and obligatory knowledge, that however many to-morrows may come, and whatever fate they may bring, we never die; that, strictly speaking, no one yet who has lived has ever died; that for good or for evil our every change from potentiality into motion is carried on beyond our own apparent transitoriness; that we are the waves of the ocean of life, communicating motion to the expanse before us, and leaving the history we have made in the shore behind.

Thus we are led to feel this greater object: that to whatever extent we, by our exertions, confer benefits on those who live, we extend the advantage to those who have to live; that one good thought leading to practical useful action from one man or woman, may go to the virtue of thousands of generations; that one breath of health wafted by our breath may, in the aggregate of life saved by it, represent in its ultimate effect all the life that now is or has been.

At the close of a parliamentary session, an uneventful leader of a section of Parliament banters his more eventful rival, and enlivening his criticism by a sneer at our Congress, challenges the contempt of his rival, as if to draw it forth in the same critical direction. Alas! it is too true that great congresses, like great men, and even like parliaments, do live sometimes for many years and talk much, and seem to miss much and advance little; so that in what relates to the mere present, it were wrong, possibly, to challenge the sally of the statesman, who, from his helpless height, looked down on our weakness. But inasmuch as no man knoweth the end of the spoken word, as that which is spoken to-day, earnestly and simply, may not re-appear for years, and may then appear with force and quality of hidden virtue, there is reason for our uniting together beyond the proof of necessity which is given in the fact of our existence. Perchance some day our natural learning, gathered in our varied walks of life, and submitted in open council, may survive even Parliamentary strife; perchance our resolutions, though no sign-manual immediately grace them, are the informal bills which ministers and oppositions shall one day discuss. Parliaments pass, royal hands sign, and the fixed administrators of the will of the nation duly administer.

These thoughts on the future, rather than on the passing influence of our congressional work, have led me to the simple design of the address which, as President of this section, I venture to submit to you to-day. It is my object to put forward a theoretical outline of a community so circumstanced and so maintained by the exercise of its own freewill, guided by scientific knowledge, that in it the perfection of sanitary results will be approached, if not actually realised, in the co-existence of the lowest general mortality with the highest possible individual longevity. I shall try to show a working community in which death—if I may apply so common and expressive a phrase on so solemn a subject—in which death is kept as nearly as possible in its proper or natural place in the scheme of life.

Before I proceed to this task, it is right I should ask of the past what hope there is of any such advancement of human progress. For as my Lord Verulam quaintly teaches, "the past ever deserves that men should stand upon it for awhile to see which way they should go, but when they have made up their minds they should hesitate no longer, but proceed with cheerfulness." For a moment, then, we will stand on the past.

From this vantage-ground we gather the fact, that onward with the simple progress of true civilisation the value of life has increased. Ere yet the words "Sanitary Science" had been written; ere yet the heralds of that science, some of whom, in the presence of our illustrious colleagues, Edwin Chadwick and William Farr, are with us in this place at this moment: ere yet these heralds had summoned the world to answer for its profligacy of life, the health and strength of mankind was undergoing improvement. One or two striking facts must be sufficient in the brief space at my disposal to demonstrate this truth. In England, from 1790 to 1810, Heberden calculated that the general mortality diminished one-fourth. In France, during the same period, the same favourable returns were made. The deaths in France, Berard calculated, were 1 in 30 in the year 1780, and during the eight years, from 1817 to 1825, 1 in 40, or a

* Opening Address of the Health Section of the Social Science Congress.

fourth less. In 1780, out of 100 new-born infants, in France, 50 died in the two first years; in the later period, extending from the time of the census that was taken in 1817 to 1827, only 38 of the same age died, an augmentation of infant life equal to 25 per cent. In 1780 as many as 55 per cent. died before reaching the age of ten years; in the later period 43, or about a fifth less. In 1780 only 21 persons per cent. attained the age of 50 years; in the later period 32, or eleven more reached that term. In 1780 but 15 persons per cent. arrived at 60 years; in the later period 24 arrived at that age.

Side by side with these facts of the statist we detect other facts which show that in the progress of civilisation the actual organic strength and build of the man and woman increases. Just as in the highest developments of the fine arts the sculptor and painter place before us the finest imaginative types of strength, grace, and beauty; so the silent artist, civilisation, approaches nearer and nearer to perfection, and by evolution of form and mind developes what is practically a new order of physical and mental build. Peron—who first used, if he did not invent, the little instrument, the dynamometer, or muscular strength measurer—subjected specimens of different stages of civilisation to the test of his gauge, and discovered that the strength of the limbs of the natives of Van Dieman's Land and New Holland was as 50 degrees of power, while that of the Frenchman was 69, and of the Englishman 71. The same order of facts is maintained in respect to the size of body. The stalwart Englishman of to-day can neither get into the armour nor be placed in the sarcophagus of those sons of men who were accounted the heroes of the infantile life of the human world.

We discover, moreover, from our view of the past, that the developments of tenacity of life and of vital power have been comparatively rapid in their course when they have once commenced. There is nothing discoverable to us that would lead to the conception of a human civilisation extending back over two hundred generations; and when in these generations we survey the actual effect of civilisation—so fragmentary, and overshadowed by persistent barbarism—in influencing disease and mortality, we are induced to the observation of at most twelve generations, including our own, engaged, indirectly or directly, in the work of sanitary progress. During this comparatively brief period, the labour of which, until within a century, has had no systematic direction, the changes for good that have been effected are amongst the most startling of historical facts. Pestilences which decimated populations, and which, like the great plague of London, destroyed 7,165 people in a single week, have lost their virulency; gaol fever has disappeared, and our gaols, once each a plague-spot, have become, by a strange perversion of civilisation, the health-spots of, at least, one kingdom. The term black death is heard no more; and ague, from which the London physician once made a fortune, is now a rare tax even on the skill of the hard-worked Union medical officer.

From the study of the past we are warranted, then, in assuming that civilisation, unaided by special scientific knowledge, reduces disease and lessens mortality, and that the hope of doing still more by systematic scientific art is fully justified.

I might hereupon proceed to my project straightway. I perceive, however, that it may be urged, that as mere civilising influences can of themselves effect so much, they might safely be left to themselves to complete, through the necessity of their demands, the whole sanitary code. If this were so, a formula for a city of health were practically useless. The city would come without the special call for it.

I think it probable the city would come in the manner described, but how long it would be coming is hard to say, for whatever great results have followed civilisation, the most that has occurred has been an unexpected, unexplained, and therefore uncertain arrest of the spread of the grand physical scourges of mankind. The phenomena have been suppressed, but the root of not one of them has been touched. Still in our midst are thousands of enfeebled human organisms which only are comparable with the savage. Still are left amongst us the bases of every disease that, up to the present hour, has afflicted humanity.

The existing calendar of diseases, studied in connection with the classical history of them written for us by the longest unbroken line of authorities in the world of letters, shows, in unmistakable language, that the imposition of every known malady of man is coeval with every phase of his recorded life on the planet. No malady, once originated, has ever actually died out; many remain as potent as ever. That wasting fatal scourge, pulmonary consumption, is the same in character as when Cœlius Aurelianus gave it description; the cancer to-day is the cancer known to Paulus Eginæta; the black death, though its name is gone, lingers in malignant typhus; the great plague of Athens is the modern great plague of England, scarlet fever; the dancing mania of the middle ages and convulsionary epidemic of Montmarte, subdued in its violence, is still to be seen in some American communities, and even at this hour in the New Forest of England; small-pox, when the blessed protection of vaccination is withdrawn, is the same virulent destroyer as it was when the Arabian Rhazes defined it; ague lurks yet in our own island, and, albeit the physician is not enriched by it, is in no system changed from the ague that Celsus knew so well; cholera, in its modern representation is a more terrible malady than its ancient type, in so far as we have knowledge of it from ancient learning; and even that fearful scourge the great plague of Constantinople, the plague of hallucination and convulsion which raged in the fifth century of our era, has in our time, under the new names of tetanoid fever and cerebro-spinal meningitis, been met with here and in France, and in Massachusetts has, in the year 1873, laid 747 victims in the dust.

I must cease these illustrations, though I could extend them fairly over the whole chapter of disease, past and present. Suffice it if I have proved the general proposition, that disease is now as it was in the beginning, except that in some examples of it it is less virulent; that the science for extinguishing any one disease has yet to be learned; and that, as the bases of disease exist, untouched by civilisation, so the danger is ever imminent, unless we specially provide against it; that the development of disease may occur with original virulence and fatality, and may at any moment be made active by accidental or systematic ignorance.

A City of Health.

I now come to the design I have in hand. Mr. Chadwick has many times told us that he could build a city that would give any stated mortality, from fifty, or any number more, to five, or perhaps some number less, in the thousand annually. I believe Mr. Chadwick to be correct to the letter in this statement, and for that reason I have projected a city that shall show the lowest mortality. I need not say that no such city exists, and you must pardon me for drawing upon your imaginations as I describe it. Depicting nothing whatever but what is at this present moment easily possible, I shall strive to bring into ready and agreeable view a community not abundantly favoured by natural resources, which, under the direction of the scientific knowledge acquired in the past two generations, has attained a vitality not perfectly natural, but approaching to that standard. In an artistic sense it would have been better to have chosen a small town or large village than a city for my description; but as the great mortality of states is resident in cities, it is practically better to take the larger and less favoured community. If cities could be transformed, the rest would follow.

Our city, which may be named "Hygeia," has the advantage of being a new foundation, but it is so built that existing cities might be largely modelled upon it.

The population of the city may be placed at 100,000, living in 20,000 houses, built on 4,000 acres of land—an average of 25 persons to an acre. This may be considered a large population for the space occupied, but, since the effect of density on vitality tells only determinately when it reaches a certain extreme degree, as in Liverpool and Glasgow, the estimate may be ventured.

The safety of the population of the city is provided for against density by the character of the houses, which ensure an equal distribution of the population. Tall houses overshadowing the streets, and creating necessity for one entrance to several tenements, are nowhere permitted. In streets devoted to business, where the tradespeople require a place of mart or shop, the houses are four stories high, and in some of the western streets, where the houses are separate, three and four storied buildings are erected; but on the whole it is found bad to exceed this range, and as each story is limited to 15 feet, no house is higher than 60 feet.

The substratum of the city is of two kinds. At its northern and highest part, there is clay; at its southern and south-eastern, gravel. Whatever disadvantages might spring in other places from a retention of water on a clay soil, is here met by the plan that is universally followed, of building every house on arches of solid brickwork. So, where in other towns there are areas, and kitchens, and servants' offices, there are here subways through which the air flows freely, and down the inclines of which all currents of water are carried away.

The acreage of our model city allows room for three wide main streets or boulevards, which run from east to west, and which are the main thoroughfares. Beneath each of these is a subway, a railway along which the heavy traffic of the city is carried on. The streets from north to south which cross the main thoroughfares at right angles, and the minor streets which run parallel, are all wide, and, owing to the lowness of the houses, are thoroughly ventilated, and in the day are filled with sunlight. They are planted on each side of the pathways with trees, and in many places with shrubs and evergreens. All the interspaces between the backs of houses are gardens. The churches, hospitals, theatres, banks, lecture-rooms, and other public buildings, as well as some private buildings, such as warehouses and stables, stand alone, forming parts of streets, and occupying the position of several houses. They are surrounded with garden space, and add not only to the beauty, but to the healthiness of the city. The large houses of the wealthy are situated in a similar manner.

The streets of the city are paved throughout in the same material. As yet wood pavement set in asphalte has been found the best. It is noiseless, cleanly, and durable. Tramways are nowhere permitted, the system of underground railways being found amply sufficient for all puposes. The side pavements, which are everywhere ten feet wide, are of white or light grey stone. They have a slight incline towards the streets, and the streets have an incline from their centres towards the margins of the pavements.

From the circumstance that the houses of our model city are based on subways, there is no difficulty whatever in cleansing the streets, no more difficulty than is experienced in Paris. That disgrace to our modern civilisation, the mud cart, is not known, and even the necessity for Mr. E. H. Bayley's roadway moveable tanks for mud sweepings (so much wanted in London and other towns similarly built) does not exist. The accumulation of mud and dirt in the streets is washed away every day through side openings into the subways, and is conveyed, with the sewage, to a destination apart from the city. Thus the streets everywhere are dry and clean, free alike of holes and open drains. Gutter children are an impossibility in a place where there are no gutters for their innocent delectation. Instead of the gutter, the poorest child has the garden; for the foul sight and smell of unwholesome garbage, he has flowers and greensward.

It will be seen, from what has been already told, that in this our model city there are no underground cellars, kitchens, or other caves, which, worse than those ancient British caves that Nottingham still can show the antiquarian as the once fastnesses of her savage children, are even now the loathsome residences of many millions of our domestic and industrial classes. There is not permitted to be one room underground. The living part of every house begins at the level of the street. The houses are built of a brick which has the following sanitary advantages:—It is glazed, and quite impermeable to water, so that during wet seasons the walls of the houses are not saturated with tons of water, as is the case with so many of our present residences. The bricks are perforated transversely, and at the end of each there is a wedge opening, into which no mortar is inserted, and by which all the openings are allowed to communicate with each other. The walls are in this manner honeycombed, so that there is in them a constant body of common air let in by side openings in the outer wall, which air can be changed at pleasure, and, if required, can be heated from the firegrate of the house. The bricks intended for the inside wall of the house, those which form the walls of the rooms, are glazed in different colours, according to the taste of the owner, and are laid so neatly, that the after adornment of the walls is considered unnecessary, and, indeed, objectionable. By this means those most unhealthy parts of household accommodation, layers of mouldy paste and size, layers of poisonous paper, or layers of [illegible] colour stuff or distemper, are entirely done away with. The walls of the room can be made clean at any time by the simple use of water, and the ceilings, which are turned in light arches of thinner brick, or tile, glazed to match the wall, are open to the same cleansing process. The colour selected for the inner brickwork is grey, as a rule, that being most agreeable to the sense of sight; but various tastes prevail, and art so soon ministers to taste, that, in the houses of the wealthy, delightful patterns of work of Pompeian elegance are soon introduced.

As with the bricks, so with the mortar and the wood employed in building, they are rendered, as far as possible, free of moisture. Sea sand containing salt, and wood that has been saturated with sea water, two common commodities in badly-built houses, find no place in our modern city.

The most radical changes in the houses of our city are in the chimneys, the roofs, the kitchens, and the adjoining offices. The chimneys, arranged after the manner proposed by Mr. Spencer Wells, are all connected with central shafts, into which the smoke is drawn, and, after being passed through a gas furnace to destroy the free carbon, is discharged colourless into the open air. The city, therefore, at the expense of a small smoke rate, is free of raised chimneys and of the intolerable nuisance of smoke. The roofs of the houses are but slightly arched, and are indeed all but flat. They are covered either with asphalte, which experience, out of our supposed city, has proved to last long and to be easily repaired, or with flat tile. The roofs, bounded round with iron palisade, tastefully painted, make excellent outdoor grounds for every house. In some instances flowers are cultivated on them.

The housewife must not be shocked when she learns that the kitchens of our model city, and all the kitchen offices, are immediately beneath these garden roofs, are, in fact, in the upper floor of the house instead of the lower. In every point of view, sanitary and economical, this arrangement succeeds admirably. The kitchen is lighted to perfection, so that all uncleanliness is at once detected. The smell that arises from cooking is never disseminated through the rooms of the house. In conveying the cooked food from the kitchen, in houses where there is no lift, the heavy-weighted dishes have to be

conveyed down, the emptied and lighter dishes upstairs. The hot water from the kitchen boiler is distributed easily by conducting pipes into the lower rooms, so that in every room and bedroom hot and cold water can at all times be obtained for washing or cleaning purposes; and as on every floor there is a sink for receiving waste water, the carrying of heavy pails from floor to floor is not required. The scullery, which is by the side of the kitchen, is provided with a copper and all the appliances for laundry work; and when that is done at home the open places on the roof above make an excellent drying ground.

In the wall of the scullery is the upper opening to the shaft of the dust-bin shaft. This shaft, open to the air from the roof, extends to the bin under the basement of the house. A sliding door in the wall opens into the shaft to receive the dust, and this plan is carried out on every floor. The coal-bin is off the scullery, and is ventilated into the air through a shaft, also passing through the roof.

On the landing in the second or middle stories of the three-storied houses there is a bath-room, supplied with hot and cold water from the kitchen above. The floor of the kitchen and of all the upper stories is slightly raised in the centre, and is of smooth, grey tile; the floor of the bath-room is the same. In the living-rooms, where the floors are of wood, a true oak margin of floor extends two feet around each room. Over this no carpet is ever laid. It is kept bright and clean by the old-fashioned bees'-wax and turpentine, and the air is made fresh and ozonic by the process.

Considering that a third-part of the life of man is, or should be, spent in sleep, great care is taken with the bedrooms, so that they shall be thoroughly lighted, roomy, and ventilated. Twelve hundred cubic feet of space is allowed for each sleeper, and from the sleeping apartments all unnecessary articles of furniture and of dress are rigorously excluded. Old clothes, old shoes, and other offensive articles of the same order, are never permitted to have residence there. In most instances the rooms on the first floor are made the bedrooms, and the lower the living-rooms. In the larger houses bedrooms are carried out in the upper floor for the use of the domestics.

To facilitate communication between the kitchen and the entrance-hall, so that articles of food, fuel, and the like may be carried up, a shaft runs in the partition between two houses, and carries a basket lift in all houses that are above two stories high. Every heavy thing to and from the kitchen is thus carried up and down from floor to floor and from the top to the basement, and much necessary labour is thereby saved. In the two-storied houses the lift is unnecessary. A flight of outer steps leads to the upper or kitchen floor.

The warming and ventilation of the houses is carried out by a common and simple plan. The cheerfulness of the fireside is not sacrificed; there is still the open grate in every room, but at the back of the firestove there is an air-box or case which, distinct from the chimney, communicates by an opening with the outer air, and by another opening with the room. When the fire in the room heats the iron receptacle, fresh air is brought in from without, and is diffused into the room at the upper part on a plan similar to that devised by Captain Galton.

As each house is complete within itself in all its arrangements, those disfigurements called back premises are not required. There is a wide space consequently between the back fronts of all houses, which space is, in every instance, turned into a garden square, kept in neat order, ornamented with flowers and trees, and furnished with playgrounds for children, young and old.

The houses being built on arched subways, great convenience exists for conveying sewage from, and for conducting water and gas into, the different domiciles. All pipes are conveyed along the subways, and enter each house from beneath. Thus the mains of the water pipe and the mains of the gas are within instant control on the first floor of the building, and a leakage from either can be immediately prevented. The officers who supply the commodities of gas and water have admission to the subways, and find it most easy and economical to keep all that is under their charge in perfect repair. The sewers of the houses run along the floors of the subways, and are built in brick. They empty into three cross main sewers. They are trapped for each house, and as the water supply is continuous, they are kept well flushed. In addition to the house flushings there are special openings into the sewers by which, at any time, under the direction of the sanitary officer, an independent flushing can be carried out. The sewers are ventilated into tall shafts from the mains by means of a pneumatic engine.

The water-closets in the houses are situated on the middle and basement floors. The continuous water supply flushes them without danger of charging the drinking water with gases emanating from the closet; a danger so imminent in the present method of cisterns, which supply drinking as well as flushing water.

As we walk the streets of our model city, we notice first an absence of places for the public sale of spirituous liquors. Whether this be a voluntary purgation in goodly imitation of the National Temperance League, the effect of Sir Wilfred Lawson's Permissive Bill and most permissive wit and wisdom, or the work of the Good Templars, we need not stay to inquire. We look at the fact only. To this city, as to the town of St. Johnsbury, in Vermont, which Mr. Hepworth Dixon has so graphically described, we may apply the description Mr. Dixon has written: "No bar, no dram shop, no saloon defiles the place. Nor is there a single gaming hell or house of ill-repute." Through all the workshops into which we pass, in whatever labour the men or women may be occupied—and the place is noted for its manufacturing industry—at whatever degree of heat or cold, strong drink is unknown. Practically, we are in a total abstainers' town, and a man seen intoxicated would be so avoided by the whole community, he would have no peace to remain.

And, as smoking and drinking go largely together, as the two practices were, indeed, original exchanges of social degradations between the civilised man and the savage, the savage getting very much the worst of the bargain, so the practices largely disappear together. Pipe and glass, cigar and sherry-cobbler, like the Siamese twins, who could only live connected, have both died in our model city. Tobacco, by far the most innocent partner of the firm, lived, as it perhaps deserved to do, a little the longest; but it passed away, and the tobacconist's counter, like the dram counter, has disappeared.

The streets of our city, though sufficiently filled with busy people, are comparatively silent. The subways relieve the heavy traffic, and the factories are all at short distances from the town, except those in which the work that is carried on is silent and free from nuisance. This brings me to speak of some of the buildings which have relation to our present studies.

It has been found in our towns, generally, that men and women who are engaged in industrial callings, such as tailoring, shoemaking, dressmaking, lace-work, and the like, work at their own homes amongst their children. That this is a common cause of disease is well understood. I have myself seen the half-made riding-habit that was ultimately to clothe some wealthy damsel rejoicing in her morning ride act as the coverlet of a poor tailor's child stricken with malignant scarlet fever. These things must be, in the ordinary course of events under our present bad ordinary system. In the model city we have in our mind's eye, these dangers are met by the simple provision of workmen's offices or work-rooms. In convenient parts of the town there are blocks of buildings, designed mainly after the manner of the houses, in which each workman can have a work-room on payment of a moderate sum per week. Here he may work as many hours as he pleases, but he may not transform the room into a home. Each block is under the charge of a superintendent, and also under the

observation of the sanitary authorities. The family is thus separated from the work, and the working man is secured the same advantages as the lawyer, the merchant, the banker now possess; or to make the parallel more correct, he has the same advantage as the man or woman who works in a factory, and goes home to eat and to sleep.

In most towns throughout the kingdom the laundry system is dangerous in the extreme. For anything the healthy householder knows, the clothes he and his children wear have been mixed before, during, and after the process of washing, with the clothes that have come from the bed or body of some sufferer from a contagious malady. Some of the most fatal outbreaks of disease I have met with have been communicated in this manner. In our model community this danger is entirely avoided by the establishment of public laundries, under municipal direction. No person is obliged to send any article of clothing to be washed at the public laundry; but if he does not send there the washing must be done at home. Private laundries that do not come under the inspection of the sanitary officer are absolutely forbidden. It is incumbent on all who send clothes to a public laundry from an infected house to state the fact. The clothes thus received are passed for special cleansing into the disinfecting rooms. They are specially washed, dried, and prepared for future wear. The laundries are placed in convenient positions, a little outside the town; they have extensive drying grounds, and, practically, they are worked so economically, that home washing days, those invaders of domestic comfort, are abolished.

Passing along the main streets of the city, we see in twenty places, equally distant, a separate building surrounded by its own grounds—a model hospital for the sick. To make these institutions the best of their kind, no expense is spared. Several elements contribute to their success. They are small, and are readily removeable. The old idea of warehousing diseases on the largest possible scale, and of making it the boast of an institution that it contains so many hundred beds, is abandoned here. The old idea of building an institution so that it shall stand for centuries, like a Norman castle, but, unlike the castle, still retain its original character as a shelter for the afflicted, is abandoned. The still more absurd idea of building hospitals for the treatment of special organs of the body, as if the different organs could walk out of the body and present themselves for treatment, is also abandoned.

It will repay us a minute of time to look at one of these model hospitals. One is the *fac-simile* of the other, and is devoted to the service of every five thousand of the population. Like every building in the place, it is erected on a subway. There is a wide central entrance, to which there is no ascent, and into which a carriage, cab, or ambulance can drive direct. On each side the gateway are the houses of the resident medical officer and of the matron. Passing down the centre, which is lofty and covered in with glass, we arrive at two side-wings running right and left from the centre, and forming cross-corridors. These are the wards; twelve on one hand for male, twelve on the other for female patients. The cross-corridors are twelve feet wide and twenty feet high, and are roofed with glass. The corridor on each side is a framework of walls of glazed brick, arched over head, and divided into six segments. In each segment is a separate, light, elegant removable ward, constructed of glass and iron, twelve feet high, fourteen feet long, and ten feet wide. The cubic capacity of each ward is 1,680 feet. Each patient who is ill enough to require constant attendance has one of those wards entirely to himself, so that the injurious influences on the sick which are created by mixing up in one large room the living and the dying; those who could sleep, were they at rest, with those who cannot sleep because they are racked with pain; those who are too nervous or sensitive to move, or cough, or speak, lest they should disturb others; and those who do whatever pleases them—these bad influences are absent.

The wards are fitted up neatly and elegantly. At one end they open into the corridor, at the other towards a verandah which leads to a garden. In bright weather those sick, who even are confined to bed, can, under the direction of the doctor, be wheeled in their beds into the gardens without leaving the level floor. The wards are warmed by a current of air made to circulate through them by the action of a steam-engine, with which every hospital is supplied, and which performs such a number of useful purposes, that the wonder is, how hospital management could go on without this assistance.

If at any time a ward becomes infectious, it is removed from its position, and replaced by a new ward. It is then taken to pieces, disinfected, and laid by ready to replace another that requires temporary ejection.

The hospital is supplied on each side with ordinary baths, hot-air baths, vapour baths, and saline baths.

A day sitting-room is attached to each wing, and every reasonable method is taken for engaging the minds of the sick in agreeable and harmless pastimes.

Two trained nurses attend to each corridor, and connected with the hospital is a school for nurses, under the direction of the medical superintendent and the matron. From this school nurses are provided for the town. They are not merely efficient for any duty in the vocation in which they are always engaged, either within the hospital or out of it, but from the care with which they attend to their own personal cleanliness, and the plan they pursue of changing every garment on leaving an infectious case, they fail to be the bearers of any communicable disease. To a hospital four medical officers are appointed, each of whom, therefore, has six patients under his care. The officers are called simply medical officers, the distinction, now altogether absurd, between physicians and surgeons being discarded.

The hospital is brought, by an electric wire, in communication with all the fire-stations, factories, theatres, and other important public places. It has an ambulance always ready to be sent out to bring in injured persons to the institution. The ambulance drives straight into the hospital, where a bed of the same height on silent wheels, so that it can be moved without vibration into a ward, receives the patient.

The kitchens, laundries, and laboratories are in a separate block at the back of the institution, but are connected with it by the central corridor. The kitchens and laundries are at the top of this building, the laboratories below. The disinfecting-room is close to the engine-room, and superheated steam, which the engine supplies, is used for disinfection.

The out-patient department, which is apart from the body of the hospital, resembles that of the Queen's Hospital, Birmingham; the first out-patient department, as far as I am aware, that ever deserved to be seen by a generous public. The patients waiting for advice are seated in a large hall, warmed at all seasons to a proper heat, lighted from the top through a glass roof, and perfectly ventilated. The infectious cases are separated carefully from the rest. The consulting-rooms of the medical staff are comfortably fitted, the dispensary is thoroughly officered, and the order that prevails is so effective, that a sick person who is punctual to time has never to wait.

The medical officers attached to the hospitals of our model city are allowed to hold but one appointment at the same time, and that for a limited period. Thus every medical man in the city obtains the equal advantage of hospital practice, and the value of the best medical and surgical skill is fairly equalised through the whole community.

In addition to the hospital building is a separate block, furnished with wards, constructed in the same way as the general wards, for the reception of children suffering from any of the infectious diseases. These wards are so planned that the people, generally, send sick members of

their own family into them for treatment, and pay for the privilege.

Supplementary to the hospital are certain other institutions of a kindred character. To check the terrible course of infantile mortality of other large cities—the 76 in the 1,000 of mortality under five years of age—homes for little children are abundant. In these the destitute young are carefully tended by intelligent nurses, and mothers, while following their daily callings, are enabled to leave their children under efficient care.

In a city from which the grand source of wild mirth, hopeless sorrow, and confirmed madness—alcohol—has been expelled, it could hardly be expected that much insanity would be found. The few who are insane are placed in houses licensed as asylums, but not different in appearance to other houses in the city. Here they live, in small communities, under proper medical supervision, with their own gardens and pastimes.

The houses of the helpless and aged are, like the asylums, the same as the houses of the rest of the town. No large building for the poor, of pretentious style, uprears itself; no men badged or badgered as paupers walk the place. Those poor who are really from physical causes unable to work, are maintained in a manner showing that they possess yet the dignity of human kind; that, being worth preservation, they are therefore worthy of respectful tenderness. The rest, those who can work, are employed in useful labours, which pay for their board. If they cannot find work, and are deserving, they may lodge in the house and earn their subsistence; or they may live from the house and receive pay for work done. If they will not work, they, as vagrants, find a home in prison, where they are compelled to share the common lot of mankind.

Our model city is of course well furnished with baths, swimming-baths, Turkish-baths, play-grounds, gymnasia, libraries, board-schools, fine art schools, lecture halls, and places of instructive amusement. In every board-school drill forms a part of the programme. I need not dwell on these subjects, but must pass to the sanitary officers and offices.

There is in the city one principal sanitary officer, a duly qualified medical man elected by the municipal council, whose sole duty it is to watch over the sanitary welfare of the place. Under him as sanitary officers are all the medical men who form the poor-law medical staff. To him these make their reports on vaccination and every matter of health pertaining to their respective districts; to him every registrar of births and deaths forwards copies of his registration returns; and to his office are sent, by the medical men generally, registered returns of the cases of sickness prevailing in the district. His inspectors likewise make careful returns of all the known prevailing diseases of the lower animals and of plants. To his office are forwarded, for examination and analysis, specimens of foods and drinks suspected to be adulterated, impure, or otherwise unfitted for use. For the conduction of these researches the sanitary superintendent is allowed a competent chemical staff. Thus, under this central supervision, every death and every disease of the living world in that district, and every assumable cause of disease, comes to light and is subjected, if need be, to inquiry.

At a distance from the town are the sanitary works, the sewage pumping works, the water and gas works, the slaughter-houses and the public laboratories. The sewage, which is brought from the town partly by its own flow and partly by pumping apparatus, is conveyed away to well-drained sewage farms belonging to the city, but at a distance from it, where it is utilised on Mr. Hope's plan.

The water supply, derived from a river which flows to the south-west of the city, is unpolluted by sewage or other refuse, is carefully filtered, is tested twice daily. and if found unsatisfactory is supplied through a reserve tank, in which it can be made to undergo further purification. It is carried through the city everywhere by iron pipes. Leaden pipes are forbidden.

In the sanitary establishment are disinfecting rooms, a mortuary, and ambulances for the conveyance of persons suffering from contagious disease. These are at all times open to the use of the public, subject to the few and simple rules of the management.

The gas, like the water, is submitted to regular analysis by the staff of the sanitary officer, and any fault he may detect which indicates a departure from the standard of purity framed by the municipal council is immediately remedied, both gas and water being exclusively under the control of the local authority.

The inspectors of the sanitary officer have under them a body of scavengers. These each day in the early morning pass through the various districts allotted to them and remove all refuse in closed vans. Every portion of manure from stables, streets, and yards is in this way removed daily, and transported to the city farms for utilisation.

Two additional conveniences are supplied by the sanitary scientific work of this establishment. From steam-works steam is condensed, and a large supply of distilled water is obtained and preserved in a separate tank. This is conveyed by a small main into the city, and at a moderate cost distilled water can be supplied for those domestic purposes for which hard water is objectionable.

The second sanitary convenience is a large ozone generator. By this apparatus ozone can be produced in any required quantity, and is made to play many useful purposes. It is passed through the drinking water in the reserve reservoir whenever the water shows excess of organic impurity, and it is conveyed into the city for diffusion into private houses, for purposes of disinfection.

The slaughter-houses of the city are all public, and are separated by a distance of a quarter of a mile from the city. They are easily removable edifices, and are under the supervision of the sanitary staff. The Jewish system of inspecting every carcase that is killed is rigorously carried out, with this improvement, that the inspector is a man of scientific knowledge.

All animals used for food—cattle, fowl, swine, rabbits—are subjected to examination in the slaughter-house, or in the market, if they be brought into the city from other depôts. The slaughter-houses are so constructed that the animals killed are relieved from the pain of death. They pass through a narcotic chamber, and are brought to the slaughterer oblivious of their fate. The slaughter-houses drain into the sewers of the city, and their complete purification daily, from all offal and refuse, is rigidly enforced.

The buildings, sheds and styes for domestic food-producing animals, are removed a short distance from the city, and are also under the supervision of the sanitary officer; the food and water supplied for these animals comes equally with human food under proper inspection.

One other subject only remains to be noticed in connection with the arrangements of our model city, and that is the mode of the disposal of the dead. The question of cremation and of burial in the earth has been considered, and there are some who advocate cremation. For various reasons the process of burial is still retained: Firstly, because the cremation process is open to serious medico-legal objections; secondly, because, by the complete resolution of the body into its elementary and inodorous gases in the cremation furnace, that intervening chemical link between the organic and inorganic worlds, the ammonia, is destroyed, and the economy of nature is thereby dangerously disturbed; thirdly, because the natural tendencies of the people lead them still to the earth as the most fitting resting-place into which, when lifeless, they should be drawn.

Thus the cemetery holds its place in our city, but in a form much modified from the ordinary cemetery. The burial ground is artificially made of a fine carboniferous earth. Vegetation of rapid growth is cultivated over

it. The dead are placed in the earth from the bier, either in basket work or simply in the shroud; and the monumental slab, instead of being set over or at the head or foot of a raised grave, is placed in a spacious covered hall or temple, and records simply the fact that the person commemorated was recommitted to earth in those grounds. In a few months, indeed, no monument would indicate the remains of any dead. In that rapidly-resolving soil the transformation of dust into dust is too perfect to leave a trace of residuum. The natural circle of transmutation is harmlessly completed, and the economy of nature conserved.

Results.

Omitting, necessarily, many minor but yet important details, I close the description of the imaginary health city. I have yet to indicate what are the results that might be fairly predicted in respect to the disease and mortality presented under the conditions specified.

Two kinds of observation guide me in this essay: one derived from statistical and sanitary work; the other from experience, extended now over thirty years, of disease, its phenomena, its origins, its causes, its terminations.

I infer, then, that in our model city certain forms of disease would find no possible home, or, at the worst, a home so transient as not to affect the mortality in any serious degree. The infantile diseases, infantile and remittent fevers, convulsions, diarrhœa, croup, marasmus, dysentery, would, I calculate, be almost unknown. Typhus and typhoid fevers and cholera could not, I believe, exist in the city except temporarily, and by pure accident; small-pox would be under entire control; puerperal fever and hospital fever would, probably, cease altogether; rheumatic fever, induced by residence in damp houses, and the heart disease subsequent upon it, would be removed; death from privation and from puerpera and scurvy would certainly cease; delirium tremens, liver disease, alcoholic phthisis, alcholic degeneration of the kidney and all the varied forms of paralysis, insanity, and other affections due to alcohol, would be completely effaced. The parasitic diseases arising from the introduction into the body, through food, of the larvæ of the entozoa, would cease, and that large class of deaths from pulmonary consumption, induced in less favoured cities by exposure to impure air and badly-ventilated rooms, would, I believe, be reduced so as to bring down the mortality of this signally-fatal malady one-third at least.

Some diseases, pre-eminently those which arise from uncontrollable causes, from sudden fluctuations of temperature, electrical storms, and similar great variations of nature, would remain as active as ever; and pneumonia, bronchitis, congestion of the lungs, and summer cholera, would still hold their sway. Cancer, also, and allied constitutional diseases of strong hereditary character would yet, as far as we can see, prevail. I fear, moreover, it must be admitted that two or three of the epidemic diseases, notably scarlet fever, measles, and whooping cough, would assert themselves, and, though limited in their diffusion by the sanitary provisions for arresting their progress, would claim a considerable number of victims.

With these facts clearly in view, I must be careful not to claim for my model city more than it deserves; but calculating the mortality which would be saved, and comparing the result with the mortality which now prevails in the most favoured of our large English towns, I conclude that an average mortality of eight per thousand would be the maximum in the first generation living under this salutary *régime*. That in a succeeding generation Mr. Chadwick's estimate of a possible mortality of five per thousand would be realised, I have no reasonable doubt, since the almost unrecognised, though potent, influence of heredity in disease would immediately lessen in intensity, and the healthier parents would bring forth healthier offspring.

As my voice ceases to dwell on this theme of a yet unknown city of health, do not, I pray you, wake us from a mere dream. The details of the city exist. They have been worked out by those pioneers of sanitary science, so many of whom surround me to-day, and specially by him whose hopeful thought has suggested my design. I am, therefore, but as a draughtsman who, knowing somewhat your desires and aspirations, have drawn a plan, which you in your wisdom can modify, improve, perfect. In this I know we are of one mind, that though the ideal we all of us hold be never realised during our lives, we shall continue to work successfully for its realisation. Utopia itself is but another word for time; and some day the masses, who now look on, or smile incredulously at our proceedings, will awake to our conceptions. Then our knowledge, like light rapidly conveyed from one torch to another, will bury us in its brightness.

> By swift degrees the love of Nature works
> And warms the bosom, till at last, sublimed
> To rapture and enthusiastic heat,
> We feel the present Deity, and taste
> The joy of God to see a happy world!

ON A MINISTRY OF COMMERCE AND AGRICULTURE.*

By Professor Leone Levi, F.S.S., F.S.A., &c.

The organisation of the British Cabinet is, to the uninitiated in the constitutional history of the country, singularly strange and perplexing. Not only is the Cabinet itself a body unknown to the law, and its composition never officially made known to the public, but its members have functions not in themselves clear or definite. The Lord Chancellor, though partially responsible, both for the framing and the administration of the law, is not the Minister of Justice. That great personage is, at once, a judge, a political officer of the highest rank, and the Speaker of the House of Lords. There are two Ministers of Finance in the persons of the First Lord of the Treasury and the Chancellor of the Exchequer, whose functions are apt to conflict, for while the Treasury has the right of issuing directions to the Exchequer for payments of public money, the Exchequer has also the right to exercise an independent control over the issues. The Lord President of Council is not the President of the Cabinet, for while the Council is indefinite in number, and with limited powers, the Cabinet consists of those Privy Councillors, who being more immediately honoured with Sovereign confidence, actually conduct the business of the Government. The First Lord of the Admiralty is not an independent Minister, but the head of a Board, having the superintendence of the royal naval forces, docks, and arsenals. And though there are five Secretaries of State for the Home Department, for Foreign Affairs, for the Colonies, India, and War, Scottish and Irish interests are but imperfectly represented in the Ministry, and education and religion are not thought of sufficient importance for separate and independent Ministers.

Of all anomalies, however, the greatest is the fact that an essentially commercial country like Britain, and a country, too, so dependent on agricultural produce, whether of home or foreign growth, has not a minister, at least, a Minister of Commerce and Agriculture. One might well wonder, how can the immense operations of trade, manufacture, industry, and shipping, be possibly carried on without such a Minister. Who is it that directs the commercial policy of the country? Who watches over her commercial interests? But the simple answer is, that the whole Cabinet constitutes the guardian of commerce; and the Prime Minister, who is primarily responsible for the conduct of national

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affairs, is, of necessity, the framer and director of every measure affecting trade and commerce. William Pitt and the Earl of Liverpool, Viscount Canning and Earl Grey, Lord Russell and Sir Robert Peel, Mr. Gladstone and Mr. Disraeli, have each acted as Ministers of Commerce when they respectively worked out their commercial policy, whether they were themselves the expounders of the same in the House of Lords or the House of Commons, or whether they entrusted their exposition to other members of her Majesty's Government. Who felt more keenly the responsibility of directing the commercial policy of the country than Sir Robert Peel? "The most important consideration," he said "that can occupy Parliament, is the principle which should govern our economic and commercial legislation. An error in the principle which directs commercial legislation is a fatal error which is likely to be perpetuated."

There is indeed a President of the Board of Trade, who is to be the organ between the Government and the commercial community, but an impression has lately gained ground that the interests of commerce are not sufficiently cared for or attended to on the part of the State; that the organisation of the Board of Trade is cumbrous and faulty; that commercial matters, now touched by financial exigencies, and anon affected by commercial treaties, suffer from want of practical knowledge in the Government itself; that with the present organisation taxes may be imposed, modified, or removed, the banking laws altered, and treaties of commerce and navigation concluded, without even a consultation with the President of the Board of Trade; and that the manifold requirements of industry and trade are not likely to receive full justice, until a ministry of commerce is established, whose head shall have a proper place in the British Cabinet.

Very early in the history of British commerce the State found it necessary to seek for assistance, at the hands of competent persons, in the direction of matters of trade. At first a Council was summoned when an emergency arose, composed of the most prudent and experienced merchants, to advise and deliberate with Parliament. In 1318 a Council was held of two merchants chosen out of every city and burgh throughout the kingdom, to consider the expediency of establishing a staple of wool in Flanders. In 1337 another Council was held for a similar purpose. In 1622 King James appointed a special commission to consider the causes of the decay of trade, and more especially—Why was wool fallen so low in price? How to prevent the export of wool? How to remedy the scarcity of money? How to increase the wealth of the kingdom? And in 1655 Cromwell appointed his son, with many lords of the Council and about 20 merchants of London, York, Newcastle, Yarmouth, Dover, &c., to meet and consider by what means the traffic and navigation of the Republic might be better promoted and regulated. Charles II. was reinstated on the 29th May, 1660, and immediately after, on 7th November of the same year, there were laid before the Government "some heads for grounds to a commission for a Council of Trade," showing the necessity of contriving a balance of exports and imports, and of inquiring on the means for improving trade. And the patent was issued to as many as sixty persons, comprising privy councillors, country gentlemen, merchants trading and merchants non-trading, doctors of civil law, and others, with instructions to deliberate on any injuries arising to English trade from the non-observance of treaties with foreign powers, and on any decay or corruption in the home manufactures, and to suggest redress; also to inquire on the best means to improve native commodities, to regulate the fisheries, the balance of exports and imports, matters relating to navigation, bullion, foreign plantations, &c. Singular enough, no reference is made to this Council, either in M'Pherson's "Annals of British Commerce" or Anderson's "History," though I found the documents themselves at the Record-office, and duly inserted in the Calendar of State papers.* What did the Council of 1660 actually do for trade there is no means of ascertaining, but a few years after, in 1668, Charles II. instituted another Council of Commerce to promote the advancement of the nation's trade, colonies, manufacture, and shipping; to take care of the colonies and plantations, as well as of the trade and navigation of the kingdom; and to give a true and faithful account thereof from time to time, with their opinion and advice thereupon. None of these councils and commissions, however, were ever intended to be permanent; and though in 1672 a new commission was issued, in 1673 commercial concerns were again referred to the Committee of the Privy Council. Again, on the 15th May, 1696, a Board was created, consisting partly of the principal officers of State and partly of special men, including the Earl of Bridgwater, the Earl of Tankerville, William Blathwayte, Abraham Hill, John Locke, Sir Philip Meadows, John Pollexfen, and John Methwen, to examine and take an account of the state of trade; to determine what trade was likely to prove beneficial and what hurtful; to consider by what means the former might be improved and the latter discouraged; by what method profitable manufactures might be settled, improved, and introduced; to suggest any mode for setting to work and employing the poor; and to inquire into the condition of the plantations, and how they might be rendered more beneficial. This Board had a more lengthened existence, at first combining in its supervision both the trade of the kingdom and the colonies, and then, in 1768, when a Secretary of State for the Colonies was appointed, the supervision of trade only; but in 1782 both the Board of Trade and the Colonial Secretaryship fell martyrs to the economical spirit of Burke. Yet the want of a Board was felt, and consequently four years after, in 1786, it was again re-established as a committee of her Majesty's Privy Council, appointed for the consideration of all matters relating to trade. And so it has continued ever since, with consultative functions and executive powers of the greatest importance. As for agriculture, a Board was first established in 1793, on the suggestion of Sir John Sinclair, but it, too, ceased to exist.

In reality there is no such thing now as a Board of Trade, for the old organisation is quite obsolete. The committee, which used to include the Lord Chancellor, the First Lord of the Treasury, the principal Secretaries of State, the Chancellor and Under-Chancellor of the Exchequer, the Speaker of the House of Commons, the Chancellor of the Duchy of Lancaster, the Paymaster of the Forces, such officers of State in Ireland as our Privy Councillors in England, and the late Right Hon. Sir Edward Ryan, is never summoned. All that exists is a President, assisted by several officers, each of whom is, in a manner, at the head of a special department. The President himself, Sir Charles Adderley, receives £2,000 a-year, and he has a permanent secretary, at £1,800 a-year, Mr. Thomas H. Farrer, and a parliamentary secretary, at £1,500 a year, Mr. Bentinck, M.P. Besides these, there are four assistant secretaries, at from £1,000 to £1,200 a-year each, viz., Mr. Thomas Gray, for the Marine; Mr. R. G. C. Hamilton, for the Finance; Mr. Henry Calcraft, for the Railway; and Mr. Cecil Trevor, for the Harbour Department; one chief of the Statistical Department, at £1,000 a-year, Mr. Valpy, and several other clerks and officers of a professional character. Till recently there was a Commercial Department connected with the Board, of which Sir Louis Mallet was the head, but that department no longer exists; and a rich commercial library, once belonging to the Board, has been transferred to the Foreign-office.†

* 1660-1661—Domestic.

† The cost of the Board of Trade to the nation is as follows:—The salaries and expenses of the Board of Trade and subordinate departments paid out of the exchequer in 1870-71 were £96,799, and paid out of the mercantile marine fund, out of the proceeds of wrecks, £66,341, making a total of £163,140. But £109,467 was

As for agriculture, there is no department now taking charge of all that may affect its interests. The supervision connected with the importation, transit, traffic, and diseases of live stock is, strangely enough, placed under the Privy Council, the same which supervises both education and science. The supervision necessary for artificial land drainage, and in connection with commissions of sewers and embankment, is placed under the Local Government Board. The duties discharged by the Copyhold, Tithe, and Enclosure Commission may be said to be in the hands of the Home-office, which has the nomination of the commissioners. And the collection, tabulation, and publication of agricultural statistics and corn returns belong to the Board of Trade. Can there be anything more confusing and unmethodical? The fact of the matter is that for years past many and varied duties have been created for the administration, and they have been thrown in the hands of such Government Boards as have been found willing to assume them, with little attention to their fitness for or even compatibility with the same.

Look at the Board of Trade. Frequently called upon to advise the Colonial Secretary in all matters affecting the commerce of the colonies, the Treasury on questions affecting the customs and excise, and the Foreign Secretary on all matters of foreign trade and commercial treaties, we might imagine that the Board would possess the most intimate technical knowledge of trade and commerce. But can it be said that the President does possess the requisite knowledge of commerce, or that he has ready means of obtaining the same? I do not know that the person who is appointed to fill the place of President of the Board of Trade is chosen by the Prime Minister with any regard to his special fitness for the duties of that office, any more than the other Secretaries of State are chosen for any technical knowledge they may possess of their functions. The number of statesmen eligible for the composition of the Cabinet, or for the more important places immediately connected with it, in the two great divisions of political parties, is too limited to admit of any such considerations. A general possession of statesmanship, or skill in political legislation and action, in the individual himself, the traditions of the office, with the help at hand, especially of the permanent secretaries, and a certain facility in obtaining special information, when required, from proper sources; these, I imagine, are the considerations relied upon in the distribution of political appointments. There is no security, therefore, that the President of the Board of Trade shall possess himself any special knowledge of trade and commerce. But if he does not possess such knowledge himself, has he the ready means of obtaining it? It is to be regretted that the Board of Trade has no longer even a commercial department to depend upon, and, still more, that its distinguished chief, Sir Louis Mallet, does no longer belong to that office. Generally, the most reliable information on commercial matters can be obtained from those who are actually engaged in trade; but are these sufficiently organised to give a collective opinion, and is their opinions, after all, always reliable? In France and other countries, where Chambers of Commerce exist in every commercial town, and where they have a semi-official authority, they form, naturally, the ready channel between commerce and the State. But in this country, where such Chambers of Commerce as exist are simply voluntary associations, comprising but a section of the commercial community, though generally the most intelligent; whilst London, the greatest emporium of commerce and banking, has no such Chamber, the President of the Board of Trade can only obtain the required information from partial sources. It is, indeed, plain enough, that if the proper government of the trade of the country depended on the Board of Trade, the amount of special knowledge within its reach is of necessity very slender.

But whatever amount of knowledge or influence may be possessed and exercised by that Board in the making of the commercial legislation and commercial policy of the country, it is not, after all, the Board of Trade that prompts and carries out such legislation and policy; whilst it is the Prime Minister who plans and directs the whole business of the administration, it is the Chancellor of the Exchequer that shapes and manages all matters of taxation affecting trade and industry; it is the Colonial Secretary that supervises all colonial tariffs; and it is the Minister of Foreign Affairs who conducts all negotiations for treaties of commerce. But here another difficulty arises. What is the use to the commercial community to make any representation to the Board of Trade respecting any grievance in foreign countries, or the operation of any foreign tariff, or the working of any treaty, if the Foreign Minister has alone the direction of such matters? Some years ago, on the representation of the Chambers of Commerce, that the double action of the Foreign-office and the Board of Trade was injurious to the interests of commerce, an assurance was given that the Foreign-office took action in commercial matters solely in concert with the Board of Trade. But the Chambers of Commerce urged that the interests of trade would be greatly promoted if commercial men in this country were put in immediate and direct communication with those who are responsible for the joint action of Government in commercial matters; and a Committee of the House of Commons was appointed in 1864, to inquire into the arrangements for trade with foreign nations. The committee went thoroughly into the subject, and at last came to the conclusion that the Board of Trade should be placed more nearly on an equality with the Foreign-office; that its chief should always be a member of the Cabinet, that the Board of Trade should be put in direct communication with the members of the diplomatic and consular service; and that an officer should be appointed in the Foreign-office to conduct the correspondence with the Board of Trade. But an amendment was proposed by Sir Stafford Northcote, and supported by Mr. Cobden, to the effect "that the more preferable arrangement, and the soundest in principle, would be to establish a Commercial Department in the Foreign-office, which should enable the Secretary of State to conduct commercial negotiations, and to investigate the complaints of merchants without the necessity of referring to the Board of Trade, except for such occasional information on matters specially committed to that Board, as the Secretary of State may from time to time require to assist him in making up his case on the questions with which he has to deal." The amendment expressed more pointedly the views of the Foreign-office, and practically the Government acted upon it by the formation of a commercial sub-department under the superintendence of Mr. Kennedy. But the more the Foreign-office takes upon itself the responsibility of promoting the commercial interests of England in and with foreign States, the less [illegible] for merchants to lay their grievances before the Board of Trade. And precisely similar is the case as regards other matters affecting trade and commerce. From an analysis of the matters that came under the consideration of the Associated Chambers of Commerce during the last three years, it appears that they were either of a legal or judicial character, such as the Bankruptcy-laws, the registration of Trade-marks, the registration of firms, Tribunals of Commerce, Patent-laws, and County Courts, which pertain to the Lord Chancellor and the other law officers of the Crown, or connected with finance and banking, such as imperial taxation, income tax, and the

received in the shape of fees in respect of services rendered by the Board of Trade, thus reducing the total cost to £62,673. Besides this, £357,629 was paid for the management and maintenance of lighthouses, but £404,459 was levied on shipping in the shape of light dues, leaving a balance in excess of £46,830. Thus, altogether the entire machinery of the Board of Trade may be said to cost no more than £16,000 a-year. A valuable return on this subject was laid before the House of Commons in 1871.

k Charter Acts, which pertain to the Chancellor of Exchequer, or again connected with foreign trade, rade with Spain and Portugal, the French Treaty, Suez Canal dues, or the Austrian duties on cloth, h naturally belong to the Foreign Secretary. In these cases the action of the Board of Trade is only subordinate or consultative character, having not power to act upon them in the same manner as on tions connected with railways and shipping, where functions of the Board are of an executory nature. omes therefore to this, that the Board of Trade, not oard, but a president and a number of officers, necessarily possessing much commercial knowledge, having but limited means of acquiring it, is at best channel for conveying the wants of the mercantile to such departments of the State as have the al superintendence of the same, whilst it is evident both such departments themselves and the mer- ile community would prefer to come into more direct act with one another without the intervention of Board as a third party.

is quite otherwise with the administrative and utory functions of the Board. As already stated, Board of Trade is divided into five Departments, viz., Marine, the Harbour, the Railway, the Financial, the Statistical, and in connection with several of n the Board possesses statutory compulsory powers most extensive character. The Marine Department rvises all our merchant shipping and seamen, includ- the registry of ships, the admeasurement of tonnage, examination of masters and mates, and the inspection ew spaces. The Board of Trade has the general rintendence of all matters relating to wrecks. All ocal Marine Boards are under its superintendence; lst every agreement entered into between the master ship and his seamen must be in a form sanctioned he Board of Trade. Beyond this, every steamship ying passengers is to be surveyed and reported upon the Board of Trade at least twice a year, and the r cannot proceed on a voyage with passengers un- with a certificate from the Board applicable to the ge, and showing that the provisions of the Act been complied with. Lastly, by the Act of 1873, re the Board of Trade have received a complaint, or reason to believe, that any British ship is by reason defective condition of her hull, equipments, or hinery, or by reason of overloading, or improper ing, unfit to proceed to sea without danger to human the Board may, if they think fit, appoint some com- nt person or persons to survey such ship, and the pments, machinery, and cargo, and to report thereon to Board, the Board having power to detain such ship he purpose of being surveyed. The Harbour Depart- t has the supervision of all harbours of refuge, light- es, buoys, beacons, &c. The Railway Department the supervision and regulation of all railways. No way may be opened for the public conveyance of engers until a month's notice shall have been given e same to the Board. And the Board may postpone opening of any railway until satisfied that it may place without danger to the public. The Board, eover, appoint inspectors of railways, and every rail- company must report to the Board every accident nded with serious personal injury. To the Financial artment belong the administration of the seamen's , the seamen's savings banks, the seamen's ey orders, the wages and effects of de- d seamen, and of pensions to merchant seamen. n there is the Statistical Department, which lishes really valuable accounts as the monthly unts of trade and navigation, and the annual state- t of the same; the statistical abstract of the United gdom, of India, of the British colonies, and of the cipal foreign countries; the miscellaneous statistics he United Kingdom; the statistical tables respecting ign countries; the agricultural returns, and returns oreign tariffs. And to the Board of Trade, there are attached the Standard Weights and Measures Department, the Joint Stock Companies Register-office, and the control of the corn returns for the purpose of tithe commutation, besides other matters connected with gas, water, &c. As now constructed, the Board of Trade has a conglomeration of offices with duties, some of which are defined by statute law, and altogether fulfil functions of the greatest practical value to the State.

It is, therefore, in this double capacity, that we must regard the Board. On the one side, officious, consultative, intermediary; on the other, administrative and executory. Now the Chambers of Commerce demand that the President of the Board of Trade should be more than a semi-subordinate officer in the Government, and that the interests of commerce should be confided to a Minister with the power and the standing of a principal Secretary of State, "to whom the other departments of the State should refer all matters affecting commerce." "Such Minister," said the memorialists, "animated with a due sense of his responsibility as the official guardian of the mighty and ever-widening interests of the industry of this great Empire, would be summoned, as a matter of right, to every Cabinet Council. He would there be enabled to see that no measure undertaken in the interest, primarily, of the national revenue or finance—no diplomatic arrangement with foreign States, and no Act of colonial legislature requiring the sanction of the Government at home—received that sanction without its effects on the interests of the commerce and industry of England having been first duly considered and discussed, and its probable consequences to those interests maturely weighed. He would further, from the means of information afforded by frequent communication (on an equal footing) with other Cabinet Ministers, and by communication with the representatives of commercial interests among the people, be enabled to discern betimes openings and opportunities for promoting those interests, and to press them with authority and effect on the attention of the entire Cabinet." And the Chambers of Agriculture, on their side, demand the establishment of a separate Agricultural Department, embracing all matters affecting agriculture now dealt with by various Government offices, and the incorporation of both the Commercial and Agricultural Department under one Cabinet Minister. I do not think that either the Chambers or Commerce or the Chambers of Agriculture do ever imagine that, were a Minister of Commerce and Agriculture created this day, he would be able to do much more than is already done for their respective interests, or that he would be able to enter into direct negotiations with foreign powers for the conclusion of treaties of commerce, or to correspond with the colonies on matters of tariff, or to be himself the framer of the Budget, in so far as it affected trade and commerce. The Chambers of Commerce know quite well how tenacious is the hold of the different Secretaries of State on everything connected with their own departments. All that these Chambers contemplate is a better consolidation of the commercial and agricultural interests in one Board, and the elevation of its President to the position of a Cabinet Minister—a position which Mr. Bright, as such President, held in Mr. Gladstone's Cabinet, and which was held by the President of the Board of Trade in almost every Cabinet since the accession of Queen Victoria. Sir Alex. Baring, in Sir Robert Peel's Cabinet of 1835; Mr. C. Poulett Thompson and Mr. Labouchere, in Viscount Melbourne's, in the same year; the Earl of Ripon and Mr. Gladstone, in Sir R. Peel's Cabinet of 1841; the Earl of Clarendon and Mr. Labouchere, in that of Lord John Russell in 1846; Mr. Henley in Lord Derby's, and Lord Stanley of Alderley in Viscount Palmerston's Cabinet in 1855; Mr. Henley again and the Earl of Donoughmore in the Earl of Derby's in 1858; Mr. Milner Gibson in Viscount Palmerston's in 1859, and Earl Russell's in 1865; Sir Stafford Northcote and the Duke of Richmond in the administrations of the Earl of Derby in 1866, and of

Mr. Disraeli in 1868; Mr. John Bright in Gladstone's Cabinet, were all Cabinet Ministers. The only exceptions I find in this long period are the Earl of Dalhousie, under Sir Robert Peel, in 1845; Mr. Cardwell, under the Earl of Aberdeen, in 1852, and Viscount Palmerston in 1855; and now Sir Charles Adderley in Mr. Disraeli's Ministry. There is nothing very new, therefore, in the demands of the Chambers of Commerce and Agriculture. Why? The principle has been conceded long ago. And such is the general practice in foreign countries. In France there is a Minister of Commerce, and the Foreign Secretary always acts in concert with him in matters pertaining to trade. In Austria the Ministers of Commerce and Foreign Affairs are on equal footing. Drafts of new treaties are drawn up in the Foreign-office, and submitted to the Minister of Commerce. In some countries there is no Minister of Commerce, the business pertaining to that office devolving either on the Minister of Finance, or the Minister of Foreign Affairs. But in the majority of States, a Minister of Commerce and Agriculture, and sometimes including Public Works, forms an essential member of the administration.

What is wanted is more unity in the business of the Board of Trade and Agriculture, and more dignity in its President. It is not so much any change in the constitutional division of duties of the different Ministers of the Crown that is required as the strengthening of the powers and authority of the Minister of Commerce, with a view to the proper discharge of both his consultative, administrative, and executory functions. And it is worthy of serious consideration whether some additional strength should not be imparted to the office by the appointment of additional officers possessing technical knowledge of commerce, agriculture, shipping, and railways, with a constitution somewhat similar to that of the Council for India.

In any case, whether as President of the Board of Trade, or as Minister of Commerce and Agriculture, let us not think that such a minister can perform any wonder in the general management of trade and finance, or that any new laws can be passed with the slightest hope that they will make the people more prudent, more cautious, or more successful in their adventures. *Laissez faire, laissez aller*, will ever be the watchword of the political economist. There is no need for more supervision, more interference, and more legislation. The commercial policy of Britain is well settled in the direction of freedom of trade, and gradual but constant reduction or abolition of all duties of customs or excise affecting trade and industry. And it is more than ever necessary to be jealous of any new power in the Minister of Commerce and Agriculture, seeing that public opinion is not so decided as once it was in its opposition to Government interference. Doubtless there are cases where the collective judgment of the nation may be sounder and better than the judgment of private individuals, and where, therefore, it may be wise to allow the State, as the organ of the nation, to enter into a course which may somewhat clash with the right of free action, as in matters of national education and the limitation of the hours of labour of women and children in factories. And there may be cases where the nation collectively can do what private individuals could not do, such as the administration of the Post-office, or the collection of agricultural statistics. But we may well be on our guard when proposals are made that the Government should buy up all the railways, or take up the business of insurance, or the like, for in the majority of cases things are worse done by the intervention of Government, than would be done by the individuals interested, if they were allowed to do them themselves. As the *Times* well said, in commenting upon Mr. Sampson Lloyd's motion for a Ministry of Commerce, "The truth is that, upon the whole, both trade and commerce can, and do, take pretty good care of themselves. As sources of wealth and means of livelihood, they attain a success in this country far beyond the example of more favoured soils and climates. This, it has been said a thousand times, is because they are left alone. As a general rule they are left alone [illegible] they are interfered with only when other interests are at stake."

On the whole, I concur in the opinion that the British Cabinet may be strengthened by the presence of a Minister having the direct superintendence of the manifest interests of commerce, agriculture, railways, and shipping; but I beg you to remember that since the general good is the sole object of the legislation, and general utility the sole principle of reasoning in legislation, whatever be the importance or influence of any one interest in the empire, it must ever be subordinate to whatever is most conducive to the public good.

COFFEE DISEASE IN DOMINICA.

A good deal of attention has been directed of late to the destruction by disease of the coffee plant in Ceylon. This disease has been conclusively traced to the presence of a fungus—*Hemileia vastatrix*—and measures have been adopted with the view of exterminating the pest, and failing this, a description of coffee, entirely new to Ceylon, namely, that of Liberia, has been introduced. These are facts by this time well known to our readers, and we refer to them only as showing a parallel case to that which has occurred in Dominica in past years, with this exception, however—that, while in the east prompt action has been taken, in the west the disease was allowed to take its course, so that what was once an extensive coffee-producing country has become at the present time one of the least productive, if indeed it is productive at all; for we are not sure whether Dominica coffee is an article now known in the British market. It is certain, however, that the 4,000,000 or [illegible] lbs. of coffee that were annually imported into this country from the little western island are matters of the past. [illegible] the returns of coffee importation for the year up to the end of December last showed that while Ceylon sent 548,970 cwt., from the other British possessions [illegible] was imported only 311,665 cwt. This decline of what was once a valuable product and a most important article of trade, has lately attracted the attention of the authorities in Dominica, with a view of the "re-introduction" of the coffee as a staple article.

Coffee cultivation, however, has really never [illegible] died out, as sufficient is produced in the island for [illegible] consumption, and a little is also sent to the neighbouring islands, but for commercial purposes it is necessary that the cultivation of the plants should be resumed on an extensive scale, and for the purpose of attaining this object application was made recently by the authorities in Dominica to Dr. Hooker for his opinion and advice as to the necessity of obtaining a skilled coffee planter from Ceylon to report on the conditions of the island for coffee planting. The result of this has been [illegible] amongst the Europeans in the island a keen interest in the causes of failure, and the probabilities of future success. Following upon Dr. Hooker's suggestion, Mr. H. Prestoe, the Superintendent of the Botanic Gardens, Trinidad, has visited Dominica, and we may expect before long a report of his opinions and experience. Meanwhile, a great deal of information on the rise and progress of the disease has been collected and published in the local newspapers, and from these we gather that it first made it appearance about the year 1833 in plantations at the northern extremity of the island, from whence it rapidly extended southward, so that within the space of a year or two every planter had suffered from its ravages. The great hurricane of 1834 did an immense amount of mischief to the whole of the vegetation, [illegible] scarcely a leaf was to be seen after it had [illegible]. When the coffee trees that had withstood the force of the hurricane began again to put forth their leaves, the brown disease spots reappeared, and spread so rapidly as to kill many trees. In the face of so [illegible]

an enemy the planters seemed paralysed, and no ...mpt of any consequence was ever made either to ...oy or to counteract its evil effects. In the face of ... which have recently come to light regarding the ...se, the writer of an article on this subject in a ...ber of the *Dominica Courant* for October last is pro...y not far wrong when he says:—"We are still ...ssed with the belief that had persevering and varied ...mpts been made by the planters and others to over... the formidable enemy against which they had to ...nd, and to continue the cultivation of the coffee ..., the tree might have held its ground until the ...ence of the disease had begun to wane, and, reason... from analogy, this might fairly have been expected. ...fforts been made this important commodity might have held a considerable place among our products, ...t all events, would not have so quickly disappeared ... commerce as the staple article of export from the ...d." That the disease was of insect origin there ...ed no doubt, but we are told in the paper before ...ed to that the records of Dominica do not appear ...ontain any description of the nature of the coffee ..., nor does it appear that any attempts have been ... to account for its existence."

...e whole history of the coffee disease, as given in ...or four consecutive numbers of the *Dominica Courant*, ...ery interesting collection of facts, and the descrip... of the insects and its ravages are pretty accurate—...st having within the past few weeks only been ...ified with the *Cemiostoma coffeellum* of Mann. This ...usion has been arrived at from specimens of the ...ed leaves, together with the insects in their several ..., mounted for the microscope, having been received ...e Kew Museum from Dr. Imray, an old resident of ...inica, and a frequent contributor to the Kew estab...ent. These specimens were, however, selected and ...ted for Dr. Imray by Dr. Nicholls, a microscopist ...e island. They were shown at a recent meeting of ...cientific Committee of the Horticultural Society, ...e Mr. McLachlan immediately identified them with ...sect above referred to, and kindly pointed out that ...mplete description of the insect, together with a ...ry of its ravages in the coffee plantations of Brazil, ... given in the *American Naturalist*, vol. vi., pp. 332 ...596 (1872).

...om this paper, which is by Mr. B. Pickman Mann, ...ather the following details:—The insect is called ...white coffee leaf miner, and is described as the ...est enemy to the coffee culture in Brazil.

...e larva, as we have shown, burrows into the leaf, ...ng the brown spots. After the larva has ceased ...ng, and changed to the pupa state, the slender ... cocoon, covered with its silky web, may easily be ...d in the fold of the leaf. The moths, whose ...ifully ornamented silvery wings hardly cover the ...th of the little finger nail, rest upon the leaves and ...ches of the tree when quiet, but they are easily ...rbed, flying with a jerking flight.

...e habitation of the larva is a mine made in the ...by eating out the parenchyma between the upper ...nd the framework of the leaf, laying the frame... bare but leaving the epidermis intact, except at ...oint where the larva eats the leaf; at this point ...wound heals up, forming a lenticular scar, raised ... the general surface of the leaf. The epidermis ...h covers the mine becomes rusty brown, almost ... in the centre. The excrement adheres irregularly ... under surface; sometimes a portion of the under ...ce of the leaf opposite the mine also turns ...n. When the eggs are laid in sets the mines of ...separate larvæ usually become united, and even ...mines of two sets may be united into one. One ..., 15 millimetres long and ten millimetres broad, ...ined seven larvæ, the scars arranged in two groups ...r and three respectively. As many as five mines, ...nhabited, have been found on one leaf, and even ... mines, made by ten larvæ, though in this case some of the larvæ had escaped. When the larvæ escapes it cuts an angular or rounded slit in the epidermis near an edge of the mine.

Cemiostoma coffeellum is the only species of the genus yet known outside the limits of Europe. The larvæ are said to attack the new leaves in early spring, and to be found from that time forth. As the coffee tree is evergreen, it seems likely that the period of hibernation is very short, or none at all. Guérin says that the insect occurs throughout the year in the Antilles, but is more or less abundant according to the seasons. The eggs are said to be hatched seven or eight days after being laid. The larvæ then live about fifteen or twenty days within the leaf, after which they make their cocoons. The imago or perfect insect leaves the cocoon at the end of six days. It would appear that the insect is reproduced several times in the year, in the Antilles once in about every forty or forty-eight days. As soon as the larva is hatched, it seems that it cuts through the upper epidermis of the leaf, and begins to eat the parenchyma. Usually it may be found under an edge or an end of the blotch, eating. When the larva is full grown it escapes from the mine, and often, or perhaps generally, goes to another leaf to make its cocoon, which it does across one of the furrows at the edge of the leaf on the upper or the under surface, but oftner on the under. The larva places itself across a furrow and begins a web by spinning a series of threads from one side to beyond the middle of the furrow, swinging the fore part of the body from side to side. Where it has made one side of one end of its web thus, it spins a like series of threads to make the other side, without changing the position of the hind part of its body. Thus an opening is left in the middle of the end of the web, in the space occupied by the body of the larva. It then turns round and places its body across the furrow in the opposite direction. Here it spins a like series of threads on each side of it, from the leaf to the former part of the web, having a similar opening in this end. It then retires beneath the web, and lays a flooring of silk. On this flooring it spins its cocoon, laying the outside threads lengthwise. The cocoons are found in the greatest abundance on leaves which are nearest the ground, and frequently on leaves which have never been injured. Mr. Mann says:—"I judge from the appearance of the scars in the epidermis that the eggs are laid unconcealed on the upper surface of the leaf, singly, or in sets of two, three, or more, but not in immediate proximity, and that two or more sets are placed on the same leaf. It is not known how many eggs are laid by one female." From one tree in a Brazilian plantation Mr. Mann gathered 153 injured leaves in the course of nineteen minutes; of these 44 contained recent mines, but the larvæ had escaped; 90 contained 122 mines still inhabited; the rest contained old mines or blotches, made by a fungus which also attacks the leaves.

The insect is said to lessen the coffee crop in Brazil by at least one-fifth; the little pest has been found in the Antilles, Island of Martinique, province of Rio Janeiro, and over the whole coffee region of Brazil. It first appeared in Brazil about twenty or twenty-three years since, being apparently brought from the Antilles with plants which were introduced about that time.

To rid the plantations of this pest several plans have been suggested; one is to cut off all infected branches, and allow the trees to recover themselves by putting on new foliage, carefully watching the progress of disease afterwards, and destroying it as fast as it appears. By this mode of dealing with the disease a large proportion of one crop of coffee would be sacrificed; to avoid this, all leaves which contain larvæ might be carefully picked off and burnt, leaving the healthy leaves to support the tree. This operation should be performed when the smallest number of old leaves remain upon the trees. "If," says Mr. Mann, "the leaves were picked at such a time as to take the greatest number of larvæ when they were about

Front view.

Back view.

The Imperial State Crown of Her Majesty Queen Victoria.

two weeks weeks old, it would not be difficult to select them, as the size of the blotches would make them very noticeable. I find that the expense would be more than met by the next year's crop." But vigilance is necessary to keep the trees in order.

Another remedy is to kindle fires at all points of the plantation when the moths begin to issue from the cocoons; lighted torches may also be carried about the grounds in the evening; the moths, being attracted by the light of the fires, soon cause their own destruction.

Dr. Imray, in the letter referred to at the commencement of this article, expresses his belief that the disease is evidently on the wane in Dominica, and by careful cultivation of the coffee plant he thinks it would soon disappear altogether. From observations extending over a long period of time, he is inclined to think that too much shade favours the generation and propagation of the insect. "I have now, "Dr. Imray says, "forty acres of young plants growing. Some have been killed by the drought that has set in, but most of the young plants look healthy, and have begun to throw out leaves. Although I keep a vigilant watch, I have not as yet observed a single patch of blight. The young trees are growing quite in the open—no protection. In my own little garden I have a small nursery of Mocha coffee plants. They are really beautiful, not a speck of blight upon them. On the opposite side of the street in a small garden there are some coffee trees shaded by plantains; there the blight abounds. The plants on my small coffee plantation, amounting perhaps to 15,000 or 20,000, have been got from different parts of the country. I mention this to show that coffee continues to grow in Dominica, and that capital and enterprise only are wanting to make it a coffee-producing country."—J. R. Jackson, in the *Gardeners' Chronicle.*

THE ENGLISH STATE CROWN.

By Professor Tennant, F.G.S.

The recent opening of the Tower free has drawn a good deal of attention to the Crown jewels preserved there, and it is probable that many members of institutions in union with the Society of Arts may be glad of a little definite information on the subject.

The Imperial State Crown of Her Majesty Queen Victoria was made by Messrs. Rundell and Bridge, in the year 1838, with jewels taken from old crowns, and others furnished by command of her Majesty. It consists of diamonds, pearls, rubies, sapphires, and emeralds, set in silver and gold; it has a crimson velvet cap with ermine border, and is lined with white silk. Its gross weight is 39 oz. 5 dwts. troy. The lower part of the band above the ermine border, consists of a row of 129 pearls and the upper part of the band of a row of 112 pearls between which, in front of the crown, is a large sapphire (partly drilled), purchased for the crown by his Majesty King George the Fourth. At the back is a sapphire of smaller size, and six other sapphires (three on each side), between which are eight emeralds.

Above and below the seven sapphires are 14 diamonds, and around the eight emeralds 128 diamonds. Between the emeralds and the sapphires are sixteen trefoil ornaments, containing 160 diamonds. Above the band are eight sapphires surmounted by eight diamonds, between which are eight festoons consisting of 148 diamonds.

In the front of the crown, and in the centre of a diamond Maltese cross, is the famous ruby said to have been given to Edward Prince of Wales, son of Edward the Third, called the Black Prince, by Don Pedro, King of Castile, after the battle of Najera, near Vittoria, A.D.

This ruby was worn in the helmet of Henry the t the battle of Agincourt, A.D. 1415. It is pierced through, after the Eastern custom, the upper part piercing being filled up by a small ruby. Around uby, in order to form the cross, are 75 t diamonds. Three other Maltese crosses, form- two sides and back of the crown, have emerald , and contain respectively 132, 124, and 130 t diamonds.

een the four Maltese crosses are four ornaments form of the French fleur-de-lis, with four rubies centres, and surrounded by rose diamonds, con- respectively 85, 86, and 87 rose diamonds.

the Maltese crosses issue four imperial arches ed of oak leaves and acorns; the leaves contain e, table, and brilliant diamonds; 32 pearls form rns, set in cups containing 54 rose diamonds and ble diamond. The total number of diamonds in hes and acorns is 108 brilliant, 116 table, and 559 monds.

the upper part of the arches are suspended four endant pear-shaped pearls, with rose diamond ntaining 12 rose diamonds, and stems con- 24 very small rose diamonds. Above the arch the mound, containing in the lower hemisphere lliants, and in the upper 244 brilliants; the zone being composed of 33 rose diamonds. The cross summit has a rose-cut sapphire in the centre, ded by four large brilliants, and 108 smaller its.

Summary of Jewels comprised in the Crown.

1	Large ruby irregularly polished.
1	Large broad-spread sapphire.
16	Sapphires.
11	Emeralds.
4	Rubies.
1,363	Brilliant diamonds.
1,273	Rose diamonds.
147	Table diamonds.
4	Drop-shaped pearls.
273	Pearls.

PHILADELPHIA INTERNATIONAL EXHIBITION 1876.

following rules and information for exhibitors en issued by the United States Centennial Com- :—

ts for exhibition will be admitted to the Machinery g from the 5th of January, 1876, until the 10th l, 1876. Heavy and bulky machinery must be y the 20th of April, and all other objects by the ay, 1876.

n the allotment of space is definitely made, each r will be notified and furnished with a permit for

xhibits in the United States section must be at the office of the Chief of the Bureau in charge department, and before unpacking or arranging icles the entry must be endorsed on the permit e.

e interior of the Machinery Building, and adjacent e railways from which trucks will carry the goods s allotted.

dations will be built at the expense of the exhi- and must be finished and ready for receiving the ery by the 1st of March, 1876. Exhibitors g foundations built will be granted facilities on tion to the Chief of the Bureau.

floor in the Machinery Building is laid directly ground, and is composed of 1½ inch yellow pine placed on hemlock sills 3 by 8 in., distanced 2 ft. The floor may be cut, when necessary for con- g foundations, on permission from the Chief of reau.

The main lines of pipes for steam, water, gas, and sewerage will be laid by the Commission, but exhibitors must supply all connecting pipes. Joints will not be permitted on steam or water pipes over thoroughfares.

A limited quantity of steam and water power will be supplied gratuitously; the steam at 70 lbs. pressure per square inch, above the atmosphere; the water at a low pressure due to a head of thirty-five feet, and a high pressure due to a head of seventy feet.

Steam, water, and motive power will be supplied gratuitously only for the purpose of exhibiting the machinery in operation, and no machinery will be allowed to run longer than is necessary for that purpose, except by permission of the Chief of the Bureau.

There will be eight lines of shafting, four on each side of the transept, extending lengthwise of the building, seven to have a speed of 120 revolutions, and one of 240 revolutions per minute; the size of the shaft nearest to the space granted to an exhibitor will be sent at the time space is allotted.

Pulleys for the main shafts, as well as the counter-shafts and belts must be supplied by the exhibitors at their own cost. Pulleys for the main shafts must be balanced, in halves, of not more than three feet in diameter, and secured so as not to injure or weaken the shafting. The form and manner of securing them to the shafts must be approved by the Chief of the Bureau.

The Chief of the Bureau will have the care and supervision of the main shafts, but all gear supplied by exhibitors will be under their care; they will also select the persons to attend to their machinery, who alone will be allowed to operate it.

To insure saftey to visitors, exhibitors will be required to inclose all machinery in motion with railings of a uniform height of 2½ ft. above the floor level. Exhibitors of machinery not in motion will have the privilege of placing railings around the space allotted to them. All railings must be placed within the space assigned, and must be of approved design.

Manufacturers of steam-engines, who may wish to exhibit them doing work, should notify the Chief of the Bureau on making application for space. Special arrangements have been made to allow engines to run a stated time doing work.

Manufacturers of steam boilers, who may wish to exhibit them for service, should notify the Chief of the Bureau at as early a day as is practicable. If accepted for use, the exhibitor must guarantee to deliver them at the Exhibition grounds on or before the first of March, 1876. All boilers will be subjected to a hydrostatic test before being accepted for this purpose.

The Commission will erect suitable boiler houses, set the boilers according to the plans furnished by the exhibitors, make all connections to the main pipes, furnish the coal and water, and provide the fireman. If the exhibitor prefers, he may select the fireman, and his wages will be fixed and paid by the Commission.

Engines, boilers, steam pumps, machinery, apparatus, and tools required by the Commission for use, and supplied by exhibitors, will be classed in a separate group, and will be especially reported on. The Commission will defray the necessary expenses of exhibitors in lending their machinery, tools, &c., for use, beyond that which they would have incurred as exhibitors simply, wear and tear excepted.

A space has been reserved for exhibitors wishing to operate steam-hammers, and for heating metals for working. Fire and light can only be used by special permission of the Chief of the Bureau.

A machine, smith, plumber, and carpenter's shop, for doing light work, will be located near the Machinery Building for the convenience of exhibitors. A fixed tariff of prices for work will be issued. Manufacturers who may wish to exhibit machines or tools in this shop, should notify the Chief of the Bureau.

The hydraulic annex, adjoining the Machinery Building, will be so arranged as to give exhibitors an oppor-

tunity to test steam and rotary pumps, and turbine water wheels. Steam and water, and steam and water power will be furnished gratuitously.

Exhibitors of locomotives, cars, and trucks will be required to furnish the rails they are to stand upon.

Fire-engines entered for exhibition, and accepted for use, will receive care, and be furnished with fuel free of expense.

No exhibitor will be permitted to erect or arrange his exhibits in a way to obstruct the light, or occasion inconvenience, injury, or disadvantageously affect the display of other exhibitors.

Signs will not be allowed to project beyond the floor area of the space allotted, nor will signs made of canvas or paper be permitted. The sizes of all signs will be subject of approval.

The transepts, avenues, aisles, and public passage ways remain under the control of the United States Centennial Commission; and no trophies, decorations, portals, foundations, or other special exhibits, will be permitted in them, except by permission of the Director-General.

Cards supplied by the Centennial Commission may be affixed to goods, stating the exhibitor's name, address, and place of manufacture, class of objects, catalogue number, and price.

Exhibitors' business cards, circulars, and samples may be placed within their space for distribution, but visitors shall not be solicited to receive them.

All platforms, counters, ornamental partitions, show cases, and appurtenances, of approved design, must be erected at the expense of the exhibitor, and shall not exceed the following dimensions, without special permission of the Chief of the Bureau:—Show cases, fifteen feet above the floor; counters, two feet ten inches above the floor, on the side next to the passage way; platforms, one foot above the floor.

Partitions of various heights and designs can be erected in different parts of the building, the dimensions of which will be given the exhibitor when notified of the assignment of his space.

In order to insure a uniform and satisfactory location of the exhibits, applicants for space desiring to erect show cases, counters, or railings, must furnish this Bureau with a scale drawing, or tracing, showing the elevation and ground plan of the same.

The Chief of the Bureau of Machinery has charge of the allotment of space to exhibitors in the United States section.

The right to alter or amend these rules is reserved.

GENERAL NOTES.

Industry and Military Service.—The Duke of Buckingham addressed the Yeomanry and Volunteers of the county of Buckingham, assembled in his park at Stowe, October 6th, and said:—"The duty of a citizen is not alone to be a good subject, and orderly in time of peace, it is his duty also to do all that is needed in times of danger. The ranks of both the Rifle Volunteers and of the Yeomanry ought to be very considerably increased. Volunteering in these days, and belonging to the auxiliary forces of the country, is no longer a matter of wearing a military coat, or of going out occasionally for drill and inspection, but it is that every man must know how to handle a carefully-prepared weapon with effect—with efficiency. No such weapon was placed in the hands of the Volunteers when they first were organised; no such weapons were placed in the hands of the Yeomanry when first I joined the regiment. But this weapon requires that it shall be properly cared for and properly used. As times of need have come for former generations, so they may come again, and if they come they must not find Englishmen unprepared."

Lancashire and Cheshire Union of Institutes.—Mr. W. H. J. Traice has been appointed to succeed the late Mr. Thomas Lawton as visiting agent to this Union. Mr. Traice has been long known in the educational world. In 1839 he compiled the Report on Mechanics' Institutions for the Society for the Diffusion of Useful Knowledge, which was published by that Society. In 1856 he prepared the "Yorkshire Handbook of Mechanics' Institutes," which was published under the sanction of the Society of Arts. He has since been for 17 years engaged under the Duke of Bridgewater's Trustees giving instruction in their colliery night schools, and latterly to the mining foremen and deputies in ventilation and the sciences as applied to mining. He has also been for some years a member of the Council of the Union of Institutes for Lancashire and Cheshire, and also of the Manchester School of Art.

Decorative Exhibition.—The Union Centrale des Arts Appliqués à l'Industrie, which has managed so many exhibitions of ancient and modern works of art in the Palais de l'Industrie, Paris, has now determined on organising next year, most probably in the same place, an exhibition of the works of modern living ornamentalists, including, of course, works in all departments of decorative art whether in wood, stone, marble, terra-cotta, or metal, and drawings, designs, engravings, &c., of all kinds, such as are excluded by the rules of the *Salon* from appearing in those annual exhibitions. It is proposed at first to make the collection biennial, but the products of art-industry in furniture, decorative carving of all kinds, porcelain and faience, ornamental metal work, bronzes, goldsmiths' work, jewellery, trinkets, and miscellaneous ornaments are so large that if the exhibition be well organised it will most probably become annual.

The Silk Crop of 1874.—According to a report just published by the Syndicate of the Lyons Union of Silk Merchants, the silk crop of Europe last year was, in round numbers, 9,050,000 lbs. of raw silk, while there were exported from Asia 11,500,000 lbs., making upwards of 20,500,000 lbs. of raw silk available for European consumption. The countries included in the report are Italy, France (with her dependencies, Corsica and Algeria), Spain, Greece, the Turkish Empire, Georgia, Persia, India, Japan, and China. The first and last together supply four-fifths of the silk used in Europe. China exported, chiefly from Shanghai, upwards of 8,000,000 lbs. The crop of Italy amounted to 6,300,000 lbs. France supplied 1,600,000 lbs.; Spain, about 310,090 lbs.; Greece, less than 30,000 lbs.; the Turkish Empire, 1,180,000 lbs.; Georgia and Persia together, 880,000 lbs.; India (from Calcutta), 935,000 lbs.; and Japan, something over 1,300,000 lbs.

The Rheea Fibre.—Early next month it is probable that some trials will be made of new machines for extracting the fibre from the stems of the Rheea plant. More than five years have elapsed since the Government of India offered a prize of £5,000 for a machine that should produce a fibre worth at least £50 per ton in the English market at a cost of preparation not exceeding £15 per ton. The promised reward induced thirty-two competitors to enter their names, of whom only one actually completed a machine, and this failed to fulfil all the conditions. A donation of £1,500 was, however, awarded to the inventor, Mr. Greig, of Edinburgh, in recognition of his ingenuity and enterprise, and it has since been resolved to invite machinists to a competitive trial in this country, withholding the prospect of an immediate pecuniary reward, but providing a sufficient supply of green and dry stems. The former, it seems, can now be procured from Algiers, the south of France, and even from Straits Settlements, while the latter will be sent from India. The true Rheea plant (*Bœhmeria nivea*, called also *Urtica nivea*) grows abundantly in Assam, the Lower Provinces of Bengal, Oude, and the Punjaub, and also on the Nilgiri hills. It is of the same genus, though perhaps not of the same species, as the plant from which China grass is produced; and the fibre, if it can be brought into the market at an average price of from £30 to £40 for the better qualities, is expected to compare favourably for many purposes with flax and hemp. A fibre of similar character is furnished by the Nilgiri nettle (*Urtica pterophylla*); but the difficulty of manipulating this "most ferocious-looking plant," as it has been described, has hitherto depreciated its commercial value.

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FRIDAY, OCTOBER 22, 1875.

mmunications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

MISCELLANEOUS.

TECHNICAL EDUCATION.

PLACE OF COLLEGES IN ENGINEERING TRAINING.

By Professor Alexander B. W. Kennedy, C.E.*

y first duty to-day is a sufficiently obvious and a very ant one, to welcome you here on behalf of the Senate the commencement of another session's pleasant urs. I believe there can scarcely be any old student his college here who will not heartily approve of this ession; and those of you who are about to commence r college life will soon find it to be true. Indeed e seems to me scarcely any position in life more envi- than that of a man just entering college. He has a le world of possibilities before him—of friendships be made, of work to be done, difficulties to be sur- nted, of experience and wisdom to be at length gained. pleasures are greater than that which you have to forward to, of entering upon and carrying out tematically the study of a subject in which you are rested. Knowledge appears at first to be accumu- d largely and quickly, as you go on, apparently more ly, but only because of your continually growing e of the infinitude of the source from which your e supply is drawn, and you learn on with a quieter higher pleasure. Then comes the delight of finding hidden connexions and analogies of things, how each into its proper place, how nothing exists by itself, all for and with other things, how ideas and pheno- na apparently the most distant throw unexpected t upon each other. You seem to get a glimpse now then of an infinite homogeneity, a web of beautiful tern into which somehow or other all the bright—or y be the dull—threads which you are spinning con- ally weave themselves. Then comes the crowning asure of all—work for oneself, the discovery of new s or the development of old ones, the exposition of ngs hitherto understood only by a few, the reduction rder of apparently contradictory phenomena. Each ker, great or small, knows that his work is not iso- d, it gains tenfold interest and importance to him as recognises that it is a part of a great whole, that his ition to the sum of human knowledge will equally fit f into the great pattern, whether it be an insignifi- t bit of its border or a gorgeous centre-piece which border seems only to set off. All these pleasures nect themselves, at least potentially, with student and along with your pleasant friendships and com- ionships among yourselves (and I hope too with your chers), and with the other delights which associate mselves with growing physical, intellectual, and moral ngth, conspire to make it a time of intense enjoyment ile it lasts, and one which can be fondly looked back upon when it is over. In welcoming you to-day, then, I am not using a mere form of words, but in good earnestness expressing my pleasure, and I am sure that of my colleagues, at meeting again those with whom we shall be so closely associated in our work for some time to come, and of whom, at the close of the session, we shall doubtless carry away many pleasant recollections.

In asking me to give the introductory address this session, the Senate of University College did not, I am sure, do so with any wish that I should attempt to enlighten you upon any general subject. I think I shall rather be doing what is in accordance with their intentions, as well as most suitable in itself, if I take this opportunity of saying something about my own subject, and about it more especially in those aspects in which it more immediately concerns University College and other similar institutions. When so much is being said and done about technical education, when one even of the old English universities is proposing to found a chair of engineering, while the University of Edinburgh B.Sc. and D.Sc. are given in the same subject, and in other institutions in Scotland and Ireland other less important degrees, I trust I shall not be speaking upon a subject in which you can take no interest if I attempt, limiting myself to my own special department, to examine so far as time will allow me what really the education of an engineer ought to be, and what place may be taken, and I hope will presently be taken, by the College in his training.

I suppose I need hardly commence here by arguing the necessity or benefit to the engineer of something more than the training merely of practical experience at his work, something in the nature of theoretical training, which alone can enable him to understand the facts of his experience, or to connect them or draw inferences from them in a complete or satisfactory way. It is unfortunately true, however, that some people still deny this, and many others, while admitting its truth. admit it only as a form of words, and practically reduce the value of their admission to nothing by the limitations they put upon it in each particular case, as well as by the sneer or smile with which they commonly receive the mention of "theory." It will be some assistance to our attempts to find out what education is required, or is the best, if we go back a little and look at what is really, whether expressed or understood, the foundation of this position of badly disguised hostility to theoretical training. This I take to be the fact, that of the older engineers, admittedly great in their profession, scarcely any had opportunities for obtaining such training, while in spite of this deficiency they did splendid work. In some notable cases the knowledge that was not acquired while they were young was obtained in manhood. But there are certainly many distinguished engineers, whose names are almost household words to us, who neither in youth nor in manhood ever mastered, or even knew, the principles underlying the work which they so successfully carried out.

That this fact should be seriously used as an argument for a conservative adherence to the system of training under which such men were not educated is as incomprehensible as it is true. In no other subject or profession does a man say, "Because I was imperfectly trained and yet have succeeded, therefore I will train my son imperfectly;" and yet it is said by some, and is practically acted upon by a far greater number. Such people do not hesitate to refer to Smeaton, Brindley, Telford, and others as models, men who, without technical or scientific training, did great work, and whose names every one receives with respect; or, in another field, to Arkwright and Hargreaves, whose mechanical genius has given to the country so much of its present wealth and prosperity; or again to Stephenson and Fairbairn, who started as engine boys, and again, without any technical education of any kind, made their positions by talent, pluck, and unlimited capacity for work. One would have thought the inference sufficiently obvious, if these

* Introductory Lecture delivered to the Faculties of Arts and s and of Science at University College, October 5, 1875.

men did so much under disadvantageous circumstances, how much more might they not have done if they had possessed all the advantages which are within our reach just now. But no, the idea seems to be, these men served seven years' apprenticeship (or whatever it may be), therefore that is the best thing for every one to do who wishes to follow in their steps. The Conservatives can certainly claim excellent precedent for this conclusion, for it is, after all, no other than one from which many of us have had to suffer:—Latin was once the universal language of European scholarship, therefore boys should spend the best part of their school life in this nineteenth century learning to write hexameters!

But if we are to follow blindly in the steps of such engineers as I have named, simply because they are their steps (and I think no other reason can be adduced for continuing the apprenticeship system pure and simple), it must be because their work was, in itself, superlatively good. I can understand that a modern sculptor should be willing to copy the method of study of his Grecian prototype, in the hope that he might also be able to copy in some degree his work; or that an architect would gladly enter into any course of training that had produced the authors of the Cathedral at Cologne; but here the original objects produced have been of their kind perfect, insusceptible, so far as we can see, of improvement, and even here modern methods of study are more likely to lead moderns to the ancient results than the copying of ancient methods.

But there is nothing of the kind before our view in engineering. We aim at building upon the foundations laid by our predecessors, and not at copying their work. The roads, canals, and docks of a hundred years ago, would be thought but little of now. Some of them were good pieces of engineering, some were very imperfect indeed, few of them contained difficulties greater than those which are now being overcome every day in ordinary contractor's work; the antiquated but most interesting locomotives exhibited at Darlington the other day have long ago been superseded; automatic machines, more perfect than Hargreaves or Arkwright ever dreamt of, are familiar to every factory girl in Yorkshire; even the bridges, once so novel or so daring or so large, Newcastle High Level for instance, or the Britannia Bridge, will only not be imitated because more satisfactory structures can now be designed.

I hope I shall not be accused of making light of the works of the great men I have named. You will quite understand that nothing could be further from my intention, that I am looking at the matter from quite a different point of view. Relatively to their time the structures I have mentioned show in the very brightest light the genius of those who designed them and carried them out in spite of very defective knowledge, want of experience, and many discouragements. To gauge the capacity of a man by the bigness of his work, or even by the degree in which it approached perfection, leaving out of consideration the conditions under which it was done, would be absurd. There are many respects in which our young engineer cannot do better than imitate the men themselves, their energy, perseverance, and self-denial; but I wish to emphasise the fact that they are not expected to imitate their work, but excel it, to design still better machines, to bridge deeper chasms, to blast more solid rock, in general to perform more impossible impossibilities. They are not to stand still, still less to go back; if they do not advance they are of no use in their profession. If, then, the engineers of the next generation are expected to do so much more than those of the last, it really seems folly that their training should be restricted to the former narrow limits. At the time when those limits were fixed, or fixed themselves, there was very little choice; now there are plenty of opportunities for everyone who chooses to take advantage of them. Are we wilfully to shut ourselves out from these because our grandfathers did not possess them, or are we to try to get the best training possible without the least reference to what training other people did get, or could get?

In speaking of "training" of course I use the word here in its conventionally restricted sense, meaning by it that part of a man's training which he receives before he is sufficiently master of his profession to exercise it on his own account, or to take any responsible subordinate position in it. Although in point of fact a man's most valuable training may be later on, yet as it is only with this earlier part that the college, as such, can be connected, it is with it only that I have to do just now. I think that if we look at the matter from the outside, without consideration of what means are existing or non-existing for imparting the training, or what amount of training men may or may not have hitherto received, we may pretty safely put down the lines which the education must take somewhat thus—not attempting any very rigid classification: first, a general scientific groundwork, a knowledge of of the principles of the sciences upon which engineering is based, commencing of course with mathematics in all its various branches, and including physics (in the most general sense of the word), chemistry, and metallurgy, and geology. Then, secondly, a knowledge of the way in which these sciences are applied, to apply themselves, to engineering work, the bearing of the laws of thermodynamics upon the theory of the steam-engine, of the laws of mechanics upon the forms of structures and so on. The theory of machines would here come in, the theory of what we clumsily call the "strength of materials," and the general principles of the design and construction of structures and machines. This part of the training, especially, should establish the identity of "theory" and "practice," so often spoken of as if they were antithetical, but between which no contradiction can exist except the superficial inconsistencies arising from the imperfection of the one or the incorrectness of the other. Then, lastly, before the training can be considered complete, not only the knowledge of these applications of the pure sciences, but also some experience in the applications themselves must be obtained. That is, the student must have practice in the design of actual machines and in the constructive and other processes of which he has already studied the principles. Only after this has been, in some way, added to the other and more theoretical part of his education, can the preliminary training of which I have spoken be considered complete.

I think the course of training of which I have thus sketched the nature in very general terms is one which must commend itself to most of those who will go so far with me as to believe in the value of scientific training at all. No doubt difficulties as to time and as to expense would prevent its being carried out in certain instances, but waiving these for the present we come next to the question: How can it best be carried out?

First as to the general scientific training. If it be once granted that such training is advisable there can hardly be any question that the college is the place in which it can best be obtained. Of course I use the word "college" in its most general sense, intending to include under it those science schools of a high order which are colleges in everything but the name. In general, the alternative to the acquisition of this scientific training at college systematically is obtaining it by home study, after work hours, while the student is spending the day in the works or the office. It cannot be denied that in some cases men have in this way taught themselves a great deal, nor can it be denied, I think, that knowledge gained by this laborious method—by this poring over pages which require re-reading and re-re-reading before their contents are intelligible—becomes one's own in a sense in which the same knowledge obtained with little mental effort by listening to lectures does not. This may be some consolation to those who have not had the opportunity of trying the easier method. But for any one who has the chance of employing it wilfully to throw it away because certain other men had

not, would be folly. The process of seriously studying science in leisure hours is in the best possible case unsatisfactory, and in the immense majority of cases it is simply impossible. And even in the few instances where a man has the necessary perseverance and enthusiasm for his subject, it is yet a great strain both upon mind and body: the hours which ought to be hours of relaxation must be continually given up to study, sleep must be reduced to a minimum, and close mental attention must be given to more or less abstruse subjects at times when both body and mind are sufficiently fatigued at the end of the day's regular work. It is very hard and very exhausting, and the man who has tried it himself will be the first to wish others, if possible, to obtain more quickly, more easily, and at the same time more completely, the knowledge which he has so dearly bought. The evening classes for technical subjects which are now, fortunately, so common, are very valuable in their own place, but do not meet the case under consideration. While they are most useful in supplementing imperfect education, and may often greatly help home study, they cannot form any substitute for a regular course of college training, both for the reasons I have already given, and because the time of instruction in them is necessarily so limited as to render impossible much beyond elementary teaching. The study of science on the one hand, and the office or shop work on the other, each require for their proper carrying out the whole of the student's time, except that portion of it which he must give to other studies or occupations to prevent a one-sided mental growth, or for the sake of his health. I therefore place the college at the very commencement of the young engineer's training, as indeed the only place where he can obtain that thorough and systematic teaching of science which I believe to be the essential foundation for his after work. Although speaking only of technical training here, I may just mention that a knowledge of French and German will be of great use to the student, and should be obtained or extended during this section of his work. The German technical literature is especially valuable, and every engineering student will find great advantage in being able to make free use of it.

What follows this first part of the training requires more detailed consideration. Its successful carrying out is of quite as vital importance to the student as the foundation work of which I have just been speaking. A knowledge of mathematics, for instance, is essential, is indeed the very first essential for the student of engineering. Almost all that he afterwards learns will somehow or other be connected with it. But a mere knowledge of mathematical processes, mere facility in working equations, not only is insufficient, but in some cases may be positively harmful to him. The questions upon which he will in his profession be called upon to employ his mathematical knowledge are never abstract ones, are most often questions in which there is great complexity arising from the conditions under which actual design or construction has to be carried on. It occurs very frequently indeed that they are not questions involving any very profound mathematical knowledge, but to the extent to which they do require that knowledge, they require it to be thorough and accurate. The solutions to such questions obtained by an inappropriate application to them of mathematical processes or expressions have often proved far less trustworthy than the purely empirical solutions of the so-called "practical" man, who is thus confirmed in his contempt for theory and theorists in general, and for mathematicians in particular. Similarly there can be few either of the "examinati, examinandi, or examinatores," who do not know from experience how much more difficult it seems always to be to answer a question which involves some particular application to practice of even a well-known law or formula, than one in which deductions from the same law or formula have merely to be written out in symbols. The only possibility of finding correct solutions to the complex problems of practice to which I have referred lies in the solver having an exact and correct comprehension of the real meaning of the formulæ which he employs, of his being able, as it were, to crystallise them in his brain, to translate them into physical phenomena. If they are to him nothing more than equations he is certain to apply them in cases to which they have no real reference, and then reasoning correctly upon them with all the apparent certainty which mathematical processes give, will come to conclusions which are completely incorrect and useless. To prevent this, then, it is all important that the student should early learn to grasp the real significance of the formulæ with which he is working, and the way in which they can be applied to the sort of problems with which he has to deal. I am not now speaking of the study of mathematics for itself, although I suppose that even to that much of what I have said is applicable, but of its study as an essential part of an engineer's training, and in reference to this I have no hesitation in saying that a man's knowledge of mathematics ends exactly where his ability to apply that knowledge to his work problems ends; anything beyond this is useless so far as his profession goes, and is even, as I have pointed out, liable to have in certain cases disastrous consequences.

What I have said as to mathematics applies to a very great extent also to physics, on which therefore I need not enlarge. I use both expressions here in the widest possible sense, to avoid the repetition of the names of the various secondary sciences which may be included under them.

The question now is, can this knowledge of how to apply scientific principles to engineering work be acquired in an office, or by private study, or will it, too, be best obtained in college education? To attempt to work at it in what ought to be a man's leisure hours has all the disadvantages I have already pointed out in the case of the attempt to study the sciences themselves in the same way, with the additional drawback that there are, in our own language at least, but few books which would be of any use to the student. There are some exceptions, in the shape mostly of books on special sections of engineering construction, written by engineers who have a really scientific knowledge of their subject, but the number of such books is small. We have indeed no lack of works professing to be text-books of engineering or some of its branches, but too many of these are written by men who have not recognised that it is necessary for the author even of an elementary text-book to understand his subject himself before he attempts to instruct others in it.

There is perhaps more plausibility in the notion that this part of the training might be given in an engineer's office, and I would by no means say that this was impossible in itself. It certainly is impossible, however, in an engineer's office as it is at present constituted; for even if the head of the office himself possesses the requisite knowledge, it does not follow that he has the faculty of imparting it to others, and in any case his time is far too much occupied to allow him to do more than give a little help now and then, or a few words of suggestion, to the pupils under his care. He is generally a busy man, with more work on his hands than he knows well how to get through, and even were he anxious and able to give instruction to his subordinates, his more immediate duties would render it impossible that he should do so. We find ourselves reduced then to the alternative that this knowledge of the application of science to professional work must either be obtained systematically at college or "picked up" piecemeal, and with no sort of completeness, during apprenticeship and in after years.

A considerable portion of it may be given, I believe, most usefully in the form of lectures and ordinary class instruction. The principles of design, for instance, could be treated in detail in this way: the functions of all the more important members of machines or structures, and the methods of determining their forms and arrangements, could be explained, and the way in which their dimensions are calculated. The mathematical or

mechanical assumptions made in the calculations could be made clear, their influence upon the result, the consequences of such conditions not being fulfilled, the extent to which the results obtained could be considered accurate, and so forth. In the same way much could be taught as to the art of construction, and the nature and characteristics of the materials with which the engineer has to work. This is not a place in which to go into details, so I do no more than indicate in this general way the outline of the sort of instruction to which I refer.

I should not omit to mention here the study of drawing, which should be carried on really throughout the whole course of training. It is impossible for an engineer to be too ready or too accurate in the use of his pencil. In the earlier part of his college course geometrical drawing will aid him wonderfully with his mathematical studies, while later on it becomes the language in which he expresses his mechanical ideas. At the same time graphical, that is, geometrical, methods of computation are all important to him in the solution both of statical and kinetical problems. These graphical methods afford to him in an immense number of cases easily obtained solutions, which possess a degree of accuracy even in excess of his requirements. Of their many advantages for his purposes, as indeed for many others, over numerical or symbolical methods, I need hardly say anything.

I may be here met with the very reasonable objection, if made from knowledge and not from ignorance, that men cannot be taught the nature of the materials with which they have to deal without handling them, that they cannot gain any familiarity with either the theory or the design of the steam-engine without seeing it at work, and so on for all the other subjects I have mentioned. This I most freely admit, but not so the deduction by which it is frequently followed, that therefore the workshop and the office, not the college, are the place for the studies about which I am speaking. I shall come very shortly to the mention of what appears to me to be the true function of the office and workshop in training the student. Both are essential to him, but neither I think at this stage, nor exactly for this purpose.

Let us take the special cases which I mentioned, they will illustrate my meaning as well as any others. Familiarity with the theory and design of the steam-engine cannot be obtained without handling the machine itself. I grant at once that it is scarcely possible to imagine a man, however many lectures he had attended, or however many books he had read, designing a satisfactory engine without ever having seen one. But "handling" is a vague expression which may mean half a dozen things or nothing. It is not difficult to sketch out the sort of "handling" which would be of the most real use to the student. It would presuppose in the first place what is known as an "experimental" boiler and engine, *i.e.*, machines specially arranged for being experimented upon. With these the students would carry on systematic courses of experiments, measuring in the former, for instance, the quantity of water evaporated per unit of weight of various fuels, under various conditions as to the extent and arrangement of the grate, with various arrangements for admission of air and different pressures of steam; finding also the quantity of air consumed, the constitution and temperature of the escaping gases, and so on. In the engine would be measured the quantity of steam condensed during admission into the cylinder, the quantity liquefied during expansion, the quantity liquefied in the jacket, and the relative economy of steam jacketting with different ratios of expansion, the losses by radiation, the proportion between the useful and the total indicated horse power, and so on. I conceive that some such course of work as this is the sort of "handling" of the machines spoken of which would be of the most importance to the young engineer. It would indeed be of so great importance to him that I think it must be considered to form an essential part of any really complete system of training. Then as to the "handling" of the materials themselves, the iron and steel and so forth, with a view to the thorough grasping of the nature and characteristics of each. This would surely require that the students should themselves make, or at least take part in, systematic experiments upon the strength and elasticity of the materials in question, used in various forms and subjected to various stresses. This certainly seems the most natural way in which the required familiarity with the physical properties of the materials can be obtained, indeed the only way in which it can be obtained thoroughly.

We are now in a position to look at the question of where this portion of the training should take place. I think we must conclude that it cannot be given in the factory. One or two manufacturers have certainly gone so far as to spend much money and time upon the construction of experimental machines such as I have described. Such action on their part deserves the most hearty recognition. One is glad, too, to feel sure that even financially they will be greatly the gainers by this judicious expenditure of time and money. But even in these exceptional cases, only a part of the apparatus required is provided, and even this cannot be used systematically for educational purposes, but only for such courses of experiments as its owners find necessary for their own information. I see no reason, on the other hand, why any separate institution should be formed for the purpose of giving this kind of instruction, and conclude simply that it, too, should form a part of the regular college training of an engineer.

Up to this point I have spoken only of such college training as is to be had more or less completely (somewhere, I fear, quite completely), and subdivided in a number of different ways, in various institutions throughout the kingdom. Now, however, we find ourselves face to face with requirements for meeting which no existing institution, so far as I know, affords the means. At present, each man gets this particular portion of his training as best he can during his apprenticeship or the years which follow it. He gets it in the most incomplete way, and, indeed, unless he is really himself anxious about it, and takes pains to look for it, he does not get it at all. As a consequence, we find that a comparatively small number of engineers have become in time, from circumstances or from inclination, specially familiar with what I may call in general, experimental engineering, but that the majority are, through no fault of their own, deficient both in this branch of their profession and in the knowledge to which it leads. What is really required, appears to me to be a kind of engineering laboratory, if I may use the expression, attached to the college, and supplied with the requisite machinery and apparatus. It would be essentially a laboratory for the carrying on of experiments in engineering and mechanical physics; and I do not think it would be possible—at least possible, certainly not wise—to make a distinct separation between it and the ordinary physical laboratory, for, although there are many series of experiments which would be peculiar to each, there are still many which must necessarily be common to both. Many things would be included in the work of this laboratory besides those which I have chosen in illustration of its necessity—experiments in connection with many hydraulic problems, with the laws of friction, with the accuracy of the instruments commonly used for measuring pressure or work, &c. Demonstrations might also be made in several departments by the construction of models, for the actual construction of a model teaches very much more than merely seeing or examining one. In this way, for example, the stresses in braced structures could easily be examined and measured, the nature of centrodes *(Polbahnen)* and axoids could be illustrated, and many other matters, of which the comprehension may be much aided by the hands. At the same time, such a laboratory attached to a college would not only be of value for the sake of teaching, but also to fully as great an extent for

the sake of original research and experiment. There is ample room for this; attempts further to develop scientific engineering are continually hampered by the want of more extensive or more accurate experiments. We have in far too many matters nothing to rely upon but the imperfect or imperfectly reported results of antiquated experiments, while our most trustworthy experiments have in very many cases not been undertaken as part of a scientific investigation but for some much more limited object, and are thus frequently insufficient for the formation of general conclusions. Thus, in almost every direction, it would be possible to carry out courses of experiment with the accuracy and completeness of scientific investigation which should give results of almost incalculable value to the practical constructive engineer. And I may add that while such experiments seem to me to be daily becoming more necessary, I see very little hope of their ever being carried out—in this country that is to say—unless our colleges and science schools take the matter up in some such way as I have indicated. The expense is here, as in many other cases, the principal difficulty, for the cost of the necessary apparatus, although by no means enormous, would be considerable, while the fees must be kept moderate if the laboratory is to be really useful. Although, however, it might not "pay," in the commercial sense of the word, directly, yet the increased efficiency of the engineers whom it would take part in training would, even as a matter of £ s. d., return to the country an enormous profit upon the few thousand pounds laid out. I can only hope that it may not be long before the importance of this kind of training is recognised in a sufficiently practical way to allow it to be set in operation.

I have now to consider only one more section of the general scheme of training sketched out. I have said that I think the young engineer, before his education can be considered complete, must have some experience in the actual application to practical design and construction of the knowledge he has acquired. There is no reason, of course, that the work in the drawing class should not include, in its more advanced stages, the design of more or less simple machines and structures, indeed this should form a necessary part of it. But at the same time it does not appear to me that this can ever take the place of work at design in an engineer's office. In the one case a few hours a week, in the midst of other engrossing works, are spent upon designs for which the data are furnished by the Professor. These are chosen from an educational point of view, to familiarise the student with certain problems or certain constructions, they are worked at under the eye and with the help of a teacher. The student's errors are pointed out and to a certain extent rectified, but nothing results either from the errors or excellencies of the design, except in regard to what they have been the means of teaching the student. In the office the conditions are entirely different. There the whole time of the pupil or apprentice is spent upon his work, while the design at which he works is for something which has actually to be constructed. The design is no longer made to instruct the designer (another reason for his being instructed beforehand in the principles of design), but for its own sake. Mistakes, therefore, or defects are not tolerated, but corrected to the satisfaction of the chief of the office before the drawing is allowed to pass. The design in fact is made under a sense of responsibility which cannot exist where its actual construction has not to be looked forward to. At the same time the conditions which govern the nature of the design are the complex ones of actual practice, and are not simplified as they must be for educational purposes. The same things apply even more strongly to experience in construction; but here I may say that I think the real object of an apprentice entering a workshop is sometimes misunderstood. It is not that he may learn to be a good workman, although of course it will be so far to his advantage if he does become a good workman, but that he may see how tools are handled, what can and what cannot be done with them, what is difficult and expensive, what is easy and costs little. He requires to see, too, how the different members of a machine are put together, the translation into material reality of the mental building up of a design with which he is already more or less familiar. It seems almost self-evident that the place most suitable for gaining this experience will be a place in which there are numerous good mechanics at work, and where full-sized machinery of various kinds is in process of construction, in other words, in the works of an engineer. I do not think either of these conditions can be attained in the workshop of a college or technical school. Such a workshop can only do imperfectly what will have afterwards to be properly done in the factory, while the work in it will occupy time which might be more usefully employed in the legitimate work of the college in such a manner as I have endeavoured to point out. Hand work falls within the functions of college instruction only so far as it occurs in the experiments or investigations or model constructions of the laboratory of engineering physics which I have endeavoured to describe.

In speaking of office work I intended to refer to the offices of both civil and mechanical engineers (to use the popular subdivision); I have not, however, referred to the practical work of the former, in the first place because nobody has the notion that in order to understand it is necessary to be proficient in handling the pick or the trowel, and in the second place because its nature is such that it cannot even be imitated on a small scale for educational purposes, and, therefore, it has never been proposed that it should be studied elsewhere than at the works themselves.

Instruction in the theory and use of field instruments is a subject which perhaps forms a kind of debateable ground. I think, however, that its nature is such as to render it possible to give it at college to a sufficient extent to be useful to many who are not to become civil engineers, and who would not, therefore, have any opportunity of obtaining it in an office, while some previous acquaintance with the theory and construction of these instruments will allow the young C.E. to make faster and better progress when he comes to their use in actual work. For these reasons I think we are justified in retaining it in the place which it has already received in most of those colleges which have arranged anything like a systematic course of instruction for engineering students.

I have now concluded my attempt to sketch out the requirements to be fulfilled by any complete system of engineering education, and what appears to me the best mode of meeting them with such educational appliances as are now or may be shortly in our hands. I place all the earlier part of this education at college, having given my reasons for thinking that it cannot be obtained elsewhere satisfactorily, but I consider that actual work in the office and workshop is essential for its completeness, and that this work should come after, and not before, the college training. I have endeavoured to show that even in the most complete course of training which can be arranged by our colleges as they at present exist there is one great deficiency, means for supplying which, it seems to me, it is within the function of the college to furnish. I have also made suggestions as to what these means should be, and shall be well satisfied if what I have said, by bringing forward in a somewhat concrete form what I know has often been spoken of generally before, does a little in hastening the realisation of the scheme which I have outlined. That I have by no means over-rated its importance will, I believe, be admitted by the great majority of members of the profession to which I have the honour to belong, and most heartily by those who have themselves worked the hardest to supply the unavoidable deficiencies of their own training.

The placing of the workshop at or close to the end of the course of training is so obviously the proper course from an educational point of view that I should hardly think it needed defence. I have heard it objected to, however, on the ground that after two or three years of college life the mechanical shop work would be peculiarly irksome and disagreeable, that, in fact, the student would have become too much a "fine gentleman" to raise at five, don fustian, and bark his knuckles. To this I can only say, that if it be the case in any particular instance, that young man has entirely mistaken his vocation, and it is just as well that he should find it out before it is too late. If a man hasn't sufficient interest in his work to overbalance altogether these small and temporary discomforts, and to regard this part of his training as not only necessary but interesting, he may as well give it up at once, he cannot expect ever to succeed in it.

The course of training which I have described is at once extended and somewhat difficult. It may perhaps cost too much time for some, too much money for others. In any case let the student remember the saying of Göthe, "Was man nicht versteht, besitzt man nicht" (What is not *understood* is not *possessed*). Whether the quantity of knowledge you are gaining be great or small make sure that you really do gain it, that you comprehend it, grasp it, can apply it. If time presses, or if you are not naturally quick at learning, do not attempt too many subjects; do not attend a single course of lectures more than you are able thoroughly to appropriate to yourself. The knowledge you would gain by doing so would be mere information, useless to you, and occupying time which might be more profitably spent. And remember, too, that the extent or perfectness of the training through which a man has passed does not by itself determine his success in his after work. This depends also upon other things, which no perfection of training can give, and without which the best training may be useless. Perseverance and determination, capacity for dealing with men as well as with metals, energy and decision, perhaps above all unlimited capacity for work, are required; and while no training can be too perfect to combine with these, yet in themselves they are the best guarantee that their possessor will use every possible exertion to supply the deficiencies of an imperfect training, and will attain that success as an engineer which he would deserve as a man.

Advices from California state that a large piece of one of the Tulare county big trees is being prepared for exhibition at the Centennial. The piece of timber selected will be 16ft. long and 21ft. in diameter at one end and 19ft. at the other. The heart of this will be taken out, leaving only about 1ft. of the body of the tree attached to the shell or bark. This outside shell will then be divided into eight equal parts, each of which will weigh 4,000lbs. without the bark. It is necessary to divide it into this number of parts in order to allow it to pass through the numerous tunnels on the road between California and the east. The eight parts will weigh 30,000 lbs., and require two cars for transportation. This timber was taken out of the General Lee, a tree 275ft. high, which contained more than 200,000ft. of lumber, besides, probably, about 200 cords of wool. Krupp, of Essen, will exhibit a mammoth 1,000-pounder gun at the Exhibition.

A new branch of industry, says the *Engineer*, has sprung up, which will be of great convenience in Government works and other large factories. A contractor has come forward and agreed to purchase at a good price all the old "cotton waste," a material which, after being used to clean machinery, has hitherto been burnt as valueless. He has made terms with one large department of the Royal Arsenal, and carried away some tons of the waste. This he washes in some chemical solution, which entirely cleanses the cotton of grease and other impurities, and when dried it is again as fit for use as when it left the cotton mills. The grease is clarified with fine oil, and the refuse is sold to the soapmakers.

TO WHAT CAUSES ARE TO BE ATTRIBUTED THE ILL CONSTRUCTION AND WANT OF SANITARY PROVISIONS WHICH EXIST IN THE DWELLINGS OF THE UPPER AND MIDDLE CLASSES, AND WHAT IS THE BEST METHOD WHICH SHOULD BE ADOPTED TO REMEDY AND RECTIFY THE SAME?

By H. H. Collins.*

"Builder and House Decorator, funerals furnished with economy and dispatch," a truthful irony which most peripatetics must have noticed, and the veracity of which all sooner or later will probably have realised. Like the plumber who always left a defect in his work that it might be rectified by some brother workman, "to make it good for trade," so the modern genius of the British builder ingenuously advertises with honest candour and charming naïveté his intention of so building for the living, that he may bury them the sooner with "economy and dispatch"; thus emulating the philanthropy of Sairy Gamp, who, you will remember, expressed an equal pleasure "in laying people in" as she did "in laying them out."

I cannot surround my subject with the masterly eloquence, the elegance of expression, the erudite scholarship, and the charm of manner, which, in a few days hence, you will have the good fortune to listen to in the address with which we shall be favoured by the chairman of this department. Mine is essentially a practical and prosaic subject, covering only those every day and familiar trivialities which make up the sum of our domestic comforts and contribute to the preservation of our general health; but because they are so common, apparently so trivial, and so constantly before us, they escape our observation, and are treated with an undeserved carelessness and neglect much to be deplored.

I hope, however, before the close of my paper to quicken attention to the evils to which I shall direct your notice, to elicit from the experience of others further testimony of their existence; to eliminate from discussion suggestion for their removal; to publish such testimony through the useful aid of the press, and by such promulgation to awaken the community from the torpor in which it is indulging, and which, if prolonged, may become a sleep of death. If I succeed, this association may once again congratulate itself on contributing towards the effectuation of a great public service.

I propose to limit my paper to the consideration of those dwellings situated within the area of the metropolitan district—to those which are commonly designated as "town houses"—although the observation, which I shall have to make apply in a greater or less degree with equal force to suburban as well as to urban districts.

It might with justice be imagined that the houses of the upper and middle classes would, in addition to containing every convenience and luxury, be constructed with due care and regard for every sanitary consideration; that in the metropolis of the kingdom (where architects, engineers, and medical men most renowned do congregate), taste, comfort, and cleanliness would accompany and embrace each other; that in the City, from whence all legal enactments emanate, legislation would be widely promulgated and best obeyed; that with an ever progressing civilisation, a scientific knowledge growing greater and greater each day, a wealth increasing year by year, the subject of my paper would be but a libel on the age, and the statements which it contains far beyond the realms of fact or truth. Not so, however, is the case, and still may it be exclaimed—

> "How well you build let flattery tell,
> And all mankind how ill you dwell."

By continuous effort, indomitable perseverance, and unwearied patience through a lengthened period of years, sanitarians have succeeded in thoroughly enlisting the

* Paper read at the Social Science Congress.

sympathies of the thinking public to the unsanitary condition of the houses of the poor, and to their general neglected social position, with so beneficial a result that assistance has come from all sides to help and succour those whom it has become the fashionable cry to denominate as a class who cannot help themselves. Legislation has been effected. Commercial intelligence with its capital has been invested. Philanthropy and benevolence have been enlisted, and the cry has even degenerated into a ministerial policy. Those who cannot help themselves have been and are being helped to model dwellings by associations whose name is legion. Parks have been and are being laid out, in which cottage residences, of no mean pretensions, are being rapidly erected, baths and washhouses have been brought to their very doors, public libraries have been secured for their amusement and instruction, so that they may enjoy *Mens sana in corpore sano*. The Education Act has secured culture for their young; the Artizans' Dwellings Act will provide space for their growth; whilst the Public Health Act will preserve in salubrity the same when acquired. I sincerely rejoice that this is so. I sympathise warmly and I recognise with gratitude these landmarks of our country's true greatness, but even philanthropy may be degraded into a fashion, and we may pat the poor man on the back too much, so much indeed that it may be deterimental to the interest of the middle class. I do not hesitate to affirm that whilst we must not rest too long, nor be too thankful, we can afford to pause, to consider whether in many instances the middle and even upper strata of society are not so reduced as to require assistance, whether, in point of fact, it is not they who cannot help themselves. I venture to assert, without hesitation or reservation, that, with regard to the subject of my paper, none are more powerless, few more helpless, than the classes to which I refer.

Bear in mind that in all these dwellings for the poor, the assistance of the best professional ability has been consulted, their accommodation has been carefully planned, their sanitation has been studiously arranged, with what success is proved by the fact that, whilst the average mortality of the metropolis is 24 per 1,000, the mortality in these dwellings of the poor is only 14 per 1,000. Those who are said to be able to help themselves are, as I shall show, deprived of all these advantages. It is time that charity should begin at home.

I propose in the first instance, to inquire:—1st. How the evils which I shall indisputably prove to exist have arisen and why? 2nd. To enumerate in what they consist? 3rd. To endeavour to suggest the means of remedying and preventing them.

To what causes are to be attributed the grossly defective sanitary condition of the abodes of the upper and middle classes? I shall show beyond a doubt that these pretention's houses of the well-to-do contain more unknown and concealed dangers than the unobtrusive dwellings of the poor. Let us consider the history of the circumstances under which a house of the metropolis or its suburbs rises into existence.

The land is let by the owner upon the shortest lease that he can procure a builder to accept, and at the highest ground-rent that can be obtained. The lessee, building for speculation, generally not overburdened with cash, more often impecunious from the commencement of the transaction, immediately creates an improved ground-rent, disposes of the same at less than the market value, and thus provides himself with funds; he then proceeds to finish, with as much celerity as he possibly can, borrowing as large an amount on mortgage of the building during its progress or after its completion as he can obtain. Then he lets and sells, or more frequently than not the property passes into the possession of the mortagee, who hastily and economically completes it himself. The house being let, is probably again parted with, both on the part of the lessor, lessee, and mortgagee, and the unfortunate tenant finds himself in possession of a structure which he must nearly rebuild, to live in with comfort, or else he must submit with resignation to its inconveniences and defect. Throughout the process thus sketched, it will be observed that each party to each transaction has his interest opposed to his honesty. The landlord, eager to convert his land into ground-rent, cares but little how or by whom this desirable consummation is obtained; the builder, anxious for his profit, and working for "dear life," expends as little as he can, and depends on the ignorance or avarice of the public to recoup his minimum outlay; the mortgagee, desirous of realising, and (finishing by compulsion), emulates by necessity the example of the builder. Throughout all is speculation, seldom or ever "investment," which latter would be a panacea for the evil. When the transaction is concluded, all the original parties to it have vanished, leaving not a trace behind. Then comes the next tenant, who whilst able to pay a fair rental, cannot afford, or is unwilling to expend the large sum necessary to make this Frankenstein of a house fit for habitation, in executing that which he not unnaturally considers as improvements to another man's property, or property to which in a few years he will have no claim, and which will have in due course passed to his successor; he therefore complies in as niggard a mode as he can with the terms of his holding. The landlord, in obtaining re-possession, copies his late tenant's example, and so the "town house," originally ill-constructed, and now deteriorated by time and use, becomes a "death trap" for those who enter into its portals. But you will say, is all this done without any architect's or engineer's supervision? I am obliged to answer in the affirmative. As a general rule the public of the metropolis are totally unprotected in this respect. It is true that oftentimes the professional man lays down the plan of the estate, and sometimes designs the elevations because the interest of the owner would otherwise be affected; but here his duty stops. The surveyor who advises as to value for purposes of mortgage only directs his investigation as to the "market value" of the property submitted to his consideration; if badly built he advises less, if well more, to be advanced; he simply determimes what the public will, in his opinion, give for the house, "what it will fetch," whether the locality is an improving one, and then calculates its worth in "market overt," and so reports to his employer. With its defects of plan or its want of sanitary arrangements he has absolutely nothing to do—the public will not appreciate them in the price, why should he? It is a true business transaction. Aye, but you rejoin, how about the legal enactments? Surely the local authorities or the district surveyor intervene, and the public are thus protected? This time I am compelled to answer negatively. It is true that there are Acts of Parliament which, in every theory, afford great and useful powers; it is equally true that up to the present (as facts prove) they have been inoperative, or at all events have not stemmed or prevented the evils to which I am directing your attention. I venture to assert that London and its suburbs are infinitely worse provided for than many second-rate provincial towns, most of which have the construction of their buildings and streets regulated by bye-laws issued under the powers of the Public Health Act, and sanctioned by the Home Secretary. If you turn by way of example to "The Bye Laws" of this town,* wherein we are now assembled, you will find most admirable arrangements for the concern and preservation of the public health. If these are effectually carried out, house sanitation is undoubtedly greatly, if not perfectly, protected. Doubtlessly in the course of our discussion we shall learn how far these provisions have passed from theory to practice, and if they have been adopted, and with what success. I will merely mention a few points, and I may say that most of the bye-laws of similar towns which I have in-

* Brighton.

spected contain the same provisions. The widths of streets and heights of houses are stringently regulated. The strength, construction, and quality of materials for building the walls of houses are defined, a wise precaution is taken, it being stipulated "that no new house shall be inhabited without a certificate has been given by the Board that the same is fit for habitation." A considerably larger space surrounding the houses for ventilation is demanded than that compelled by the Metropolitan Building Act. Careful provisions are made as to drainage and ventilation of drains, some of which, however, are, I think, open to emendation.

Within the metropolitan area the regulations affecting the widths of the streets, drainage, &c., are provided for by the Metropolis Local Management Act and its amendments. Before I had carefully considered their provisions, I judged from the irrefragable testimony of facts which experience had presented to my notice that the enactments contained in these Acts were, from occult cause beyond my ken, impossible to be put in execution, that they were or had become, as I have said, practically inoperative. I found, however, on careful perusal, that the clauses were sufficiently numerous, and their language sufficiently wide to admit of such construction, as, if enforced, would largely contribute to the sanitary welfare of the population. By the 73rd section, Vestries can compel houses to be drained at proper levels, and it directs "that fit and proper sinks, and fit and proper syphoned or otherwise trapped inlets and outlets for hindering stench therefrom, and fit and proper water supplies, &c., &c., and all such other fit and proper works and arrangements as may appear to the Vestry, or to the Board, or to their officers requisite to secure the safe and proper working of the said drain, shall be provided." By subsequent clauses it declares that it shall be unlawful "to erect any house, or to rebuild any house, or to occupy any house unless the drainage is constructed to the satisfaction of such surveyor. Provisions for notices to be given by builders, &c., &c." General precautions to prevent evasion are laid down. Yet, I repeat, the majority of our London houses, new or old, are badly drained and badly constructed. I fear the apathy of the public, the ignorance of those who should administer the provisions of the Act, and official redtapeism are the foundations of the neglect at present. The clauses are for all practical purposes, as far as the interior of our houses are concerned, dead letters. I point to facts as evidence that this is so, and in answer to your "Why?" I ask you to examine into the subject for yourself, and you will soon receive a definite reply to your query. That it is possible to put these clauses into effect we have triumphant evidence, but then the officer who has vivified the dead bones of the law, clothed them with practical intelligence, and moved them with the motive power of the strength of his will and intellect, is a gentleman thoroughly versed in the subject—I am proud to add an active member of our council and association—I mean Mr. Arntz, the surveyor to the Board of Works for Westminster. He has not only laid down an admirable series of regulations for the drainage of the houses in his district, but he has thereby, in compliance with the Act of Parliament, pointed out in clear and unmistakeable language, so that he who runs may read, that which he will pass as fit and proper works; and, in order not to afford any excuse for non-compliance, he has illustrated his intentions by means of a working diagram, which, by his favour, I exhibit and direct your attention to. Now, whether houses are allowed to be occupied until "passed" by him I know not, but in answer to my inquiries he has written to me:—"The system has been in operation about two years, and has been applied to a large number of houses and buildings in and outside my district. As yet there have been no refusals to comply with requirements;" and he adds that he is "sure the public is willing enough to adopt improvements when they are shown to be practicable and without serious difficulty"—an opinion which, I am certain, most of us will coincide with.

Possible then as it is to ensure good drainage by Act of Parliament, it will only be accomplished by the active co-operation of the public.

The construction of our town houses is governed by "The Metropolitan Buildings Act," an Act passed to regulate the construction of buildings so as to prevent accident by fire, and which does not pretend to affect, except very indirectly, the sanitation of the buildings themselves. Impressed with its anomalies, the confusion of its clauses, the ambiguities of its language, and the difficulties attending its working, the Metropolitan Board of Works, with that public spirit which always distinguishes its action, in the Session of 1874 introduced into Parliament a Bill containing most wise and useful material for ensuring the future health and welfare of the house dwellers of the metropolis.

This Bill was referred to a Select Committee. I think if the Board had been content with a little it might have obtained more, and if it had determined to amend the present Act it would have succeeded, but unhappily for the sanitation of the metropolis, it endeavoured to combat the selfish interests and conveniences of various bodies which rose hydra-headed at every step taken; these proved strongest, and the Board succumbed. One unanimous expression of opinion, embodied in the form of a resolution, was arrived at by the committee, *inter alia*, viz., that it was important "That the district surveyor should have full power to stop the progress of any building in which the material or construction is calulated to be dangerous to health, and to summon the builder or owner before the magistrate." At present, on this head we are legally helpless.

As I actively assisted the Bill, I may say that it was prepared with great care, drawn with the skill which pervades the work of the Board's solicitor, promoted with vigilance by Colonel Hogg and the members of his Board, defended with acumen by Mr. Philbrick and Mr. Bazalgette, and withdrawn with great regret after a protracted struggle before one of the most prejudiced and hostile committees which it has ever been my lot to encounter. It is to be sincerely hoped that the Board will not be deterred from performing its bounden duty, that of securing an efficient workable Building Act for the preservation and protection of its numerous and ever-increasing constituents, and that it will shortly re-introduce an amended measure.

The present Act entirely fails to maintain anything like proper sanitary construction in metropolitan houses, besides which the conflicting decisions of magistrates weaken its authority, and enfeeble the efforts of those who seek to construe its provisions to serve the public interest. But determination and zealous energy have now and again succeeded; and but recently Mr. Knightley, our district surveyor for Hammersmith, obtained from Mr. Ingham, the magistrate, an order for the demolition of a wall which had been erected with mortar consisting of 20 per cent. of sand and 80 per cent. of clay, and which was wittily described by the *Daily Telegraph* as "a wall on which Humpty-Dumpty could not sit with any chance of safety, to say nothing of the 'eligible tenants' who, in time to come, might seek the shelter of the wall, together with three others and a roof covering all, the whole forming what is called by courtesy a house." Probably, however, if this decision be appealed against it may be upset. I only quote the case as an exception to prove the rule. The Building Act, for all practicable points of sanitation, is, I much fear, unworkable, unless, indeed, the magistrates uphold the efforts of the district surveyor, which hitherto, they certainly have not done.

There is one other Act, the Nuisance Removal Act, which, in some measure, is incorporated with the Metropolitan Local Management Act, and the provisions of which are constantly applied by Vestries, but, as a rule, its application is limited to the houses of the poor, and

ldom or ever to those of the upper or middle classes. Here, again, the poor man's dwelling has an advantage over the rich one. Inspection, which would be resented as an interference by the wealthy, would in reality prove a safeguard and a blessing.

In the course of my own experience, extending over more than twenty years, I am able to speak of the utter neglect and crass ignorance of sanitation which I have encountered, and which, indeed, I have to combat with every day. I select a few examples with which to conclude this part of my subject.

A few years ago a client of mine, who resided in a large house in a wealthy suburb, informed me that his wife and two daughters had suffered in health ever since they had occupied their house, that he had consulted several medical men without beneficial result, and that he wished me to make a survey of the premises. He paid a rental of about £200 per annum. I found that the drainage was in every way defective, although he told me that he had expended a large sum of money on making it "perfect"; the gradients were bad, the pipes choked, and the joints unsound. The servants' water-closet was adjacent to the scullery, which was in communication with the kitchen, the sink being directly opposite the kitchen range. The water-closet was supplied direct from the cistern, the waste from which entered the drain, although it was said to be trapped. The waste of sink was simply connected with the drains and trapped with an ordinary bell-trap, the cover or trap of which I found broken. Under the kitchen range hot-water tap I found a trapped opening, also leading into the drains. The domestics complained of frequent headaches and general depression, and I need not add that it excited no surprise, seeing that the kitchen fire was continuously drawing in from the sewers and house drains a steady supply of sewer gas to the house and drinking water cistern. In addition, I found the basement walls damp, owing to the absence of a damp proof course, and the want of dry areas. The upper water-closets, house-closets, and cisterns, were situated over each other, off the first floor landing, and directly opposite the bedroom doors. The bath and lavatory were fixed in a dressing-room, communicating with the best bedroom, the wastes from which were carried into the soil pipe of closets. This latter was unventilated, but was trapped with an S pipe at the bottom. The water-closets were pan closets, and were trapped by D traps. The upper closet periodically untrapped the lower closet and bath traps, leaving the impure air free access to the house and cistern, which latter was also in communication by means of its waste pipe with the house drains. The overflows from safes of the water-closets were practically untrapped. The peculiar nauseating odour of sewer gas was distinctly perceptible, and I had but little doubt but that atonic disease was rapidly making its inroads on the occupants. The landlord refused to recognise the truth of my report. My client, acting on my advice, relinquished his lease, took another house, the sanitation of which was carefully attended to, and his wife and children have had no recurrence of illness.

Some short time since I had to report on a new house not quite completed, built in a fashionable quarter of the metropolis, the rent being £160 per annum. This is the state of sanitation I found to exist. The basement cistern, lined with zinc, was in direct communication with the pan of the servants' water-closet. Both cistern and water-closet were enclosed in an unventilated space. The sink was placed in a scullery directly opposite the kitchen range, with waste connected with drains. Numerous sinks had their wastes carried directly into house drain. The upper closets and bath-room were fairly situated, but the hot-water pipes were in contact with the lead pipes, and the wastes of cisterns were tapped into the soil pipes, which, in this instance, were common iron rain-water pipes, with joints made in oil cement. Of course I recommended my client not to take the house without these sanitary defects being properly rectified. A surveyor of some repute called at my office with my report in his hands; he characterised my objections as puerile and my requirements as unnecessary, and informed me that in the house in which he dwelt (a yet more fashionable locality) the state of things I complained of had existed for over 20 years, and that neither himself nor his family had ever experienced any inconvenience. It was simply a case of "Persuade a man against his will, and he is of the same opinion still." I refused, on behalf of my client, to take the house without my demands being satisfied; the landlord, however, consented, and the alterations were effected.

I have recently purchased on behalf of a client the lease of a mansion in Portland-place from a well-known nobleman, who had spent, as I was informed, a fortune in providing new drainage; indeed, I found the principal water-closet built out of the house altogether, the soil pipe of it, however, was carried through the basement, where it was supposed to be connected with the drain. Upon removing the floor boards to examine it, I found the ground surrounding the connection literally one mass of black sewage, the soil oozing through the joint even at the time of examination, and the connection with the main drain laid in at right angles. The 9-in. drain pipes ran through the centre of the house, having a very slight gradient, and had evidently not been laid in many years, yet they were nearly full of consolidated sewage, and but little space was left for the passage of the fluid. With but a slightly increased pressure the joints would have given way, and the sewage would have flowed under the boards instead of into the sewer. The sinks, water-closets, and cisterns were all badly situated, and all more or less defective in sanitary arrangement. In the butler's pantry the sink was placed next to the turn-up bedstead of the butler, who must have inhaled draughts of impure atmosphere at every inspiration. The soil pipes of the closets had, indeed, been ventilated with a zinc rectangular tube, but as this had been so placed as to let the sewer gas through an adjacent sky-light into the house, and the odour being extremely disagreeable, it had been by his lordship's directions (as I have been told) closed. Here was evidence that it had, at all events, been doing some service, and probably had only poisoned a few of the domestics. I found the bends of soil pipes likewise riddled with holes, as described by Dr. Leargus. There happened to be a housemaid's sink situated close to a bedroom door, the waste from which had been carefully connected with the soil pipe, so that, probably, had the closets been satisfactorily ventilated, this arrangement would have defeated the object in view. I should also mention that the best water-closet was situated on the bedroom floor, under the stairs, and was lighted and ventilated through a small shaft formed of wood boarding and carried to the roof; it also opened by a window to the main or principal staircase. The gutter of the roof ran through the bedrooms and under the floors; at the time of examination it was full of black, slimy filth. This is a fair specimen of the sanitary arrangements of a nobleman's town house, situated in one of the best streets of this great metropolis, and in the year of grace 1875.

I have repeatedly examined houses, the rentals of which would not be less than £600 per annum, in the most aristocratic portions of the metropolis, and have found sanitary defects equal and on a par with those I have above referred to.

But a short time since I discovered, in three separate instances, under the basement of houses, disused cesspools, filled more or less with excrement emitting a disgusting odour, and covered with loose or rotten boarding; the old brick drains had simply been cut off from the sewer and left as they had been originally laid in.

Upon surveying one house for a client of mine preparatory to making an offer for its purchase, I noticed the peculiar odour of sewer gas; it had

been unoccupied for some months, and its keepers had evidently from habit lost the use of their olfactory organs. Upon making inquiries, I discovered that after living in it for six months the last inmate had given up the lease. No cause was assigned. An investigation of the parish maps showed that at a short distance from the house one of the main sewers terminated, and across it a dead wall had been built. A ventilating pipe from the house had been connected with this sewer, and was conducting the sewer gas collected at its head into the same.

I narrate one other instance, as an illustration how persuasion, when combined with interest, may exercise an influence where force fails. A client, being desirous of purchasing two semi-detached houses situated in a good and rising neighbourhood, instructed me to report on their value and sanitary condition. Accordingly I attended and commenced my survey accompanied by the builder, to whom from time to time I put a few leading questions. Shutting up my note-book on the conclusion of my survey, the builder addressed me thus: "Ah, sir," said he, "your client won't buy these houses; I know how you're going to report." "Well, my friend," I replied, "you know more than I do, then. There are certain matters which will have to be attended to; but I am sure you will do these rather than lose the sale of the houses"; and I explained to him *what* I considered necessary, and *why*. "Well, sir," said he, "you are right, and not unreasonable. A good many of the things you mention I did to the first two houses I built, but I found it no use; I could not get any return for the money expended; the public did not appreciate them. I asked for those houses a little extra rent to recoup the outlay, but the applicants said they could get the houses over the way at a less rent, and I was obliged to let them. So, sir, I built these and the others as cheaply as I consistently could, and omitted these improvements." "Well," I rejoined, "consent to these alterations, and I will agree on behalf of my client, to pay half the cost." He did so. I purchased the houses, and I am happy to state that the result of my arguments has been to induce him to introduce the same arrangements in the houses now being built by him in the same locality, and he tells me that he has not regretted adopting them either morally or financially.

We will now consider definitely, what are the sanitary defects which exist in most of our London structures? To render these clear to your comprehension, I have prepared diagrams, to which I shall refer as I proceed.

As a general rule the subsoil of the houses is not disturbed, the foundations are at once laid upon the virgin soil; but if the same consists of gravel or sand, then it is quickly excavated and sold, the void thus left being filled up with rubbish of the most improper description, the spongy character of which, combined with its prutrescent nature, lays a sure "foundation" for future illness. Subsoils, as a general rule, are quite undrained; sometimes they are saturated with impurities, and they are seldom in healthy sanitary condition. The next important and generally most defective arrangement is that of the drainage. The ordinary plan in a London house is to bring the main drain pipe through the passage of the basement in the centre of the house, and to connect thereto the various branches from the water-closets, sinks, cisterns, &c. This system would be objectionable if properly carried out; as generally executed it is absolutely dangerous. One generally unsuspected, and, therefore, more dangerous peril connected with the drainage of our town houses, is the existence of cesspools in the centre of dwellings. These are often very nearly filled with putrescent alvine matter, and are simply covered over with tiles, stones, or boarding, which, in the course of time, have become rotten or decayed. Connected with these cesspools we find old brick drainage still left under the houses, forming admirable runs for rats and vermin, and receptacles for the storeage of noxious gases. This state of things, as I have before referred to, I have found in my own practice existing in what are called first-class houses, situated in well-known streets, and inhabited by wealthy and even aristocratic denizens. As corroborative testimony, I quote Dr. Whitmore's observations in his last report to the Marylebone Vestry: "Many of the best houses in the parish, situated in aristocratic streets, have brick drains thirty or forty years old, and most of them very defective." How is this to be accounted for? The sewers of London were originally only intended for surface purposes; indeed, for a long time it was a penal offence to connect soil drains with the same. In the year 1844 a report of the Commissioners appointed to inquire into the health and state of towns was published, and to their recommendations may be attributed most of the improvements in drainage works and most of the legislative enactments, which have since taken place. About this time, and notably with the advent of the Metropolis Local Management Act, 1855, it became compulsory to connect house drains with the sewers and to close up cesspools, sanitary science being little understood and less appreciated. Avoidance of expense was the first consideration, and instead of eradicating the defects once and for all, the cesspits were left in, and the old brick drains were either connected with the sewers or left in without the precaution, oftentimes, of even stopping their ends. Even when pipe drains are used, with joints fairly cemented round, they are scarcely ever properly laid, their gradient is invariably too little, and the consequence is that they soon become silted up, the pressure of the sewage causing the joints to leak, and producing the saturation of the soil, with general escape of insalubrious vapour to the interior of the house.

The undrained subsoil, improper foundation, and defective drainage naturally render the basement of the house totally unfit for habitation. As a general rule the walls are thin, built of porous bricks without impermeable material to act as damp-courses. The bearing is ordinarily laid without tongues or other precaution to keep back the noxious exhalations which, at varying alterations of temperature, rise from the soddened earth and permeate through the superstructure. In truth the houses constructed for the dwellings of the upper and middle classes are but as receivers over a still below them, in which impurities and gases are distilled over, being collected and condensed above.

The position of the kitchen range, fire-places, sinks and cisterns, combined with their connection with the system of drainage, assists in pumping out the impure atmosphere, disseminating it through the [illegible]. The basement passages and staircases are nearly always unventilated dark conduits, forming channels for the diffusion of the soiled air into the ground or principal floor of the house; from thence it is guided into the space occupied by the principal and back staircases. Sometimes these staircases are lighted from lanthorn or sky-lights (and these by the way are not always constructed to open, and if so constructed are seldom taken advantage of); generally they are ceiled at the level of the last bedroom floor, and have a room or rooms carried over the same. The staircases of most London houses are inadequately lighted (scarcely ever ventilated) from the small yards which are left in the rear of the houses, such yards often forming themselves shafts for the collection of impure air which is conveyed therefrom into the bed-room floors. From off the landings of the staircases water-closets, housemaids' closets, &c., are arranged, which contribute by their defective arrangements to further poison the air and to lead it to the bedroom accommodation of the house.

A favourite arrangement of some of the best and most expensive houses of the metropolis is to place the water-closet in the centre of the house, ventilating the same into the principal staircases (and sometimes, but not often carrying up a shaft to the roof); this brings the noxious gases thoroughly well into and up to the

oom floors of the house; by this plan the soil is also carried through the centre of the premises, its position can generally be discovered, either from discolorisation of the paper or paint, or from the itic vapour given off. The staircase, which should the ventilator of the house—indeed as its lung—ade the vehicle of contagion, all the impurities of ouse discharging themselves into it. These water-ts are usually planted opposite the best bedroom, are generally in conjunction with a small house-'s sink, contrived under the stairs, the waste from h is carefully carried into the soil-pipe of the closet. ably, taken all in all, no better system could well be ed for carefully introducing into the house, and re-ng therein, any sewer gas which may arise from hoked drains or covered cesspits in the basement. coal gas is not half as well laid on as our sewer the smallest leakage of the one is easily detected, as easily rectified, and thus danger can be quickly happily avoided, but with the other, the where-its of a slight opening, or a minute perforation, ost difficult of discovery, and is usually expensive laborious to rectify; the danger is rampant, and can-be subdued before the injury has been thoroughly ted. Cupboards for soiled linen and other impure er are generally found underneath the stairs, and g unventilated contribute their quota to the infection e air, and by their position promote its distribution. more considered as a luxury, but assuming its pro-position in every well appointed house, either of the dle or upper classes, is a bath-room; few greater veniences are rendered more dangerous nuisances, by tion and construction, than these modern appliances. bath-room is generally located in some small room cent to or in connection with a bedroom or bedrooms, etimes without any fireplace or ventilation, and etimes only a borrowed light.

he supply pipes for hot water are generally con-ed in good houses with a boiler of the kitchen range, are conveyed to the bath through the house up a e left in the wall, which contains also the soil pipe of water-closet apparatus; these soil pipes are sometimes ad and often of iron, plain or galvanised. The bath, ally of thin iron, zinc, or copper, seldom properly ported or cradled, has the waste therefrom connected the soil pipe, sometimes with the trap of the water-et, or with an independent trap. Under the bath, to vent overflow to the rooms below, is placed a zinc safe, ch again is supplied with a small orifice leading into before-mentioned soil pipe. This arrangement is n most prejudicial in a constructive and sanitary t of view. Constructionally, it is wanting in eco-y. The hot-water pipe causes a contraction and ex-sion of the joints of the pipes, creating leakage and ay. Sanitarily, it produces defects which permit of entrance to the house of impure air, and by suction ws it into the bed and other rooms. The overflow waste frequently become untrapped, and in certain ditions the flow of water from the bath waste empties trap of the water-closet.

The position of the cisterns next claims our atten-n; generally speaking, they will be found located the most out of the way and inaccessible parts the house, and consequently, from this cause alone, ome neglected and unclean, the water being fouled by imentary sludge and feculent matter, which quickly umulates therein. In the basements they are usually ated in the vaults and over the scullery sinks, the llery itself being a narrow, ill-ventilated slip, in-quately proportioned for its work. The waste pipe m the cistern is usually carried into the drain where s supposed to be trapped. The result of the arrange-nt is this—that, as regards the waste, it conducts the er gas into the water, where it is absorbed; that the pure air proceeding from the sink, with its generally ective overflow, is also imbibed by the water in tern; and that a similar process goes on from the supply of the servants' water-closets, which is also generally connected therewith. When you consider that the whole of the potable water of the establishment is usually drawn from this supply, you cannot wonder at the lethal effects which are produced. In the upper portion of the house, more often than not, the cistern is placed in the roof—sometimes on the roof, in connection with the ventilating pipes of closets (if any be provided), fully exposed to all the contaminating influences of the dirt and filth which congregate there. The wastes of the water-closet apparatuses are connected therewith, as first mentioned, and with the most lamentable resultants.

The facts above enumerated are, perhaps, the most salient sanitary defects of the internal arrangements of the houses of the middle and upper classes, although many other imperfections might easily, if time permitted, be animadverted, on such as position and plan of landing; want of ventilation, not only of drains and conveniences, but of the houses generally; method of heating; and carelessness as to disposition and aspect of rooms with regard to the purposes they are destined to fulfil.

Now, how are these defects to be remedied and prevented? 1st. We require additional compulsory, not permissive, sanitary requirements; the Building Act should be revised, so as to confer greater authority on and larger powers to the district surveyor, and local authorities should be amenable to a Central Board to carry out with strictness the provisions of the Acts of Parliament. 2nd. The clauses of the present Acts should be carefully utilised, and not rendered inoperative by the perfunctory manner in which their obligations are construed, amounting to avoidance thereof. 3rd. It should be imperative that Vestries or local authorities should appoint well-qualified and well-paid officers to interpret and to carry into effect the laws relating to the health of the people—men whose professional attainments, scientific knowledge, and social position will command respect and ensure obedience—men who have the *fortiter in re* to insist, and the *Suaviter in modo* to persuade. *Vide* the success attending Mr. Arntz's efforts.

The best prevention, however, will be by educating the people to a sense of their own danger and ignorance; we shall never succeed in making them wise, cleanly, temperate, or pious by Act of Parliament. If we cannot appeal to their higher and better qualities, we must address ourselves to their lower and meaner natures; we must indisputably prove to them how their individual interest and welfare is combined with a due regard to sanitary precautions. If once it becomes an acknowledged fact that people will not inhabit houses deficient in the essentials of life, fit air to breathe, fit water to drink, fit drainage for health, depend upon it houses will be erected with due regard to sanitary conditions. Unsanitary houses will be altered, and their defects rectified; the supply will soon equal the demand. Mammon will become good friends with Hygeia, and people will soon learn—"That something there is more needful than expense, and previous to taste—'tis sense."

The points to be observed and the precautions to be adopted in building healthy urban dwellings happily need no great amount of intelligence for their comprehension, require no scientific skill for their procuration, and involve no large expenditure in their execution; they are but few, simple in the extreme, and only accord with common sense observation.

Old houses mended cost little less than new before they are ended, and by attention to the following suggestions, laid down with no dogmatic intent, the lives of both old and new houses, together with their inmates, may be prolonged and preserved structurally and sanitarily to their natural term of existence.

All subsoil should be properly drained, proper thickness of concrete should be applied to foundations, damp-proof courses should be inserted over footings, earth should be

kept back from walls by dry areas properly drained and ventilated, external walls should be built of good hard well-burnt stock brickwork of graduated thicknesses, and never less than 14 inches thick; internal divisions should be of brick in cement.

The mortar or cement should be of good quality.

All basement floors should have a concrete or cement bottom, with air flowing under the same, and the boarding thereof should be tongued so as to prevent draught and exhalation penetrating through the joints of the same.

Ample areas back and front should be insisted on, the divisional or party fence walls of which should never be allowed to exceed 7 feet in height, to allow free circulation, and to prevent the areas becoming wells or shafts for stagnant air.

The main drains should be carried through the back yards, and to prevent inconvenience to adjoining owners from any obstruction, they should be laid in subways, so that the sewer inspector could gain ready excess thereto, without entering any of the premises or causing any annoyance to the tenants. No basement should on any account be allowed to be constructed at such a level as will not permit of the pipes leaving good steep gradients to the sewer.

All pipes should be of glazed earthenware, having joints made in Portland cement and resting on good solid foundations.

The connection with the sewer should be direct, merely inserted in the eye with a hanging flap—it is a moot question as to the insertion of a syphon between the house drain and the sewer. I have always found this to silt up and become a nuisance, and of late years I have discarded them. If used it would be well to ventilate them. All main drains should be ventilated in proportion to their area and length by lead ventilating pipes carried up to ridges of roofs. Special care should be taken to prevent any direct connection from the house with the main drains. All sinks should be placed next external walls, having windows over the same, and removed from the influence of the fire grates. All wastes should discharge exteriorly over and not into trapped cesspits, all of which should be provided with splashing stones fixed round same; these cesspits require care in their construction. Syphon traps and bell traps are to be avoided wherever possible, they often cause the very injury they are intended to prevent; care must be taken to turn eyes in brickwork wherever pipes pass through walls to prevent joints breaking. The scullery sink should have a special fat trap provided, or one of "Field's" patent self-acting flush traps, which I have used with great success. The basement cisternage should be placed in convenient and accessible positions, protected from dirt and guarded from the effects of alternations of temperature. They should be of slate or galvanised iron and never of lead or zinc. They should be fitted with overflows discharging over the sink or over trapped cesses as just mentioned. They should be supplied with stout lead encased block-tin pipe; the services therefrom for all drinking purposes should be of the same description, and should be attached to an ascending filter, so that the water may be delivered free from lead or organic impurities. Lead poisoning is more frequent than is generally believed, but readers of *The Sanitary Record* and other scientific journals find from time to time numerous records of its danger. Dr. Alfred Hill, the borough analyst for Birmingham, states that "it is a cumulative poison, it remains stored in the system to manifest its effects at some future period." Dr. Muspratt writes that "the source of slow lead poisoning is almost invariably found to be the water employed for domestic purposes, the lengthened use of which causes depression of spirits, emaciation, cholic, and paralysis." Our chairman, Dr. Richardson, has also stated his opinion that contamination of water by lead is the cause or source of various obscure diseases. The servants' water-closets, of which there should always be two, for the accommodation of each sex, should be placed in an open, well-lighted, and well-ventilated position, it is a false idea of decency which dictates locating them in out of the way positions—out of sight, out of mind; precisely because they are used by the least careful portion of the household should they be open to inspection if we wish to insure their salubrity. The cisterns should be distinct in position and supply from the drinking water cistern, the wastes thereof should turn out over cesspits, and the closet should have earthenware hoppers, having flushing rims, with syphon traps, and pull-down chain.

Cupboards under stairs, undersinks, under dressers, out of the way places should be avoided, and where fitted up should always be well-ventilated. All passages should be well lighted and ventilated. Borrowed lights are better than not having any other. Every room should be furnished with a fire-place, and Comyn and Ching's ventilators over doors and windows should be freely disposed. It would conduce to the health of the house without adding 1s. to its cost, to build next the kitchen flue a separate ventilating flue, and to conduct the products of combustion from gas and other impure or soiled air, &c., into the same, from ventilators placed in the centre of, or close to the ceilings, as may be found most convenient. By carefully proportioning the inlet and outlet ventilation, the air will be kept moving without draught, and preserved in a pure and sweet condition for respiration. The windows and doors will then serve only their legitimate object of admitting light and affording egress and ingress to the various apartments. The staircase should be made the main ventilator of the house; and it is essentially necessary to preserve the air surrounding the same, uncontaminated, pure, and undefiled. It will be better to light and ventilate it from the top; and, to prevent the Ethiopians or blacks of London finding their way into the house, an invisible gauze net may be placed under it, which can periodically be easily removed and cleansed, or it may be furnished with a movable inner ornamental flat light.

The water-closets, both on the ground of sanitary considerations and constructional economy, should be placed over each other *out* of the house, and separated therefrom by necks or lobbies lighted and ventilated each side by windows extending to the ceilings. The passages should be enclosed by glass screens, and may be made very ornamental features. For instance, they can be fitted up with ferneries, or to suit the exigencies or taste of the occupants. The water-closets should be of valve construction. The soil pipes should be of block tin-cased pipes, and should be ventilated by being carried up well over roofs, and left with hoods or cowls open to the atmosphere. If safes are introduced under the same, the overflows therefrom should be carried through the walls and furnished at their feet with ground brass flaps to prevent any back draught. The water-closet fittings should be constructed to remove, the risers being hung as doors, so as to admit of ready inspection and cleansing. There should be an air grating fixed between the seat and the floor to prevent impure air lodging there. All closets should have an india-rubber band between seat and basin to prevent draught penetrating, a source of danger productive of illness.

The form of water-closet apparatus always to be avoided, is that known as the pan closet. The diagram will show its construction. It is a closet most favoured by the public, because the cheapest in its first cost. It consists, as you will perceive, of a large chamber called a container, which is made of iron; on this is fixed a moveable pan, into which dips the bason. The container is connected with a D trap, which is attached to the soil pipe leading into the drain. The service pipe communicates with the cistern, either through the medium of valves or service boxes, as I have illustrated, and by either elevating or depressing these, the water is allowed to flow through the pan of the closet, where it is

round the basin, and when soiled, is carried away gh the pan. container, trap, and soil pipe, washing fore it, and leaving a certain quantity of clean in the trap and pan of the closet, to seal or trap me. Now you will perceive the cumbersome con- is simply provided to enable the pan of the closet opened or shut, the excrement descends into it, progress of a very short time coats its ample with fæcal matter. The container soon becomes -combed, and the usual practice of plumbers in to cleanse the same, is to burn it out, and thus to en and destroy its surface altogether, the excre- putrifying and causing a continual distillation of hich, when the supply pipe is empty, ascends cistern, and is absorbed by the water therein; it finds its way to the house every time the is used, and if the same be unused for ngth of time, it is absorbed by the water in the nd thus given off into the house. When the soil is unventilated it also enables the sewer gas to tate into the premises. No amount of ventilation revent this, if this form of closet is adopted.

chamber in which the water-closet apparatus is should be well lighted, and ventilated top and by ventilators, as before described. A separate should be provided to supply these closets, with head of water, and at least 1½ in. pipes to ensure flush. My own experience is adverse to the em- ent, if it can be avoided, of the small cisterns "water waste preventers." The cisterns must be fur- with overflows, discharging into the open air, and, er with their supplies and services, so situated protected that the water shall not be frozen, that hall be easy of access for cleansing and examina- and be well ventilated, so that the water does not e stagnant or impure. It is advantageous to place water cistern in the same cistern chamber, but so moved as to preserve the coldness and freshness of quid. Stop-cocks should be supplied to each and supply, so that in the event of repairs being ary the stored water is not wasted.

lavatories or sinks are employed, they must be d as above-mentioned for the water-closet appa- Under no circumstances, however, must they be ht in connection with the drains. Most people the bath-room to be in proximity to the bedrooms; er so placed or not, all connection with main ge must be studiously avoided. The hot and cold known as the flow and return pipes, should be of nised iron, with junctions carefully made with ng joints in red lead; on no account should these contact with any other pipes. The wastes from the safe (and lavatories if any) should be carried gh the front wall of the house, and should turn and into rain water head, covered with domical wire g to prevent birds building their nests therein, arried down to the basement area, where they must rge over a trapped cesspit, as before described nded with a splash stone or curb to obviate the ce of the soap suds flowing over the pavement. A passed up and down these waters now and then ffectually remove any soapy sediment which may to their surface. The waste from bath, &c., into should be furnished with a ground valve flap and to prevent draught, and the bath should be fitted india-rubber seatings between the metal and wood ng for reasons before adverted to. Mansarde or g roofs should be avoided; they are injurious to alth of the domestics, whose sleeping chambers are generally appropriated to; they are unhealthy, summer, and prejudicially cold in winter, laying sis for future disease for those least able to bear utters taken through roofs known as trough should be permitted, they congregate putrescent filth, remains in them for years to taint and poison the phere.

se simple precautions, so easy of accomplishment at so trivial an expenditure of either study or money, are a *resumé* of what could and should be insisted on in the erection of every structure intended for residential habitation.

I have now as succinctly as possible epitomised the causes which have induced, and to which I attribute, the unsanitary condition of the so-called houses of the upper and middle-classes. I have sketched some of the effects which are produced by the systematic neglect of judicious planning, defective hygienic precautions, and ill-construction of our "dwellings," and I have endeavoured to shadow forth how cause and effect may be rectified or ameliorated, if not effectually prevented. The ignorance which would neglect the accumulated wisdom and experience of years becomes culpable folly. Year by year we offer up our tribute to the devouring Minotaur of disease, sacrificing hetacombs of victims to his unsatiable maw, the strength and flower of our population meekly and passionately accepting, as the decree of fate, that which a determined effort could with felicity destroy. "Let us look down, and see what death is doing." In one week of a month just passed there died in London 1,453 persons, 363 of whom were martyrs to preventable diseases, representing an annual metropolitan mortality of over 5 persons in every 1,000, or about 20,000 souls "done to death" by want of ordinary cleanly care. Dr. Simon, the talented officer of the Local Government Board, thus recently writes: "It is the common conviction of persons who have not studied the subject, that the deaths which occur in this country, now about half a million a year, are fully one-third more numerous than they would be if the existing knowledge of the chief causes of disease were reasonably applied throughout the country; 125,000 cases of preventable suffering annually attain their final record in the death register," and he adds with emphatic earnestness, "that each unit of this vast annual total represents an (often very large) other number of cases in which preventable disease not ending in death, though often of far reaching ill effects in life, has also during the year been suffered." Do we want confirmation of the lamentable truth conveyed in these remarks? Do we realise fully the terrible lessons they inculcate? The poverty caused, the grief, infelicity, and tribulation which they show? See what ghastly handmaidens follow in the wake of these preventable diseases, accompanied by others too numerous to mention. Blindness, deafness, dumbness, lunacy, and imbecility. Blindness, says the census, is due in some instances to structural changes, but it is most commonly a consequence of preventible disease. In London, in 1871, there were 2,890 blind persons, deducting those congenitally blind, and allowing for accidental causation, it leaves some 2,000 persons rendered blind through avoidable disease. Of deaf and dumb there were 1,733, a decrease, however, from the past ten years, owing, says the report, "to the aid of sanitary science, by which fevers and other diseases upon which deafness supervenes have become less frequent and less virulent." Of idiots and imbeciles there were 13 for every 1,000 persons living, and this lamentable state of things is again attributed *inter alia* to residence under insanitary conditions. Of lunatics the proportion is again grievously large; in the metropolis there were 3,630. Indirectly this calamity is again traceable to neglected sanitary precautions. Analysing these figures a little further, we find that in nearly every instance of the above-mentioned afflictions the proportion of males is greatly in excess of the female population; thus, out of 21,590 blind, there were 11,378 men and boys as against 10,212 women and girls. Of deaf and dumb, out of 11,518 there were 6,262 males as against 5,256 females. One more sad fact is developed namely, that the larger proportion of those thus afflicted are in the very prime of life, namely, between the ages of 20 and 60 years.

The number of individuals partially or wholly lost to the community, in the metropolis alone, from disease,

poverty, and crime, at the date of the census, amounted to no less than 50,345 individuals. Here then we learn appalling facts which point their own moral. When we reflect that disease is no respecter of persons, class, or status, that its incidence is retributively reflected with mathematical preciseness, our fears may indeed be awakened. Ever and anon we are startled by some lightning flash which strikes apparently those most sheltered from its influences, to-day a prince is ruthlessly torn away from a sorrowing queen, to-morrow a nation's hope escapes but by a miracle. Even the stronghold of health, the hearth of the medical professor, is invaded with impunity. We waken from our torpor tremblingly. We set our houses in order, for none know whose turn may be the next. Full of wisdom is the warning of Dr. Simon, that in proportion as the disease is present the time for preventing it is past.

Yet a few more statistics, and we will conclude. In the United Kingdom there are nearly 60,000 new houses built yearly. Assuming these to be occupied, and that each household consists of 5·33 persons, it follows that they would afford an annual accommodation for 319,800 souls. These generalised figures, however, give us no clue to the probable social status of the future occupants; I take, therefore, the three fashionable divisions of the metropolis, Kensington, St. George's (Hanover-square), and Hampstead, whose total rateable value equals one-sixth of the entire metropolitan rateable value, a sum amounting to no less than £3,537,594. Eliminating those persons in workhouse hospitals and other eleemosynary institutions, I find that they contain 458,693 inhabitants. In 1871 there were in these districts 1,503 houses being built, affording accommodation for nearly 8,000 persons, probably not greater than the increase of population would demand. What if these so-called houses are so constructed as to prove rather the graves than the dwellings of their inmates—a serious responsibility—a momentous subject for reflection!

Whilst the districts I have just mentioned are largely increasing, that of Hampstead for example, doubling itself, those portions of London shrouded in a vitiated atmosphere are as steadily decreasing; thus the population of St. Giles has diminished in the proportion of 10 in every 1,000; that of Shoreditch, 15 per 1,000; that of Whitechapel, 30 per 1,000; St. George's in the East, 17 per 1,000. These statistics point with an outstretched hand to the baneful effects produced by impure air and want of sanitary care. The mortality of the metropolis has, within the last 30 years, considerably more than doubled itself, marking with barometric niceity the periods when its drainage and sanitation had began to be properly cared for.

With facts such as these revealed to our intelligence, I can conceive no greater culpability than to neglect their monitions; that if we do not glean from these teachings of the past in order to apply their lessons to the present, we shall assuredly in the future reap a harvest of terrible retribution—a Nemesis will be called forth, fully earned and well deserved. We know with Hamlet that—

"All that lives must die;"

but most unjustifiable homicide will be the verdict of posterity if we allow our population to be slowly poisoned, and our houses to be so erected as still to be a disgrace to our enlightened civilisation.

The Austrian statistician, Brachelli, reckons the total production of minerals in all the countries of Europe for 1874 to have been as follows:—Platinum, 1,025 kilogs.; gold, 6,900 kilogs.; silver, 300,000 kilogs.; pig iron, 240,000,000 cwt.; copper, 600,000 cwt.; lead, 5,300,000 cwt.: zinc, 2·7 to 3,000,000 cwt.; coal, 4,376,000,000 cwt.; salt, 95,000,000 to 100,000,000 cwt.; manganese, 1,616,000 cwt.; antimony, 5,700 cwt.

CORRESPONDENCE.

DR. RICHARDSON'S ADDRESS.

Sir,—I beg to submit a short explanatory statement, to abate the shock of surprise and indignant incredulity which the statement made by Dr. Richardson in his [illegible] paper, of the possible attainment of a general death-rate of 5 in 1,000 by complete sanitation, will create amongst most persons not specially acquainted with sanitary science.

To such persons I have heretofore limited my declaration to the practicability of contracting for the construction of a city in which per contract the death-rate should not exceed 10 in 1,000. For this I would desire that no credit should be given to my unsupported declaration, but only a careful consideration of what might be done on a jealous scrutiny of what has been done, and the possible extension of the like conditions for doing it.

In the model dwellings, which yet admit of important improvements, the death-rate attained is about [illegible] in 1,000, but of that some five at the least may be struck off for surrounding conditions, extraneous to the dwellings themselves;—badly-constructed and badly-conducted long-time schools, which are the centres of children's epidemics; ill-conditioned outside places of work;—badly-paved and filthy streets;—air polluted by the gases of drains and of sewers of deposit which are only extended cesspools.

And now, as to the sort of data to be adduced in justification of the lower estimate, I beg to submit two. The heaviest contingents to the general death-rates are, I need hardly say, constituted by infantile mortality. The poor-houses, and more particularly the orphan asylums in the Metropolis, when first taken from the exclusive control of the Vestries, were great fever nests. As many as one-third of the children were down with fever, and there was a proportionately excessive mortality when I got them examined by Dr. Arnott and Dr. Southwood Smith. The orphan children now aggregated in the larger district half-time schools in the Metropolis come from the lowest neighbourhoods, where the death-rates are often more than 50 in 1,000. Many of the children are brought in with fatal disease upon them, and only to die. They are all, as a class, children of the lowest type in the Metropolis, and the most susceptible to passing epidemic influences. Yet of those brought there in health, or without any developed disease, the recently examined death-rates of nine Schools gave a mean death-rate of 3 per 1,000. Physicians in charge of them have expressed their astonishment at the almost entire banishment from thence of children's epidemics by rudimentary sanitation.

In the South Metropolitan Asylum, with [illegible] children, of *all* brought in, the death-rate was only [illegible] per 1,000; of those received in health it was only [illegible] per 1,000. In the Central District Orphan Asylum and District Half-time School of London, which receives children from the worst districts, and had in all 1,100 children, the death-rate of *all* brought in was 6·15 per 1,000; of those received in health 3·6 per 1,000.

And such death-rates, about a fourth of those of children of the same ages of the general population, are maintained from year to year without material variation.

As to adult life, the best practical example of rudimentary sanitation will be found in the former great fever nests—our prisons.

These are now distinguished, not only by their clearance from the old gaol fever, but by their immunity from passing epidemic visitations. Of the prisons, the military prisons may afford the most convenient examples for examination, as we know the death-rates in the ranks from which they are taken. These averaged for the Army about 17 per 1,000, *i.e.*, before the work of the Army

itary Commission, which has reduced the rate by at one-third. The worst subjects are taken into e prisons, where they are kept on lower dietaries than y have in the ranks;—yet the death-rates of those are not in a condition to be at once taken to the pital are reduced to about 3 per 1,000. As a rule y are all discharged stronger and (physically) better than when they were taken in. Of the curative er of sanitation, physicians in charge of such prisons, who are in general practice, have declared to me they had constantly occasion to lament that they not the power of taking this or that case out of the mon habitations and into the prison, for if they had y could save it.

uch examples, which I might extend, are of course n to the objections that, besides the structural arrangets, powers of control were exercised over the habits he inmates (which in the prisons combine a Maine or law and a forced teetotal rule) which could not onably be expected to be made prevalent with a eral and free population. Reserving any answers accepting such objections as reasonable, but preing, as may be done, that on examination it will be nd that one-third of the death-rates prevalent in the lel dwellings is due to causes external to them, we ertheless have an example of reduction of the death- to less than one-half of the general death-rate of Metropolis, or to 10 in 1,000—solely by structural angements, without any temperance movement, or hout any interference with the liberty or habits of population whatsoever.

On an examination and study of the examples cited, I ieve that the enumeration of species of disease stated Dr. Richardson as preventible by sanitation will be nded. At all events, the fact of the reduction of th-rates, as actually achieved amongst children and lts, to 3 in 1,000, when fairly examined, will relieve from the impression of extravagance in the anticipa- of a possible future of a general death-rate of 5 in 00 by complete sanitation.

may add that improved sanitary dwellings will not be rer to construct, while they will be vastly cheaper nhabit than the common insanitary constructions ich in excessive sickness and premature disability al additional expenses often more than equivalent their rents.—I am, &c.,

EDWIN CHADWICK.

ast Sheen, Mortlake, October, 13, 1875.

SILK CULTURE.

SIR,—Recent issues of this *Journal* have contained mmunications giving information about the sericitural operations carried out in Australia and in Italy connection with the Victorian Ladies' Silk-growing mpany. At the date of your last notice on this sub-t, a further "education" was in course of treatment Signor Ferrari's mulberry plantation near Verona, d we are now enabled to give some further details of "education" in question, and of the matters conted with it. In a letter dated from Rome, Sept. 23rd, gnor Ferrari writes to Mrs. Neill announcing that further education has produced "magnificent rms, free from death and disease. He is thoroughly isfied with the soundness of the new progeny, d he sums up his opinion of the result in the pression that "the worms leave nothing to desire." the same subject the British Consul at Milan writes der date, Oct. 2nd, as follows:—"You will be glad hear that the new education at Verona is most favourle. The cocoons are small, but perfect in shape and ality. Signor Ferrari has placed a number of them shop windows at Verona, ticketed "Produced from stralian (Victorian) grain." The appreciation thus own by Italian experts of the value of the work w being effected in connection with the Australian company is still further shown in a letter which Mrs. Neill has received from Professor Insenga, Professor of Agriculture and Director of the Instituto Agraris. He pronounces some cocoons lately exhibited at Palermo by Mrs. Neill, to be "perfect for quality, colour, health, and hardness," and he adds that in his opinion they are "the nearest approach to the far famed cocoons of Salerno that have as yet been produced." The exhibits thus referred to were composed of cocoons from the above named Verona education from Australian grain. The soundness of Australian "grain," to which the Professor's opinion thus bears testimony, is a fact of much commercial value, in view of a future market springing up in Southern Europe for this kind of produce.

The hatching out and successful cocooning of Australian grain in autumn in Europe is a noticeable result, which has been demonstrated through the action of the ladies' company, to which I have referred. Besides the reproduction in Italy from Australian grain, some good work of the same kind has already been carried out in England; for instance, I am informed that a parcel of cocoons produced at Colchester has been lately sent to Turin, and has been pronounced so good by Italian dealers there, that 25 oz. of grain from this source will as soon as possible be sent there for sale. It is expected to bring from 25 to 30 frs. per oz.

I conclude these jottings with the following copies of letters which have been placed at my disposal.—I am, &c., E. M. S.

Passy, Sept. 9th.

SIR,—The 50 ozs. sample grain have succeeded everywhere; they have been tried, and our growers in Moldavia and Wallachia are willing to purchase your grain.

J. AURELIANO,
Director of Agriculture at Bucharest.

Turin, Sept. 27th.

SIR,—The Japanese grain is losing credit every year with our growers, and our manufacturers are still disposed to pay well for the yellow cocoons, so try to bring as much grain with you as possible.

The Australian cocoons which you have sent me as specimens have been found healthy, fine, and of a good breed; bring to Italy grain of the same breed and you will find a sure sale for it at 25 to 30 frs.

Yours sincerely,
AUGUSTE MONTÈ.

CONDENSED BEER.

SIR,—In the *Journal* of the 9th of July last, you published a reprint from the *Standard* describing my "Condensed Beer," and since then several other articles upon this subject have appeared in your columns, so, finding that some persons who have read them appear to misapprehend the relative claims of the various patents, I beg you will allow me space to explain the difference between "Condensed Beer" and "Condensed Wort."

"Solid Wort" (or unfermented extract of malt and hops reduced to a solid form) was patented in 1853, by Herman Mertens, of Margate. This has been successful to some extent, but has not come into general use, probably owing to the difficulty of carrying out the entire fermentation, especially in hot climates.

A recent patent, nominally for "Beer in tablets or paste," to which you refer in the *Journal* of the 8th inst., has been taken out by a Mr. Tröster, of Paris, who also reduces wort to a solid or pasty form, and in addition prepares a ferment in small capsules or packages.

When water is added to either of the above, liquid wort is reproduced, which requires to undergo a comparatively long fermentation to convert a portion of the saccharine matters into alcohol, thus developing the requisite strength and flavour, and changing the wort into drinkable beer.

Now fermentation is probably the most delicate and difficult part of brewing; it is not an easy matter to control it even in England during the heat of summer, and the chief obstacle to the success of brewing in tropical climates, is the difficulty of fermenting the wort safely. In Germany, where the low system of fermentation is practised, this process is carried on in cellars plentifully supplied with ice; and at Burton, the greatest care is necessary to keep the temperature at a sufficiently low point at this stage of brewing. This subject is well explained in the Cantor Lectures on the "Chemistry of Brewing," by Professor Graham, recently published by your Society.

The patent granted to me, applies not to wort, but to beer when ripe and in fit condition for drinking, after the fermentation has been conducted at the brewery, in which the flavour has been fully developed, as well as the requisite amount of spirit to give it strength.

By the process secured to me, beer is taken at its best condition, its alcohol is separated and saved by a method of gentle distillation, *in vacuo*, and the residue is condensed in a vacuum pan, like milk; when finished, it is enclosed in hermetically sealed packages, the alcohol first being added to it again, and acting as a preservative. The fermentation which was present in the beer when it was taken, is suspended by the heating, and the condensed beer remains sound in this condition, apparently for any length of time, as I have some that has now been kept for nearly two years.

When remade by adding water, it is not wort, but real beer, having all its flavour and alcoholic strength, and lacking only effervescence, which can be quickly imparted by reviving the suspended fermentation for a short time in order to develop sufficient carbonic acid gas to give it the required briskness; or it is fit to drink immediately, if charged with carbonic acid gas, like aërated water. The refermentation is so slight, that it can easily be conducted in any climate, and where yeast cannot be readily obtained, a raisin or grape put into a bottle will cause a sufficient fermentation to give it life, or a small quantity of brisk beer will set a large quantity of the remade beer into fermentation.

As any kind of beer will keep in this form, a light draught beer, such as it has not hitherto been considered safe to export, can be readily shipped, to be remade in large quantities abroad.

A paragraph has recently gone the rounds of the papers, referring to the invention of beer powders by a German chemist. This is probably wort also, as alcohol cannot be retained in the form of a powder, and if the article when remade does not contain its proper proportion of spirit, it is not beer.

There are several other points covered by my patent to which I need not here refer, but sufficient has I think been said to show that it is one thing to boil down the extract of malt and hops (wort) before it has had alcohol developed in it by fermentation; and quite another thing, to take a finished and fine-flavoured beer and treat it in the manner I have described, without destroying its strength or flavour; and that, whatever may be their relative merits, there is a decided difference between condensed wort and condensed beer.—I am, &c.,

P. E. Lockwood.

19, Cromwell-place, Oct. 16th, 1875.

A German chemist observes that the sodaic salt of vanilla should be found in the refuse liquor of the wood-pulp of conifers. Vanilla in a crystalised form has not yet been obtained in this way, but attention is directed to the possibility of the extraction of vanilla from the refuse liquor of paper-mills, where wood-pulp is largely used, proving a lucrative branch of industry.

It is understood that the whole subject of copyright—literary, artistic, musical, and dramatic, imperial, colonial, and international—will come before the commission recently appointed to deal with that subject.

GENERAL NOTES.

Collisions at Sea.—M. Trève has submitted to the French Academy a new system of signalling, with the object of diminishing the frequency of collisions at sea. He proposes to employ a signal which will permit the officer of the watch, on perceiving a vessel a short distance ahead, to make known to those on board of her the tack on which he intends to pass her, and that instantaneously. The method by which this is to be accomplished consists in the use of a green or red fire ignited by electricity, the means of joining contact being close at hand. The green fire would show that the helm is put to starboard, and the red that it is put to port. This is to avoid the danger of collisions through both vessels going on the same tack.

British and Foreign Patents.—A recent number of the *Commission of Patents Journal* gives, in a tabular form, the number of patents granted during the last thirty-three years. The following are the numbers for the year 1874:—Great Britain, British India, and British Colonies and Dependencies—Great Britain, applications 4,492, patents sealed 3,162; British India, 80; Canada, 2,251; Cape of Good Hope, none; Ceylon, 2; Guiana (British), none; Jamaica, 5; Mauritius, none; Newfoundland, none; New South Wales, 50; New Zealand, none; Tasmania, 8; Trinidad, none; Victoria, none. Foreign States—Austria, 1,320; Baden, 134; Bavaria, 197; Belgium, 2,264; France (patents and certificates of addition), 5,746; Italy, 580; Portugal, none; Prussia, 187; Russia, none; Sardinia, none; Saxony, 339; Sweden and Norway, 188; United States, applications 21,602, patents granted 13,599; Wurtemburg, 168.

Exhibition of Objects of Fictile Art in Germany.—A permanent exhibition of the most noteworthy objects of the fictile art in Germany and other countries has lately been opened at Coburg, and to the museum is to be added a special school for the teaching of moulding and painting. England, Austria, Denmark, and Sweden have, as well as Germany, been represented in the exhibition; and the Duke of Saxe-Coburg-Gotha has, until the site for the exhibition and the schools shall be ready, lent a pavilion in his park to receive temporarily the articles exhibited. The first class or section is devoted to common pottery; the second, to objects which are of a slightly higher order, such as articles for household use; the third consists of fine samples of faïence and semi-porcelain; and the fourth, of fine porcelain in its most varied application to articles of utility and luxury; this last class is, however, to be restricted to articles of German manufacture.

Gas as a Fuel.—Whilst the majority of the ironmasters of Pittsburgh are waiting and watching till Messrs. Graff, Bennett, and Co. shall, at a cost of £1,000 a mile, have brought gas to their mills and forges from a well 30 miles away, capitalists in the United States are buying up the wells which lie around the one from which Messrs. Graff, Bennett, and Co. are hoping to secure a supply. Simultaneously the excitement which is beginning to appear throughout the United States iron trade in relation to the serious changes inevitable there from the use of well-gas as a fuel in that branch of industry, is being increased by the success of Messrs. Rogers and Burchfield. This firm, it will be recollected, was the first to use well-gas in ironmaking. Setting down their works in a new locality forty miles above Pittsburgh, they obtained gas from an old well which stubbornly refused to yield oil. At their Apollo Works, five miles off, they afterwards commenced to sink for gas; and the information now to hand is that they have been successful in finding it in both the wells which they have there been sinking. Leaving the United States ironmasters to adapt themselves to the new condition of things as best they may, we note as significant to the ironmasters on this side that a circular is now being distributed amongst the leading tin-plate making firms here, warning them of the competition which they will have to face as the result, in the first instance, of what Messrs. Rogers and Burchfield are enabled, by their gas and their blast together, to effect at Leechburgh. The writer is a Liverpool metal merchant, who has just returned from a tour of inspection of the mills and forges of the United States.—*Engineer*.

URNAL OF THE SOCIETY OF ARTS.

No. 1,197. Vol. XXIII.

FRIDAY, OCTOBER 29, 1875.

ommunications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ROCEEDINGS OF THE SOCIETY.

INSTITUTIONS.

The following Institutions have been received o union since the last announcement:—

Hartsherrie (by Glasgow), Academy Evening Classes.
London College for Working Women, 5, Fitzroy-street, Fitzroy-square, W.

COMMERCIAL EXAMINATIONS.

The programme of these Examinations for 76 is now ready, and may be had *gratis*, on plication to the Secretary.

EXTINCTION OF FIRE IN SHIPS.

The Fothergill Gold Medal is offered for an fective means of preventing or of extinguishing e on board ship. Communications, illustrated need be by models or working drawings, must sent in to the Society not later than the 31st of ecember, 1875.

The Council will take into consideration, with a iew to reward, the best written paper containing ggestions fitted to secure prevention of fire, or e means to be adopted for the safety of life and roperty when fire breaks out on board ship.

The Council reserve to themselves the right of ithholding the medal or reward offered, if, in e opinion of the Judges, none of the communica-ons sent in are deserving.

MISCELLANEOUS.

THE PORT OF TRIESTE, ANCIENT AND MODERN.

y Captain R. Burton, Her Majesty's Consul at Trieste.

This great emporium of Austrian trade lies in north titude 45° 38′ and east longitude (Greenwich) 13° 46′, the heart of the temperate zone, and almost at the ot of the Julian or South-Eastern Alps.

The Adriatic Gulf, whose longer axis trends from south-st to north-west, forms at its curving head a minor inlet r bay, whose greater length is disposed from south-west o north-east, almost at a right angle to the main line, nd this is the Golfo di Trieste (Sinus Tergestinus). The mouth measures some 16 geographical rectilinear miles from Grado to Cape Salvore, the north-westernmost projection of the Istrian peninsula. Measured from point to point, the circumference in round numbers may be 60 miles (rectilinear geographical). The bight is again divided into sections by the rocky projections of Duino and Miramar. The north-western bay is the Sacca di Duino (Sinus Diomedes), which receives the Timavo River, and the south-eastern represents the Sinus Tergestinus proper. Trieste, therefore, has one great advantage—it is the most inland of the neighbouring ports, even Venice, and it is the natural station for Vienna and the heart of the Austrian Empire.

Immediately about the city, the shore line which, defined by the stony escarpment of the Carso, the limestone platform which supports the Julian Alps, after running in a straight and often in a perpendicular line from west north-west to south south-east, sweeps round suddenly to the south-west, at the north of the new town, where the railway station now stands; and it preserves this direction along the sea front of the harbour as far as the projection called Sant'Andrea. After that the shore line, now eocenic, not nummuletic, resumes its former curve, and once more trending west north-west, to south south-east, defines the eastern bank of Muggia Bay, a splendid natural harbour, which has by no means risen to the development which it deserves.

The chord forming the Trieste Roads is about 1,700 direct yards from the Fanale (lighthouse) to the opposite or north-eastern shore, and its depth to the arc would be about direct 900 yards, giving an area of 1,530,000 square yards. Formerly, more recessed than now, and successively deep water, marsh, salinas, cultivated lands, houses, and New Town, it received three torrents, or fiumaras, locally called Burroni, which, even within the last century, formed swampy embouchures. To the north was the Martesin or Mortesin, running between the Rojano and Scorcola suburbs, and now discharging north of the new mole, No. 1; the next, defined by the heights of Longera and Guardiella, fell into No. 3, which ran between the bulges of Chiadino and Rozzol (Rozzolo). The latter is the Rozzol Potok, which has now become the Torrente Klutsch. The courses within the city and the mouths are now built over; the only debouchures left are the Martesin and the Klutsch, a Cloaca Maxima which annually carries into the port about 1,000,000 cubic feet of fæcal matter, rendering the north of the new town, and especially the fine villas built upon the Scorcola buttress of the Carso encampment, comparatively unwholesome.

The current of the Adriatic begins to be felt about the Ionian Islands, thence it subtends the Dalmatian and Istrian coasts, passes the Muggia, or Back Bay, flows round the lighthouse point, still passing northwards, and stretches down the east coast of Italy to lose itself in the gulf of Taranto. But the tides, which sometimes rise to nearly four feet, take the inverse direction in the Trieste harbour, and the ebb runs from north to south. The discharge of the Isonzo and the Timavo rivers is supposed to explain the Trieste backwater, which is greatly increased by westerly winds causing currents; others again attribute the inverse or north-south flow to the Stegaizza (in German the Wider-See), as the vortex is called all down the coast from the Slav Stèk. The Roads of Trieste have two main defects.

1. They are liable to silting up from the washings of the inverse current or backwater meeting the discharge of the little torrents and the city drains.

2. They are directly open from south-west to north-west, and under an obtuse angle to the winds raging between north and east. Yet MacCulloch justly declared the Trieste Roads to be among the best in Europe.

An eminent antiquary, the late Dominico Cavaliere de' Rossetti, writing in the periodical, *L'Istria* (Nos. 14 and 15, April, 1850), divides as follows the history of the Trieste Port into four epochs, which we may now increase to five.

1. Roman: beginning from the date of Trieste being made a Municipium (A.U.C. 576=B.C. 177), and a Colonia under Julius Cæsar (A.U.C. 695=B.C. 58), and ending with the fall of the Western Empire, A.D. 475. This first period thus represents about 6½ centuries.

2. Italic: whose limits are A.D. 475—1382; some 900 years, during which the destruction of Pola and Aquileja (A.D. 452), the chief Roman centres, caused the rise of the Venetian Republic (A.D. 697).

3. Austrian: from A.D. 1382 to 1717, when Trieste, which spontaneously submitted to the Empire, was made a free port by the Emperor Charles VI., a comparatively short period of 435 years.

4. Commercial: the period extending to 1860; and

5. Innovation and injury, lasting from 1860 to the present day.

Concerning these several epochs I will offer a few observations.

I.—Roman Period (B.C. 177—A.D. 475).

Trieste being the central point between Venetia, Istria, Illyria, and Pannonia, it naturally attracted the attention of the conquerors, whose engineering, be it noted, far surpassed, in conception and in execution, anything attempted since their day. They found the Sinus Tergestinus proper a baylet with two lobes. The northern half, from the beginning of the sweep to the centre of the modern town, was the arc of a circle; the southern formed part of an ellipse, and here they rightly determined to build their outer port. An islet (perhaps two) with a nucleus of sandstone, rare on this limestone coast, lay distant about one mile from their city, it measured nearly 100 fathoms in circumference and 35 in diameter. This they connected by a reef or natural dyke with that part of the shore which is still known as the Camarzo (Campo Marzio), and here they raised their western mole, 120 fathoms (720 feet) long, in two lengths of 40 and 60 fathoms, wisely leaving an opening of 20, so as to assist rather than oppose the natural current by which the harbour was kept from silting up. This islet, afterwards termed the Zucco, fronted by water 50 feet deep, was provided by them with a pharos on an octagonal base. The double mole, bending north-west by north to north, was composed of fine cut blocks 6 to 8 feet square, which were visible till 1751. The examples of Aquileja, Ravenna, Ancona, Puzzuoli, Pompeii, and a host of other places, suggest that they formed arched causeways, another highly scientific precaution persistently neglected in later days.* From the modern Riva Grumula, at the foot of the hill called "De' Santi Marteri," from the days of olden history, where the Molo Giuseppino now projects from the Piazza Giuseppe II., they threw out their eastern arm, another arched pier, 180 fathoms (1,080 feet) long, in water 6 fathoms deep, and the included space formed the Porto esterno, or Delle navi; it is now popularly called La Sacchetta. The Romans also laid out, eastward of the markets and the merchants' quarters, the inner port or dock (Darsena,† or Porto Interiore), a basin similar to those which we see everywhere along the Mediterranean shores, from Algeciras to Bayrút. It was, doubtless, immediately at the foot of their walled town, which extended in pear-shape eastward up the hill crowned by the Temple of Neptune. To judge from later days, the form of the dock was a truncated triangle with the shore for base, and a narrow entrance facing north-west. The eastern arm was formed by a mole projecting perpendicularly from the shore, afterwards called "Molo della Bandiera;" the western, a similar erection, disposed at an obtuse angle to the coast, converged towards the former. This inner port gradually shrank away from the city walls, but it remained, with various changes, till about the middle of the present century, under the name of Mandracchio, locally pronounced "Mandratsho."* The term was probably introduced by the Neapolitan and Genoese sailors who manned the fleet of Charles VI.; it is still preserved in the name of the short quay which extends from the San Carlo mole to the fish-market (Pescheria).

The Romans, moreover, had a number of subsidiary ports, small parallelograms of masonry, a system still preserved on the coast. The positions, and even the remains, may be traced at Cedas, Grignano (Miramar), Sestiana, and Duino to the north; and southwards in Muggia or Back Bay, at Sant' Andrea, Broglietto, and Servola (Silvula ?).

II.—Italian Period (A.D. 475—1382).

The history of this age is one of fluctuations and insecure liberty, ever threatened by Italian wars and barbarian incursions. The two-fold port must, however, have been preserved to a certain extent, despite general neglect. In A.D. 1150, two salaried provveditori and one notary had charge of the quays, harbours and moles, and subsequent statutes were passed (A.D. [illegible], [illegible], 1354, 1365), which forbade sand and soil to be cast into the water, or the stones left by the Romans to be removed from the inner mole of the outer port. Probably the Darsena or Inner Port sufficed for general use, and possibly, during this epoch, the little piers, the western and smaller, called Delle Beccherie and the eastern, Delle Porporella, a name applied throughout the Peninsula to old ruined moles, were built. Also about the middle of the Italic period (A.D. [illegible]), the torrent flowing under the eastern walls, where the Via del Torrente still retains the name, was canalised under the name of Portizza (little gate), or Canale del Riborgo, corrupted to Triborgo.†

III.—Austrian Period (A.D. 1382—1717).

According to some authorities, Charles VI., who, influenced by Prince Eugene of Savoy,‡ carried out the plans of Charles V., found Trieste a mere nest of fishermen, like modern Grado. This is not probable. The city of San Giusto had her independent native nobles, her bishop and chapter, her municipal councils of 180 and 40 members, her own armed force, and her establishments for advanced education—theology and philosophy—presided over by Benedictines and Jesuits. The Sacchetta, or outer Roman Port, was probably no longer wanted in the decay of commerce, but we find (A.D. [illegible] and subsequently) orders for preserving and cleansing the Darsena, despite which, about A.D. 1604, it was almost silted up. In 1470, Frederick III., after restoring the city walls, raised the Batteria Civica on the western mole of the Mandracchio, 120 fathoms long, and created magazines on the eastern, where the Government House now stands. In 1620, the castle then and now called La Fortezza, with its bulwarks, the Rotonda, Venezia or Zudecca, and Barbacane, was built in its present state by Giacomo Vintana, of [illegible], who fitted the Civic Battery with twenty guns. In 1666, the Captain of Trieste, Count Carlo della Torre Popaita, after escaping a terrible storm, erected on the Zucco islet a chapel (chiesetta) to San Niccolò, pro-

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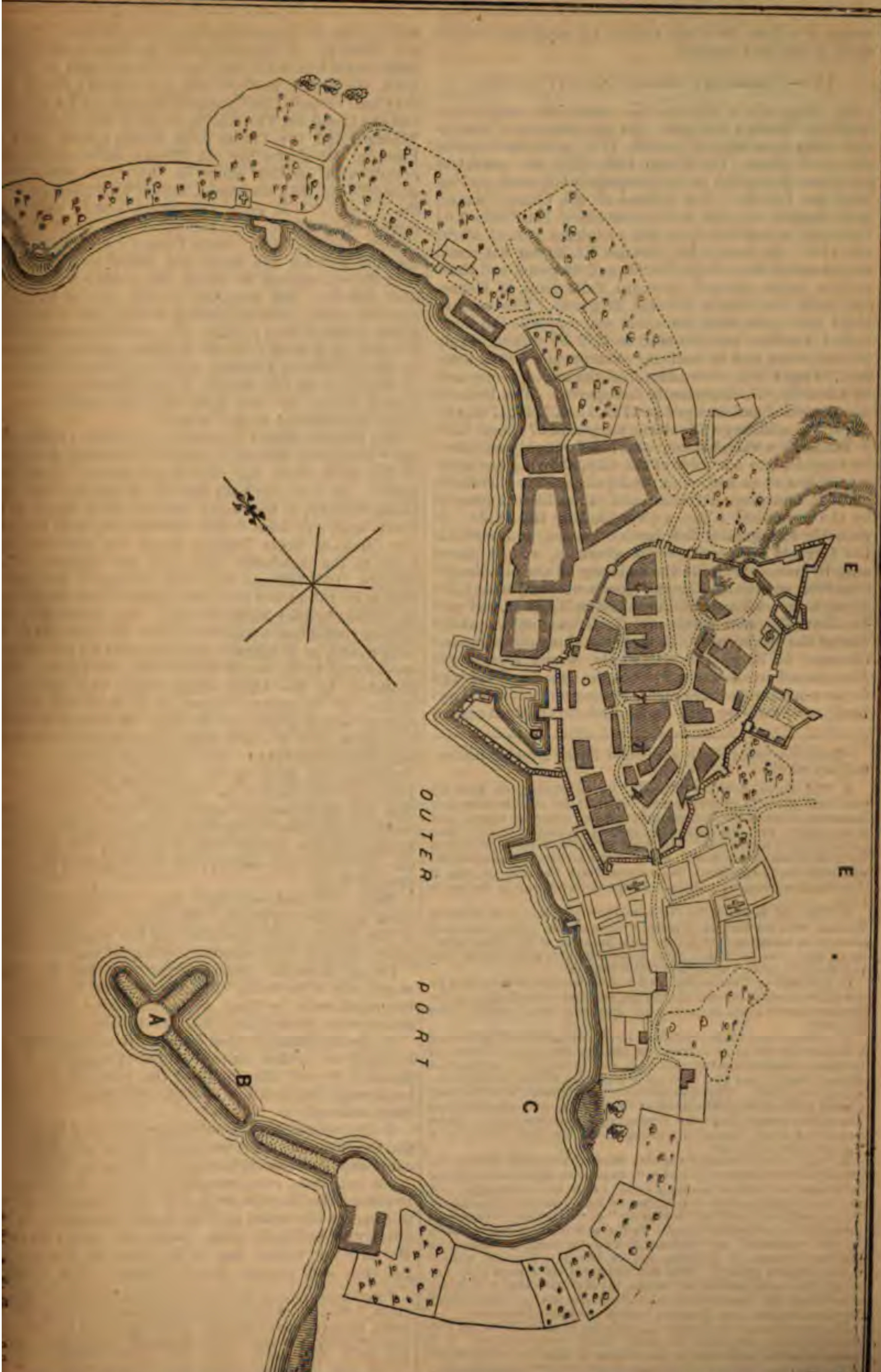
*This arched mole is apparently Dr. de' Rossetti's theory; the adjoining little Roman ports, Cedas, Santa Croce, and Sestiana, show no sign of it, and contented themselves with a gap which might or might not have been provided with a bridge. The silting currents would have been diverted from the outer port of Trieste by the eastern mole.

† The dictionaries (Italian and Spanish) make Darsena an equivalent of the Greek ἐνδοτέρος λιμὴν, the Latin Portus Interior, and the low Latin Arsena, "la parte più interna del porto, cinta per lo più da muraglia," a dockyard, a wet dock. The Arabs and Turks have adopted it in the forms El Darsana and the corrupted Attarasanas (Et Tarsánah). Some derive the two latter from Tarsh-Khanah, a commissariat depôt, an armoury, a barrack.

* "Mandracchio" is explained in the dictionaries—"La parte interna di un porto, oppure seno di mare fatto ad arte." [illegible] scholars derive it from "mandria," a herd, the small craft crowding in like cattle; Keltic scholars from "man," or "maen," land, rock, hill, and "truch," or "troch," a cutting, trench, or canal.

† The word is properly Riborgo, *i.e.*, Rio del Borgo.

‡ Both he and another local benefactor, Giovanni [illegible] Donadoni, are now clean forgotten.


OUTER PORT
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tector of sailors; this was ruined by wind and weather early in the next century.

IV.—Commercial Period (A.D. 1717—1860).

In June, 1717, Charles VI. signed the instrument creating Trieste a free port; the carrying out of the decree dates from September 10th, 1718, when the Imperial visit took place. On March 15th, 1719, the patent of commerce was given to the Compagnia Orientale trading with the Levant. The Salinas of the Campo Marzio were warped up, and the Lazzaretto of San Carlo (Old Lazzaret) was raised upon the reclaimed ground about A.D. 1731. In June, 1734, Charles VI. began his naval armament of three ships (70, 60, and 40 guns) and three galleys, under Admiral Giovanni Pallavicini, of Genoa, and built two vessels (32 and 30 guns). The present Molo San Carlo, still the chief pier opposite the Communal Theatre, was founded in 1751 by sinking a ship of that name, and by building a stone pier 300 ft. long. In 1788 some 60 ft. were added, and the head was crowned by a battery, which presently disappeared. The Darsena was deepened and dredged in 1721, 1722, 1736, 1741, and 1749. The Riborgo Canal was purged in 1741 and 1749.

We have a valuable map of 1718,* roughly engraved on copper-plate by order of the City, showing her superior claims, as an emporium, to Aquileja, Fiume, Portoré, and San Giovanni di Duino; and it has been illustrated by the periodical *L'Istria* (No. 18, May 4th, 1850). It probably exaggerates the depth of water, and conceals the torrents; it omits seven churches, and it shows only by nameless circles the emissary of the old Roman aqueduct outside the Cavana (south-western) Gate; the Nymphæum, afterwards Fonte di San Niceforo, and now La Zonta (of wine lees); and the Ustia fountain, at the foot of the Istria road. It gives the three great gates—Cavana; Il Porto, the water-gate, where two bronze Moors stood on a tower and struck the time; and Riborgo to the north, with three roads, leading to Lubiana (Laybach), to Staribreg, and to Moncolono (modern Contovello), with the three secondary gates, Donota, Portizza, and Pescaria. It does not show the three then-existing boat-canals which fell into the Salinas, north of the old town, where the modern city now stands; these were the Canal Grande, the Canale di Riborgo, or La Portizza, and the Canal del Vin, which, crossing the Piazzetta di Riborgo, and the Piazza della Borsa, united with the Portizza. It shows the old Roman walls which were rebuilt with smaller stone in the Italic period, and strengthened with buttresses, united by a passage called the "Volto." It gives one round tower, and many square, neglecting the pentagons (?) built by the Romans. In the Zucco (Santa Teresa) mole, it shows the aperture left for the scour, and useful to boats which then did not require to round the point; it makes the islet circular, and supplies it with two pierlets, one running north, and measuring twenty, the other east, thirty fathoms long; these are now incorporated with the islet, as is shown by its pyriform aspect. Finally, on the opposite or northern shore, it places the Batteria di Musiella* at the mouth of the Martesin, or Rojano torrent, where the new lazzaretto afterwards was, and where the railroad station is now.

The Empress Maria Theresa (A.D., 1740 to 1765), called the "Mother of Trieste," ordered (1749) the demolition of the walls, that the city might spread itself more freely. In 1751, she built the old lazzaretto, the lighthouse battery, a four-sided ravelin, with apex to the north-west, and base facing shorewards, and the solid pier (Molo di Santa Teresa), which has done so much harm to the Sacchetta. In 1754, the present Canal Grande (196 fathoms long by 13 broad, holding 1[illegible] vessels of 150 to 300 tons) was made or rather deepened up by the engineer Mattia Pirona. The sooner it is filled and converted into a *place* the better. In 1769, the Lazzaretto nuovo, or di Santa Teresa, reserved for severe cases, was erected to the north of the town. Here also, partly sheltered by the Carso escarpment, was opened the Bacino del Lazzaretto nuovo, or di Santa Teresa, concerning which much will be said. It was divided into two parts, and it could contain ten large, or thirty to forty-five small keel. The Canale di Riborgo, or Della Portizza, was filled up by warping, between 1799 to 1818, and the Bourse or Exchange, was built upon it. The old Mandracchio lasted till 1858, and soon afterwards became the Public Gardens, fronting Government-house, and the modern Piazza Grande. In fact, about the end of the last century, the city began to assume its present shape.

From 1768, and especially from 1804, a multitude of plans and projects for the "abonimento" (improvement) of the Roads were submitted to the municipal authorities; happily they remained uncarried out.

Dr. de' Rossetti, premising that "Il non far nulla è meglio che di far male," in 1850 proposed to obviate the two chief evils by these means (Massime Generali per conservare e perfezionare il Porto di Trieste).

1. By an artificial islet formed by sinking ships and building an arched mole or moles of masonry at some distance beyond the chord of the port, so as to act as breakwater and defence against rare gusts and storms from seaward.

2. By reforesting the adjoining hills, and by encasing the torrents with built walls and basins where the water could deposit its mud, instead of silting up the harbour.

An important recommendation which he offered was to restore the Boccola or gap in the Roman mole, so as to promote the scour, and he would have made it compulsory to build all moles, piers, and quays on arches. He saw the future use to be made of Muggia Bay, the true and natural port of Trieste. His words are

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* References to old plan of the Port of Trieste in the last century See page 981:—

A. The Zucco, now the "Fanale" or lighthouse, an islet 110 geometric paces in circumference. It was built on sandstone (not the common limestone of the coast), and had a circular shape; now it is pyriform with the stalk to the east, and a bastion of four faces protecting the north-west. The Roman Pharos is said to have been built on an octangular base. About 1666 the chapel of San Niccolò was built on it by Count Carlo della Torre Popalta, Captain of Trieste, after escaping a storm. It was washed away by the sea in 1718.

B. The old mole (Molo del Lazzaretto Vecchio, now di Santa Teresa), with its bocoola or passage, by means of which boats were saved from rounding the "Zucco," and the scour of the "Sacchetta" or old port was increased. The Roman mole is said to have been 18 feet above water, and signs of it still remain.

C. Old port or "sacchetta," defended eastward in Roman days by a mole, extending towards the Zucco, and here represented by the Beccherie mole; but cut stones 6 ft. long have been found in water 9 ft. deep.

D. Interior port (Mandracchio or Dock), defended on the west by a battery of 20 guns, repaired in 1620 by Giacomo Vintana, of Gorizia. A chain was thrown across, and in the east (the direction of the "Bora") was the Molo della Bandiera, where Government-house now stands. The Mandracchio communicated with the main square, adorned with the statues of Charles VI. and Leopold; there was also a tower (Torre del Orologio), where two bronze Moors struck the hour. East of the Mandracchio lay the "Saline," now the new town of Trieste.

E. The Roman walls of the city were of large cut stones; the defences of the Middle Ages were of smaller material, with pilaster buttresses, and *volti* or passages passing from one to the other. Of the towers only one was round, the rest were squares or pentagons. To the south-east was the "barbacane" or "dongione," a name still preserved by a vicolo or alley. To the extreme east was, and still is, the "castello" or "fortezza," with its Leopold bastion, its Bastione Venezia or Zudecca, and its Rotonda, Venetian work of the fourteenth century. The city had three chief gates:—1. Triborgo, the north-eastern; 2. Cavana, the southern; and, 3. Il Porto, connecting the Mandracchio with the main square. The others, Donata, Portizza, and Pescaria, were of secondary importance.

F. Porto Sporco (foul harbour), probably so-called from the Torrente Martesin (not shown on map), which discharges here. It is bounded north north-west by the Batteria di Musiella, at the mouth of the Burrone (fiumara) di Rojano, where the new lazzaretto afterwards was, and where the "Südbahn" station now is.

* All adjacent places of old had some Musiella, Mugli, Mucl, or Mucia, a word which has not been satisfactorily explained, either castle, municipality, or colony. At Trieste, it was the name of the northern battery, as the Batteria Civica was the southern. Musiella also had a rubble mole, which, with another farther south, projecting from the Rojano church (San Pietro), formed the "Porto Sporco," or foul port.

0 "*L'Istria*," April 13, 1850) "Se le bisogne di aggio e di nuovi stabilimenti portolani lo deranno, vi si destini il seno di Muggia, il quale olo del Lazzaretto Vecchio fino alle Saline di Zaule ata e lido e mare atti ad opera e stazione qualunque. otrà Trieste gloriarsi d'avere due porti, nel secondo uali potrà senza pericolo e con somma utilità edere a tutte quelle occorrenze, per servire alle si fecero progetti che, eseguiti non gioverebbero lla totale rovina del primo." And he characterised roject of a "port inside a port" as follows:—"Non co nemmeno adesso che cosa intendesi di dire quando rla di costruire un porto per Trieste. Non vi trovo enso che nel dire di voler costruire una casa nella Trieste ha il suo porta nella sua Rada interna, a per quanto la natura lo comporta, e già come sicura abbastanza quando si tolgano gli abusi e le genze (torrents and drains). Chiunque voglia delle costruzioni solide entro alla corda dei due aretti (old and new)* non potrà aspettavi che la dizione dei posteri, come se lo merita quel' ingegnere nell' anno 1751 chiuse la bocca del Molo Romano detto cco', ora 'Molo di San Teresa.'" I cannot but think right. My plan would have been simply to open Lighthouse mole, and to prolong it as a tentative sure by a floating breakwater, which could readily e been removed if found injurious, lengthening at same time the existent quays and moles, and running amway along the town front from the railroad to the chetta.

his Triestine worthy deserves well of his country. public life was devoted to advocating her interests, his private hours to studying her history, literature, antiquities. In 1811, General Joubert offered to ke him Podestà (Mayor), but he refused to serve ler the French invader. After the defeat of Napo- n I. at Leipzic (1813), and the recovery of Trieste by stria (1814), a false report was spread that the city San Giusto was to be treated as a conquest, and to e her position as a free port. Rossetti, a poet and a iter of distinction, then girded up his loins, described in quent prose the noble municipal establishments of the tin race, recited the privileges of his native city, and tinued for the rest of his life to advocate her cause, d to serve her in various civil dignities. He found a mere "Hof" of 6,424 souls; he left her a flourish- g port with 20,000, a total which has grown to sixfold. rn, March 19th, 1774, he died on November 29th, 42, and the centenary of his birth has lately been rthily celebrated by his fellow citizens. Besenghi gli Ughi, a critic who is by no means mealy-mouthed, d of him, Domenico de' Rossetti, "Aveva avuto il raggio di durare tanti anni (68 years) a fine di ingen- ire od almeno dirozzare quel nudo scoglio di mare l soffio umanissimo della coltura e delle lettere."

V.—Period of Innovation and Injury (1860—1874).

Trieste had now escaped the immediate effects of ubborn Germanisation, and the day of Constitutional- m had made her a free town as well as a free port. er Emperor entitled himself "Signore di Trieste;" she ad her Diet distinct from that of Istria; she returned ur members† to the Lower House at the capital, and er "Magnifico Podestà" and municipality took un- mited charge, often with very little wisdom, of all or internal arrangements.

We now come to the days when the public began to lamour for the "bonification" of the Porte. The Suez Canal, believed in by all men except Lord Palmerston, had aroused the Mediterranean world with the hopes of sharing in the rich trade of the nearer and the farther East. Algiers, Marseilles, Genoa, Ancona, Leghorn, Naples, and Brindisi, began almost simultaneously to brush up their old-fashioned establishments, and the citizens of Trieste were seized with a desire to convert their open roads into a closed port or a system of docks. They complained that their city had none of the great works extending from Havre to Stettin; that their imports of coal and iron, and their exports of grain, wood, and flour, had greatly increased without proportionate conveniences; and that the waste of money in the daily embarkation and disembarkation of 35,000 zoll. 'zentners (about 1,740 tons), costing per annum 1,188,000 florins, was not only a *lucrum cessans*, but a *damnum emergens*, for which the consumer had to pay.

After 1854, too, the grain trade had so developed itself that ships, finding no room at Trieste, were driven to Venice, or had to land their cargoes in Muggia (Back Bay) where the Sponda di Servola had recently been bought with the view of establishing a new port. And in 1861, the glut was further increased by the opening of the Pesth-Kanischa-Pragerhof Railway, which added the cereals of Hungary; the two articles, grain and building woods were expected to form five-sixths of the freightage of that line. On the other hand, the roads of Trieste had cost but little; during the thirty-five years preceding 1872, the total expenditure of harbour improvements amounted only to 360,000 florins.

Before giving an account of the various projects proposed, and of the plan finally adopted, let us briefly consider the evils to be remedied. The Roads, I have said, are comparatively open, exposed in winter to northerly, in summer to southerly gales. The former are chiefly the two land winds, *Greco Levante* (east north-east), and the *Patria Bora* (Boreas), a generic term for the Baltic current, which ranges between north north-east and north-east. This mountain blast rushes down like a Pampero upon the heated atmosphere of the seaboard and the sea; it seldom extends from Trieste far down the Gulf, but it shallows the shore water, and it causes a furious "*ressac*," its average may be 200 days in the year, and its violence during 30 to 33 prevents work in the harbour. Exposed parts of the streets must be roped to prevent men being blown into the sea; near Fiume, a railway train has been upset, and many accidents, even fatal, annually occur. The furious whirls of wind do good by cleaning the streets and scavengering the foul Old Town; at the same time they injure agriculture by rapidly drying up the rain. The enforesting of the mountain plateau (*emboscamento del Carso*) may mitigate the pest, but it has already worked some harm by equalising the temperature in summer, and by thus abolishing the "Embatto" which, rising at 10 a.m., blew till 4 p.m. This sea-breeze was most useful to sailing ships making the roads, and the "Borino," or land-wind of the same season, was equally favourable to those leaving it.

The sea-winds are also two, both the gift of torrid Africa. The "Libeccio," or south-wester is rare; it seldom outlasts the third day, but the long fetch raises the heaviest sea; it has tossed small boats and rafts upon the quays and into the squares. The rainy and misty "Scilocco" (Scirocco) is the complement of the dry and frigid Bora; the wind of spring, summer, and autumn often raging out at sea when the north-eastern blows furiously at Trieste. It lasts violently for twenty days to three weeks per annum, and it is always a depressing and malarious current whose tepid damp, however, brings showers beneficial to the droughty fields. It raises, whilst the Bora depresses the water; it chokes the twenty-one drains, not including the Cloaca Maxima (Klutsch), returning their nuisances to the town, and it seriously interferes with landing and embarking goods. During years when these winds were abnormally violent they have reduced the working days (loading and unloading) to 200, and even to 190, instead of the

* The former is now an Imperial Royal naval depot, the latter is to be demolished, the grounds being occupied by the railway. The last) "New Lazzaretto," a large pile of building, lies at some distance south-west of Trieste, behind Punta Sottile, the left hand (southern) proug of Muggia or Back Bay. Its only harm is tending to keep up useless quarantines when railroad trains are freely admitted.

† The City, 2; Chamber of Commerce, 1; Territory, 1.

normal 215, which does not include the 72 Sundays and festivals. But the evil is greatly exaggerated by the backwardness of the Port-City. There is not a single shed under which to land or house goods during the heavy and persistent rains. Instead of tramways we still find the primitive "zwei-spänniger Karren," long, low drays, often worked by carriage horses, and the cart drawn by a single ox. Turbulent Montevideo has steam-cranes on the moles; apparently, they are not dreamt of at Trieste, except for building the new port.

I was surprised to see the state of the principal harbour and emporium in the empire-kingdom which had resisted improvements for sixteen years. About half the larger sailing vessels frequenting the port are compelled, by want of quay space, to load and unload by lighters; and almost all made fast to the "rive" (quays) instead of being berthed alongside, are ranged stern on, so as to be connected with the shore by a plank. This primitive fashion of taking in and discharging freight is used in modern ports only when extremity compels. Cargo was carried ashore by "facchini" without any trace of labour-saving machinery; and ships were often only too glad of landing their contents in any way they could. For instance, the B. & N. A. S.S. *Morocco* anchored in the roads on the evening of my arrival (Friday, December 6th, 1872). She could not break bulk for two days, room being wanting at the San Carlo Mole, which, moreover, can be used only at low water, there being no berth to land goods at high tides. On Sunday she found a place, and on Monday (December 9th) she began work at about 9 a.m., when the sea ceased to wash over the pier. The operation was delayed by the heavy showers which prevail from November to May; nowhere can a bale of goods be shipped or unshipped in a marketable condition; and even the railway is still fronted, as it has been since 1858, by an open, muddy space, over which perishable commodities must be carried. Briefly, the *Morocco* was unable to leave Trieste before noon on December 17th, having taken ten clear days to discharge and load, instead of two or, at most, three, paying her crew £400 instead of £120. It would have suited her far better to pay at once £100 for proper accommodation than thus to be mulcted for demurrage. The circumstances were exceptionally against her; but during the six months of of "Bora-gales" and "Sirocco-storms" at Trieste, matters are often worse than between the 6th and 17th December, 1872. Finally, between that time and May, 1875, there has been no attempt at improvement except a few dynamite mines, sprung to deepen the "sacchetta" or space between the Molo Sartorio and the "fanale" (lighthouse).

The first and the last sensible proposal for benefiting Trieste was made in 1856. Mr. Clark, an English engineer, was authorised by the Imperial Government to apply to the municipality for a concession and a grant of £800,000. The object was to make a tunnel of 826 metres through the macigno or soft sandstone ridge, called San Giacomo, which separates the city from Muggia Bay, and to lay out a regular port with basins and moles, in the noble natural harbour behind or south of the city. But it was objected that the removal of the shipping would injure the owners of houses and magazines in the harbour of Trieste, upon which much capital had been expended. To this difficulty there are two solutions. Firstly, Muggia Bay, a safe port, defended against the winds by the two points, Sant' Andrea and Sottile, and easily fortified by batteries against attacks fatal to the new port at the edge of a large commercial city, would be a general amelioration, and what improves the whole must be held to improve the parts. Secondly, a line or lines of tramways from Muggia Bay, along the shore of Sant' Andrea and the city frontage to the railway station, would, instead of deteriorating, raise the value of property throughout the line of improved transit. The present state of affairs and the future prospect will be still worse when the new port shall be opened to trade; not only will house property suffer, but the whole city will be condemned to inevitable loss. Such, however, are the short-sighted views of individual profit which prevail. Only lately a few Greek merchants have been able to prevent the filling up of the malarious Canal Grande, because their brigantines could no longer anchor under their windows. I may here note that part of Mr. Clark's scheme is about to be revived. A tramway gallery, eight metres broad, is again proposed between the Piazza Santa Catterina and Muggia Bay below, or north of Servola. The expense, including a small reserve-fund, is laid at a maximum of £200,000; and as ground at the city end commands from 25 to 200 florins per square metre and 3 florins in the suburbs, we may expect to see it in the London market.

But Muggia Bay, the true port of Trieste, is being rapidly occupied, not by Government, as it should have been, but by private companies. Beginning from the north we find—

1. The Tecnico Triestino. These iron works have a considerable establishment behind the shore and the Servola road; as yet they have not occupied the water-side.

2. The Austrian Lloyd, whose shell of Maltese stone is said to have cost over half-a-million of florins; the large and expensive building yards and workshops occupy a large sea frontage, and a long thin wall projecting south is all the protection required against weather.

3. The Navale Adriatico (Schiffswerfte S. Marco), formerly called from its founder the Cantiere Tonello, covers perhaps the best place, and is defended by a short thin pier projecting from the centre. This establishment is understood to be insolvent, and more than one offer of purchase from England has been reported.

Beyond the latter the ground is occupied by the gasometers, by an extensive rope manufactory, by the village of Servola, and by the new slaughter-houses; about these abattoirs the country is decidedly malarious, and calls for plantations of the Eucalyptus.

During my first visit to Trieste (1856) I had noted the merits of Muggia Bay, and when taking charge in 1872 of Her Majesty's Consulate, I introduced the subject to His Excellency the Governor, Baron Ceschi, and to the President of the Maritime Government, Chevalier Alber von Glanstätten. Both lent a willing ear to my proposal that a plan for converting Muggia Bay into a port be submitted to engineers and capitalists in England. My proceedings were communicated to Mr. Thomas Page, C.E., whose name is known in connection with the Thames Tunnel and the Westminster-bridge; unfortunately he had other engagements. This project, like the tunnel, is by no means dead; during the last few months there has been much talk about it.

I now proceed to notice with necessary briefness the principal plans and proposals for the "bonification" of the harbour between 1856 and 1863. During the latter year Sir Charles Hartley, C.E., the chief engineer on the works at the Danube Mouth, was invited by the "Hafencommission" to give his official opinion upon the thirteen proposals which had been submitted to it. Of these twelve proposed to improve the harbour and one to build a ship canal. The distinguished English engineer, I believe, was in favour of a long mole run seawards, and perpendicular from the Bacino del Lazaretto nuovo (the Quarantine Basin), now unhappily filled up.

I. The plan of the Fratelli Martin (Dec. 31, 1856) proposed to increase the harbour accommodation by prolonging the existing piers, which are now eleven. Beginning from the south they are:

(1.) *Molo Santa Teresa* (Lighthouse pier), the long jetty extending from the old Lazaretto now a Government depôt, to the lighthouse, and arresting by its solid dam the scour of the Sacchetta (inner or southern harbour). The same depôt has within its walls two more stumps of moles which were built by and used for the oldest of the three quarantine grounds.

Molo Barland, or *Molo del Carbone*, from the hman who built it and from its modern use; it is a nere stump.

Molo Bruno, at the sharp angle where the shore Sacchetta, bending from north-west to north-east, he harbour proper. This little projection has a arch, a necessary wanting in all the other piers he following and No. 9.

Molo delle Piere Cotte, so called from the bricks here ; it is about 18 paces long.

Molo Sartorio, a longer line off which ships rly lay when performing short quarantine. It is d by the Casino of the I. R. Guardie di Finanze nz-Wache), a painted building, capped by an old-ned anemometer, where daily observations are led at 8 a.m. The Fanale (Pharos) tower also the state of the thermometer and barometer upon e ladder-like scale, with a moveable wooden slat; instruments are as usual Centigrade; and it would visable that our ship instruments should be pro- with this system, as well as with Fahrenheit and ish inches. Observations for weather are also on the roof (cupola) of the I. R. Academy of merce and Navigation; but the arrangements are liberal enough; for instance, there is an utter want smological instruments in a city where earthquakes requent, if not severe.

) *Molo del Vin*, for landing wine.

.) *Molo Giuseppino*, opposite the Piazza of the same e, where, on April 3, 1875, the statue of the late peror Maximilian was unveiled by H.I.R. Majesty. is a thin line of masonry where wine boats unload he south, and on the other side the Austrian Lloyds sometimes foreign ships lie.

.) *Molo della Sanità*, the shortest of the moles, front- the quarters of the Maritime Government, pilot's e (corpo dei Piloti e della Sanità), and wholly occu- by the Casino della Sanità (health officer), which lately been enlarged.

.) *Molo S. Carlo*, the principal landing pier before tioned; it has a single arch at the root and it ted only enlarging.

10.) *Molo del Sale*, another short or half pier; it be overlapped by the new mole W. IV.

11.) *Molo Klutsch*, a long thin line at the northern- st bend of the bight, where the new works begin. re the very offensive main drain (Klutsch) discharges ough three arches to the north or almost under the lway sheds. The Klutsch was built partly by vernment and partly by the Südbahn. All these rs are well and solidly made of the *grès* or sandstone the adjoining hills. It is a material which requires reful selection, and the present state of the masonry ilt in the days of Maria Theresa shows how well it n resist sun, rain, and water. For pavements it is not ppery like limestone; but when not well chosen, and pecially when the joints are wide and not close as they ould be, the surface scales and wears into holes. All the l piers were built with caissons and *béton*, except the ng narrow Molo Klutsch, which was laid on slabs; they quired only lengthening, broadening, and providing th arches near the heads, so as not to arrest the scour. he "rive" or quays also called loudly for widening.

II. The next important plan for "bonification" was oposed by Cav. S. C. Rosenkart, in an "Antrag," a mphlet printed by the Austrian Lloyd's Office, May , 1861. The same merchant also published "Denk- hrift zu dem am 13 April, 1867, zwischen den hohen inisterien der Finanzen und des Handels einerseits nd der K. K. Südbahn-Gesellschaft anderseits, bezüg- h des Hafenbaues in Triest abgeschlossenen ueber inkommen," von S. C. Rosenkart Wien, 1867. His lan was to preserve and deepen the Bacino del Lazza- etto nuovo, the quarantine basin, a measure very opular with the citizens, and to defend it by a mole 00 feet long, projecting from the Santa Teresa Battery, n the road to Barcola (San Bortolô). The objections were that this project would add berthage sufficient only for six large vessels, not for 18 as the author supposed; moreover, that instead of approaching the town these works would go further from it, where the waters are more exposed to the south-west (Libeccio) and the south south-west (Ostro-Libeccio) winds.

III. Major von Schröder proposed two straight "dighe" or projecting moles, one from the Molo Santa Teresa, or lighthouse pierhead, to run almost north, and the other trending to the south south-west from the western side of the Bacino del Lazzaretto nuovo; both converged to a mouth 1,150 feet broad. This was objected to be-cause it would cut the valuable roadstead in two, encroach upon the centre of the port, and unload ships in the roughest water.

IV. The plan of Cav. J. Mauser proposed as a princi-pal feature to cut a canal through the point S. Andrea, so as to communicate with Muggia Bay. It was to be 180 feet wide, sufficient, in fact, for three ships abreast; it was to connect the Sacchetta with Muggia Bay, about Strudthoffs establishment, and it was to be crossed by two large bridges. In fact it was a trimming between part of M. Talabot's and Mr. Rieter's systems.

V. Captain Drago Poppovich published (June 14, 1862) a lithographed "Memoria" and a "Piano del Nuovo Porto di Trieste," which accompanies this paper.* With the concurrence of many merchants and armateurs, he proposed to modify the "Talabot" harbour, which he contended would be most injurious. The principal changes are in the breakwater and in the part about the railway station. The former was converted into a dyke 3,050 feet long, beginning with a clear passage 600 feet broad, between it and the fanale or lighthouse; running to the north by north-east, and leaving another clear passage 350 feet wide fronting the new Molo del Lazzaretto nuovo. This breakwater, thrown out 2,050 feet beyond the "Talabot" dyke, necessarily enclosed more room. The new mole was to project 1,950 feet to the south south west, towards the breakwater, thus protecting the Lazzaretto basin, which was to be deepened and to be supplied with an outer dock 1,950 feet long (north north-east to south south-west) by 1,450 broad (east to west). The railway Darsena, or basin north of the Torrente Klutsch, was to be filled up a by a triangle with a base of 2,000 feet. Quays and wharves were to front the city; the existing moles were to be retained, but the four (Nos. 5, 8, 9 and 10) were to be enlarged to a length of 900 by a breadth of 150 feet. The Molo Klutsch, the northernmost, was included in the made ground, and the Molo Santa Teresa, the southernmost, was to be opened by a wide scouring passage for the benefit of the Sacchetta. To this plan it was objected that the dangers of the Bora (north-easter) easter) would be increased, that all but the well-sheltered Sacchetta would be more exposed to the fury of the Libeccio (south-wester), and that a large portion of the basins fronting the town would be taken to make wharves.

VI.—The last of these twelve projects which requires notice proposed to build the new docks upon the Algiers-Marseilles model, north of the Lazzaretto basin, and half an hour distant from the city. This was simply to take the town out of town.

The Porto-Canale was a gigantic scheme worked out by MM. Rieter and Buzzi, the former a merchant, the latter a civil engineer; and it seems to have been the after-growth of the Suez Canal. It was described in two works "Verbindungs-Kanal der beiden Buchten Triest und Muggia," Trieste 1862, and "Dilucida-zioni sul Porto-Canale Rieter," by L. Dott. Buzzi, Trieste Coen 1863. The minute sections and plans published to illustrate this undertaking were highly praised by Sir Charles Hartley. This mighty salt-water sea-arm was to set out from the southern end of the Canal Grande; to cross the Piazza della Barriera Vecchia, about 60 ft. above sea-level; to

* This will appear with the plans of the "Talabot" scheme in the next number of the *Journal*.

cut through the ridge of San Giacomo, 174 ft. high; and to issue near Servola Point, after a total length of about a sea mile and a half. The breadth was to be 180ft., the depth of water 31 ft., containing some 216,842 cubic fathoms, and the sole to be sunk 37 ft. below sea-level. It was to be crossed by two "monumental" standing bridges, one 174 ft. high, and the other 67 ft.—evidently too low for safe transit—together with five swinging bridges, on the "Irving" principle. Fifteen transverse tunnels, sunk 28 ft. below the canal, or a total of 65 ft. (28+37) below sea-level, would enable the water and gas pipes to pass under it between city and suburb; and it would be aided by a tramway or tramways connecting the Rive Grumula and Servola, *viâ* Sant' Andrea.

This grandiose undertaking—whose expense was modestly fixed at 17,000,000 florins—looked forward to the day when the city shall contain 300,000 souls. It offered the advantages of a quay 84 ft. wide and 18,000 ft. long, and containing a water area of 38 acres (1,162,000 square feet), passing through the centre of the town. At the Muggia end, it would bring into use 30,000 "klafter" or fathoms (120,000 metres) of building ground, which might be expected to yield 3,000,000 of florins. This, I may note, was the object of Mr. Clark's tunnel, and of the present plan before alluded to.

On the other hand, malcontents declared that no borings had been made on the San Giacomo ridge to ascertain the proportions of clay and sandstone and the possible existence of harder rock; that the swinging bridges would cause delay, and the tugs would injure the banks; that the removal of 4,774,000 cubic metres above, and 1,187,000 below, sea-level—estimated to require 10,000 to 15,000 workmen for five years—must at least be doubled; that the expropriation of 250 houses, lodging 5,000 souls, and 80 acres of ground, inadequately laid down at 7,281,000 florins, would soon exceed 20,000,000 florins; and, finally, that the 17,000,000 florins of the estimate must be extended to 45,000,000 florins, thus greatly exceeding the Talabot project. In fact, the public voice declared the scheme to be commercially impracticable.

(To be continued.)

THE RESOURCES AND CONDITION OF ROUMANIA.

The kingdom of Roumania was formed by the union of the two principalities of Wallachia and Moldavia under a firman granted by the Sultan, June 12th, 1861, and was publicly promulgated at Bucharest and Jassy before the end of that year, the name of Roumania being given to the united provinces. Wallachia is divided into eighteen, and Moldavia into thirteen districts, each of which has a prefect or governor, a receiver-general of taxes, &c. The chief cities are Bucharest in Wallachia, and Jassy in Moldavia, but the former city has become the recognised capital of the Roumanian kingdom.

Considerable ignorance prevails as to the countries bordering on the Lower Danube. The Moldo-Wallachians, the Servians, and the Bulgarians are strangely jumbled together in the minds of the general British public; yet there exists as marked a difference between a Roumanian (Moldo-Wallachian) and a Servian, or Bulgarian, as between an Englishman and a Frenchman, or German. There is greater dissimilitude between the towns on the left bank of the river—Galatz, Ismail, Giurgevo, or Turnu-Severin—and those on the right bank—Silistria, Rustschuk, Nicopolis, or Widin—whether considered as to outward form of the buildings, or the character, language, and costume of the inhabitants, than between almost any neighbouring towns that could be mentioned. Ignorance seems to extend even to the geographical position of Bucharest. Consul-General Green mentions the circumstance of a writ of summons, issued by one of the inferior law courts of the British metropolis, directed to Bucharest "in the kingdom of Egypt"; and it is therefore not surprising that letters addressed to the Roumanian capital should sometimes travel to India in search of Bokhara. Of late years we are informed that Bucharest has made great progress as a centre of the commercial and banking transactions of the principalities. The loans contracted abroad and the government and municipal securities in circulation have been of great advantage to the capital in a business point of view. The habit of hoarding has been checked, and the local newspapers now find it necessary to quote regularly the value of the various securities which are extensively held in the country. An exchange has been established by the principal bankers and merchants to facilitate their operations. The "Bank of Roumania" was founded by English and French capitalists, in 1865, with a capital of one million sterling. The "Société Financière de Roumaine" is of recent formation, and besides there are a number of private bankers.

The finances of Roumania are generally considered to be in a satisfactory condition, inasmuch as the higher rates of interest paid upon the earlier loans have been reduced upon subsequent borrowings. A considerable portion of the revenue is absorbed by the army. This force is divided into four classes, namely the permanent army, with its reserves; the territorial army and its reserves; the militia; and the national guard in the towns, with the masses in the rural districts. The reigning Prince is the Commander-in-Chief; the Minister of War has the general administration. The permanent army consists of eight regiments of infantry, four battalions of riflemen, one battalion of pompiers of Jassy, two companies of foot gendarmes, and one company of discipline. The cavalry includes two regiments of hussars, one squadron of instruction, and five squadrons of horse gendarmes. The artillery consists of two regiments of seven batteries, one company of pontoniers, one company of armourers, and one section of transport service. The staff corps is formed of one battalion of four companies of engineers. The flotilla of two companies, and the administrative corps of one company of workmen, one company of hospital attendants, and one squadron of transport corps. The territorial army consists of eight regiments of infantry, called "Dorobanze," eight regiments of cavalry, called "Calarashi," and one battery of artillery for each of the thirty-three districts into which the principalities are divided. The conscription for the standing army and the territorial army takes place simultaneously, the smaller number drawn being taken for the permanent army; but those who are willing to find their own horses pass into the "calarashi," whatever number they may have drawn. The territorial is subject to be mobilised and concentrated for manœuvres or other service. The militia is composed of two classes. The first-class consists of all those from twenty-one to twenty-nine years of age who have not been drawn for the permanent or territorial armies; the second-class consists of all those from twenty-one to thirty-seven years of age who have served in either the permanent or territorial armies. They are exercised every Sunday in their own districts, and if called out for more than forty-eight hours are paid and fed on the same footing as the army, and are subject to the same discipline. The masses and national guard include all men of thirty-seven to forty-six years of age, are organised, and may be called out for garrison service in time of war, or to maintain order in time of peace when the troops are concentrated for manœuvres.

The first railway opened in Wallachia was that between Bucharest and Giurgevo, connecting the capital with the Danube. Its length is 42 English miles, with a single line of rails. It was opened on the 31st October, 1869, and is worked by the State. It has been extended about three miles down the river, to a point called Smûrda, where vessels lie when the waters are too low for them to reach Giurgevo. The next Roumanian line

pened was the extension of the Austrian "Lemberg-ernovitz" railway, from Cuceava to Roman, with two anches, and this was opened in 1870. The benefit con-rred on the country was immediately felt by the in-eased value of all agricultural produce in its neigh-ourhood. By this means Bucharest is in direct railway mmunication with the Danube at Guirgevo. Imme-ately opposite Giurgevo is Rustchuck, with its railway Varna. It is also in daily railway communication ith Western Europe by another line opened in 1872, d the English mails arrive in five days, *i.e.*, the London orning papers of Monday arrive at noon on the follow-g Saturday. Letters and newspapers passing through ance and Vienna at present travel less quickly owing postal agreements in Austria.

From the reports furnished by Vice-Consul St. John on the trade of Jassy, the chief city of Moldavia, e learn many interesting facts with regard to the past story and present condition of the people. Although thing very remarkable in its existing aspect, it affords culiar interest in the fact that few countries have ade such rapid progress in everything that makes up e civilisation of a people. Only a few years ago its habitants had to learn the very rudiments of civilisa-on. They were, to all intents and purposes, though ing in Europe, an Asiatic people in their habits and stoms, their immobility, and their secluded mode of e; but all this now belongs to the past. A total and dical change has been accomplished, and with such pidity that old men are still to be met with, though ey are fast dying out, who are fair representatives of e former state of things. The people of these princi-lities claim to be the descendants of a colony of mans, forested here by the Emperor Trajan; nce the name of "Roumania" which within the last w years has been introduced, and is now universally lopted by the natives as the name of the united incipalities. Nor do their pretensions seem to be together unfounded, if apart from the testimony of story, the language spoken by all classes may be taken evidence. Words of common use, such as *apa*, ater; *pane*, bread; *lemnu*, wood; *lapte*, milk; *albu*, hite; *negru*, black; and numberless others are almost re Latin; the conjugations also of the verbs, which are ur in number, exactly correspond to the four con-gations in Latin. From time immemorial this country s the battle-field of nations;—Scythians and Romans, ns and Bulgarians, Hungarians and Poles, and last of , Turks, to whom they were in the sixteenth century d to submit, in order that, having only one master, a p might be put to internal feuds, and a safeguard aced against foreign aggression. From that time the untry was governed by Hospodars, appointed by e Sultan, who were always strangers, and generally eeks, caring for little else but their own interests d pleasures, till at last, some forty years ago, a native yard or nobleman was created Hospodar. Under his vernment endeavours were made to found schools, nstruct roads, and to encourage foreign settlers. But the country subsequently possessed only a few schools, d these of very inferior order, the literature and nguage being too poor to form a proper vehicle of in-ruction, the wealthy classes had to send their children foreign countries to be educated, more especially to ance. During the last few years national schools, and *mnasia*, for the higher branches of instruction, have en founded in every town. They are conducted en-ely after the French model. The instruction at all e public schools is entirely free; there is also one iversity at Jassy, but the instruction there is confined law and literature. The country is purely agricul-ral. It exports large quantities of maize, wheat, and her cereals, besides cattle, hides, wool, bristles, and t. The staple food is Turkish maize, which is said to ow there better than in any other country. The mmon beverage is wine, which is produced in immense antities, but for want of care and skill in preparing it, very little, if any, is exported. The hills, surrounding Jassy on all sides, are covered with vineyards. The produce of the soil, although great, might be more than doubled, as scarcely one-half, which is almost every-where exceptionally good, is under cultivation. This is owing chiefly to the want of hands and capital. In order to secure labourers to take in the crops peasants must be engaged sometimes three years in advance, by which means a heavy burden is thrown on the landowners, and the peasants find themselves in a continual state of indebtedness. The estates, also, are nearly all heavily encumbered. Manure is scarcely ever used. Owing to the great want of labour the system adopted is to till only a small portion of land, and to leave the rest for some time to nature. Threshing, sowing, and other agricultural machines are being gradually introduced. The country can scarcely be said to have any industries, all it can boast of in this respect being a manufactory of very rough cloth, chiefly used for the army, one for soap, and one or two for rough paper. Lately another has been erected for finer paper used for printing purposes. The want of a more extensive industry is much felt, as in years of pastoral drought, which frequently happens, there is little to export in return for the immense quan-tities of articles of use and luxury imported. Another great drawback to the prosperity of this principality is the absence of a native middle-class. The higher ranks of society have only the law opened to them as a profes-sion. The lower ranks consist of servants and peasants; all other professions, trades, and commercial pursuits are almost entirely monopolised by Jews and a few foreigners. The richness of the soil, together with the vast forests and abundant minerals of every description to be found in the Carpathian mountains, have already engaged the attention of foreign speculators, as several schemes have been projected to purchase extensive estates by means of companies. There is no doubt that, if properly carried out, and the resources of the country fully developed, such an enterprise would turn out most profitable.

The reports of Consul-General Green are equally in-structive with regard to the resources of Wallachia. The chief city, Bucharest, is situated forty English miles due north of the town of Giurgevo on the Danube, in the vast Wallachian plain which extends south of the Car-pathians, from Turnu-Severin to the Sereth, Bucharest, or Bucuresci as it is called by the natives, became, in the union of Moldavia and Wallachia proclaimed by Prince Couza in 1861, the capital of Roumania as it had previously been for more than two centuries the capital of Wallachia. The plain between Giurgevo and Bucharest rises to a considerable height above the Danube, and on reaching Bucharest suddenly sinks, forming a hollow in which the city is placed, and through which the muddy stream Dimbovitza follows its tortuous course to join the Danube to the south-eastward. The city covers a space of more than twenty English square miles. Seen from the Giurgevo railway station on the heights of Filaret or from the hill on which the metropolitan church is built in the southern quarter of the town, the view is extremely picturesque, a charm principally derived from the quaint forms of the spires of the numerous churches, interspersed with a profusion of acacia, poplar, and other trees, which attest, except in the centre of the town, the abundance of spare room for building purposes. The population is estimated to be 221,000 souls, the increase of late years having been rapid and far greater than the progress made in building, by which house rent has risen exorbitantly, and will, no doubt, continue to do so. There is a marked division of classes among the inhabitants of the Roumanian capital. The Boyards remain as exclusive as ever. The military, judicial, and civil authorities, and the learned professions do not, as a rule, belong to this class, but form with the smaller landed proprietors a separate category, with few exceptions not amalgamating with the Boyards. Next come those engaged in mercantile pursuits, principally foreigners—Germans, Austrians, Greeks, Frenchmen,

and Swiss—who, again, keep very separate from each other. The artisans of the better class are principally Germans, Transylvanians, and some Frenchmen; those of inferior calling, Roumanians and Jews. The labouring population is Roumanian, Transylvanian, Bulgarian, and Gipsy, if the latter can be separated from the Roumanian. The Gipsies are also the professional musicians of the capital, as they are throughout the whole country, swarming in the taverns and coffee shops. The Jews, who, according to the late estimate, are said to number 247,424 in the two principalities, do not exceed 31,400 in Wallachia, of whom 15,000 are in Bucharest. The sanitary condition of the city, and, indeed, that of all Roumania, is far from satisfactory. The fever of the Lower Danube is virulent, pulmonary complaints, scrofula, and insanity prevail extensively. Diptheria in an epidemic form has been raging, especially among children, for several years, and if not checked must eventually depopulate the country.

THE SALE OF FOOD AND DRUGS ACT, 1875.

The following circular has been issued to the borough authorities by the Local Government Board:—

SIR,—I am directed by the Local Government Board to draw the attention of the Town Council to the Sale of Food and Drugs Act of the last session (38 and 32 Vic., c. 63), which will come into force on the 1st of October, 1875.

In accordance with the recommendation of the Select Committee of the House of Commons upon the Adulteration of Food and Drugs Act, 1872 (35 & 36 Vic., c. 74), the present statute repeals that Act, together with the Adulteration of Food and Drink Act, 1860 (23 & 24 Vic., c. 84), and the 24th section of the Sale of Poisons and Pharmacy Act, 1868 (31 & 32 Vic., c. 121), and, whilst re-enacting several of the provisions thus repealed, it has made many important amendments in the previous law.

The following statement shows the most material of these amendments:

APPOINTMENT OF ANALYSTS.

Express power is now given to the Local Government Board by section 10 to require, in the case of any future appointment of an analyst, satisfactory proof of his competency. They are, moreover, empowered to qualify their approval by such modifications with respect to the period of appointment and removal, or otherwise, as they may think proper. It must, however, be distinctly understood that these provisions do not in any way relieve the local authority from the responsibility of satisfying themselves that the person appointed by them is in every respect qualified to discharge with efficiency the duties of his office.

Another important amendment is that in future no analyst is to be appointed for any place in which he is engaged, either directly or indirectly, in any trade or business connected with the sale of food or drugs.

The Act of 1872 prescribed as the qualifications of an analyst that he should possess competent medical, chemical, and microscopical knowledge; but section 10 of the new Act requires that he should possess competent knowledge, skill, and experience.

The Act, however, in no way interferes with any existing appointment.

In consequence of the difficulty which had been experienced in obtaining the services of a competent analyst for small areas, section 11 empowers the Town Council of any borough to engage the services of the analyst for the county or any neighbouring borough, and the Board hope that the local authorities referred to will freely avail themselves of this new power. At the same time, they may remark that the facilities thus afforded by the Legislature to meet the difficulty referred to have removed any ground which may have previously existed for neglecting to comply with the requirement of the law.

DUTIES OF ANALYSTS.

Complaints have been made that when a long interval has been suffered to elapse between the taking of the sample and the making of the analysis, in the case of commodities liable to decomposition, a change has often taken place in the constitution of the article, which has rendered the analysis unreliable. These complaints are met by section 13, which requires that the analysis shall be made with all convenient speed; and it will be seen, by reference to the note to the form of certificate given in the schedule, that, as regards perishable articles, the analyst is to report specially whether or not any such change has taken place.

Under the repealed Acts the analyst was required to specify in the certificate whether, in his opinion, the article was adulterated, and in the case of articles of food and drink, whether they were so adulterated as to be injurious to the health of the consumer. In the present Act a form of certificate is prescribed, which requires him to state the parts or percentages of the foreign materials; but he will be at liberty to express therein his opinion as to the purpose for which the mixture was made, and also whether or not the ingredients are injurious to health.

The Act of 1872 required the analyst to make to the authority by whom he was appointed a quarterly report, showing the number of articles analysed, and the nature of the adulterations detected. Every such report must for the future specify the result of each analysis, and the sum paid in respect thereof, and must be presented at the next meeting of the authority. Certified copies of all such reports are to be annually transmitted by the authority to the Local Government Board. (See section 19).

PROCEEDINGS TO OBTAIN ANALYSIS.

Under the Act of 1872 the only officers who could be employed to obtain samples for analysis were inspectors of nuisances, inspectors of weights and measures, and inspectors of markets. Section 13 authorises the employment of medical officers of health and police constables for this purpose, in addition to the inspectors before referred to, and not only the authority appointing such officers, but any authority charged with the execution of the Act may direct them to procure samples.

Another important amendment will be observed in section 14, which requires the purchaser to notify to the seller, after the purchase has been completed, his intention to submit the article purchased for analysis, and to offer to divide it into three parts, each to be marked and sealed or fastened up. If such offer is accepted, he is to deliver one of such parts to the seller and one to the analyst, and to retain the third himself, for production in case of proceedings. If the offer is refused, the purchaser is to divide the article into two parts, retaining one himself, and delivering or sending the other to the analyst.

Hitherto it has been necessary for the officer of the local authority personally to deliver the sample to the analyst. This provision having entailed considerable expense and inconvenience, especially in cases where the analyst resided outside the district, it is provided by section 16 that if he does not reside within a distance of two miles of the residence of the person requiring the article to be analysed, the sample may be forwarded to him by post in a registered packet, subject to any regulations of the Postmaster-General. A copy of the regulations which the Postmaster-General has issued on the subject will be found at the end of this circular.

It has frequently happened that a trader has refused to allow a sample to be purchased when he has had a suspicion that it was required for analysis. Section 17 now imposes a penalty not exceeding £10 upon any trader refusing to sell, for analysis, samples in such

quantity as shall be reasonably requisite of any articles exposed for sale, if the officer tenders the price for the same.

Description of Offences.

In lieu of the somewhat complicated provisions of the previous Act as to the offences of adulterating articles with injurious ingredients, and of selling the same when so adulterated, the present Act (sec. 3) imposes a penalty of £50 for mixing, with intent to sell, any article of food with any ingredient so as to render the article injurious to health, or for selling any article so mixed, the offender being liable to be imprisoned for six months, with hard labour, for every second and subsequent offence.

Section 4 imposes similar penalties on any person who, except for the purpose of compounding in accordance with the demand of the purchaser, mixes, with intent to sell, any drug with any ingredient so as to affect injuriously its quality or potency, or who sells any drug so mixed.

By a further amendment (section 5) proof of guilty knowledge on the part of the defendant is not required from the prosecutor; but the defendant may show that he had no knowledge of the adulteration, and that he could not with reasonable diligence have obtained that knowledge.

The principal offence created by the Act of 1872 was that in relation to the ordinary retail sale of articles of food which had been adulterated, although not with injurious or poisonous ingredient; but, as there was no statutory definition of the term adulteration, there was a great want of uniformity in the administration of the law, and considerable hardships were in consequence inflicted upon some branches of the trading community.

It is obvious, moreover, that there may be other fraudulent practices which do not necessarily constitute adulteration, such as the substitution of one article for another, or the admixture of one article with another of the same kind, but of inferior quality. The term adulteration, therefore, is not used in the present Act; and in future it will constitute an offence to sell, to the prejudice of the purchaser, any article not of the nature, substance, and quality of that demanded. It will not, however, be an offence to add to food or drugs any matter or ingredient required for their production or preparation as articles of commerce in a state fit for carriage or consumption, provided that the addition does not fraudently increase the bulk, weight, or measure of the article, or conceal its inferior quality. Exceptions are also made in favour of proprietary medicines and patented articles; and the seller is also protected when the article is unavoidably mixed with extraneous matter in the process of collection or preparation.

Section 8 further amends the law, in the case of compound articles, by enabling the seller to protect himself against proceedings if, with the article, he delivers to the purchaser a label, distinctly and legibly written or printed, to the effect that the article is mixed. It is necessary, however, that the matter added should not be injurious to health, or intended fraudulently to increase the bulk, weight, or measure, or to conceal the inferior quality of the compounded article. The giving of a false label renders the person liable to a penalty of £20.

While these alterations have been made to meet the reasonable objections of traders as to the uncertainty of the law, it will be seen that section 9 constitutes a new offence, by providing that no person shall, with the intent that the same may be sold in its altered state without notice, abstract from any article of food any part of it, so as to affect injuriously its quality, substance, or nature; and no person shall sell any article so altered without making disclosure of the alteration, under a penalty not exceeding £20. This amendment will, for example, render the fraudulent abstraction of cream from milk an offence punishable summarily.

It will be observed that, with respect to tea, special provision is made by section 30, under which all imported tea will be subject to examination by persons appointed by the Commissioners of Customs; but, although this provision will doubtless operate as a protection both to the public and the trading community, it will not exempt any seller of tea from the proceedings to which he may be liable under the provisions beforementioned.

Before concluding this part of their circular, the Board are desirous of removing an erroneous impression which appears to prevail in certain localities, viz., that the special legal provisions made by the Licensing Act, 1872, with regard to the offence of adulterating beer, are still in force.

It is true that statute contained enactments on this subject, and a schedule of adulterants of beer was appended to it. Moreover, certain regulations framed with regard to the then state of the law, were then issued, under which the officers of the Commissioners of Inland Revenue and the police were in the habit of instituting prosecutions in cases where the percentage of salt and other substanes was considered excessive. The Act of 1872, however, together with the schedule, was repealed by the Licensing Act, 1874, with the express intention that proceedings for the offence of adulterating beer should thenceforward be placed on the same footing as those in respect of other articles.

Proceedings against Offenders.

An important amendment in the law will be found in section 21, which enables a defendant to tender himself and his wife to be examined on his behalf.

It will also be observed that the Justices or Court of Appeal may in their discretion, upon the request of either party, cause any article to be sent to the Commissioners of Inland Revenue to be analyzed by the chemical officers of that department at Somerset House, the expense of such analysis to be paid by the complainant or defendant, as the Justices may direct. It will also be competent for the defendant to require the analyst to be called as a witness, and the parts of the articles retained by the purchaser to be produced (section 21).

As it is important that great care should be observed in forwarding the samples to the Commissioners of Inland Revenue, and that the analysis should be effected with the greatest despatch consistent with accuracy, the Commisioners have prepared instructions for the guidance of the Clerks to the Justices in performing the new duty imposed upon them. A copy of these instructions is appended to this circular in order that they may be communicated to the Justices acting for the borough.

In connection with proceedings against offenders, the Board may further point out that it will be open to the defendant to prove that he is protected by any provision or exception contained in the Act with reference to compounded articles. He will be entitled to be discharged if he proves, to the satisfaction of the Justices or Court that he bought the article as the same in nature, substance, and quality as that demanded of him, and with a written warranty, that he had no reason to believe that the article was otherwise, and that he sold it in the same state as when he purchased it; but he will be liable to pay the costs of the prosecutor in such a case, unless he has given him due notice of his intention to rely on this defence.

Section 27 constitutes the forging of a warranty a misdemeanour punishable by imprisonment, and imposes a penalty of £20 for the misapplication of warranties and the giving of false warranties.

Section 28 enables a person in an action brought by him for breach of contract on the sale of any article of food or of any drug, to recover the penalty incurred by him, together with the costs in relation to the proceedings under the Act, if the article was sold to him as being of the nature, substance, and quality as that which was demanded of him, and he purchased it not knowing it to be otherwise.

APPLICATION OF PENALTIES.

Penalties recovered under the Act by the officers of a local authority who have appointed an analyst, or agreed to the acting of an analyst within their districts, are to be paid to them, and by them to such authority, to be applied towards the expenses of executing the Act.

The Board have thought it right not to confine their observations to those provisions of the Act which relate more immediately to the duties devolving upon the Court of Quarter Sessions; but in drawing attention to a statute of so much importance, they have adverted to the chief alterations in the law which affect the trading community and the public, and which may be summed up as follows:—

As regards the trading community, it protects the seller—

(1.) By permitting those practices in the established usage of trade with respect to the addition of harmless ingredients not intended fraudulently to increase the bulk or weight of the article, or to conceal its inferior quality, which clearly ought not to constitute an offence.

(2.) By enabling him to protect himself in the case of a mixed article, by affixing a label to it.

(3.) By giving him the right, when he has a written warranty, to plead the warranty as a defence.

(4.) By providing that, if convicted, he may, in an action against the wholesale vendor for breach of contract, recover the costs of his conviction, if he proves that that the article was sold to him as being of the same nature, substance, and quality as that demanded of him, that he purchased it not knowing it to be otherwise, and that he afterwards sold it in the same state.

(5.) By repuiring the purchaser, when he intends to have the article analysed, to divide the sample, and leave one part with the seller.

(6.) By providing, in the case of tea, that it shall be examined by officers of the Customs at the port of lading.

(7.) By enabling the seller and his wife to be examined as witnesses on his behalf.

(8.) By authorising the Justices, where the result of the analysis is questioned, to have the article referred for analysis to the laboratory at Somerset House.

As regards the public—

(1.) The former law only protected the public against adulterated or mixed articles; but the new Act protects the purchaser against the delivery of any article which differs in substance, nature, or quality, from the one demanded.

(2.) It punishes the seller who abstracts any part of an article so as to affect injuriously its quality.

(3.) It prevents the sale of articles, mixed with ingredients not in accordance with the demand of the purchaser without a label indicating that they are mixed.

(4.) It enables medical officers of health and police constables, in addition to the inspectors authorised by the former law, to obtain articles and submit them for analysis when directed to do so.

(5.) It assists the local authority of a small district in obtaining the services of an efficient analyst by empowering them to engage the analyst of another authority; and it enables a purchaser, in a district where there is no analyst, to obtain analyses from the analyst of another district.

(6.) It compels the trader to sell a sample for analysis on demand.

(7.) And, lastly, it renders the law more intelligible, and therefore more practicable, accessible, and certain.

It will be seen, therefore, that whilst some of the amendments which have been made afford to the trading community the reasonable protection to which they were justly entitled, others have rendered the law much more stringent and effectual in the interest of the public.—I am, Sir, your obedient servant,

JOHN LAMBERT, Secretary.

Regulations issued by the Postmaster-General for the transmission by post of samples by analysis:—

1. Each packet must be addressed according to the official designation of the analyst, as "Public Analyst," or otherwise, and the nature of its contents must be stated on the front of the packet.

2. Any postmaster at whose office a packet for a public analyst shall be tendered for registration, may refuse to accept it for this purpose unless it be packed in so secure a manner as to render it at least unlikely that its contents will escape, and injure the correspondence.

3. Liquids for analysis shall be contained in stout bottles or bladders, which shall be enclosed in strong wooden boxes with ronnded edges—the boxes being covered by stout wrappers of paper or cloth; and no such package shall exceed 8 inches in length, 4 inches in width, or 3 inches in depth.

4. No packet whatever addressed to a public analyst shall exceed the dimensions of 18 inches in length, [illegible] in width, or 6 inches in depth.

5. The postage and registration fee on each packet must of course be prepaid.

Regulations to be observed in transmitting articles for analysis to the Commissioners of Inland Revenue:—

1. The sample retained by the purchaser, as stated in sections 14 and 15 of the Act, should be carefully sealed up and secured either in paper or in a box, as the case may be.

2. The seal should be bear a motto or device not in common use, to enable its identity to be sworn to.

3. If sent through the post, the instructions issued by the Postmaster-General for the transmission of such samples should be carefully carried out, and the parcel should be addressed to

The Commissioners of Inland Revenue,
Inland Revenue Office, Somerset House,
London, W.C.

The Principal of the Laboratory.

And in addition to the nature of the contents being stated on the front of the packet, as enjoined by the Postmaster-General, the name of the place whence sent should be stated.

If dispatched by railway or other conveyance, the address above given, with the name of the place from which forwarded, will be sufficient.

4, At the time the parcel is dispatched by post or otherwise, a letter should be sent by post to the principal of the laboratory apprising him of the transmission of the sample for analysis, and stating the nature of the alleged adulteration, and such other particulars as may be considered necessary to facilitate the examination of the sample.

Arm. Bertrand has succeeded in producing a galvanic deposit of bismuth on the surfaces of other metals. He uses a double chloride of bismuth and [illegible]. The operation is performed cold, with a solution containing [illegible] 35 gr. of chloride per litre. A single Bunsen pile should be used. On coming out the objects are coated with a [illegible] looking slime, beneath which the sheen of the bismuth can be detected. The latter adheres very closely to the subjacent metal, and takes a fine polish, the colour being [illegible] betwixt antimony and old silver.

The Dutch Chambers, before adjourning, voted a credit of £800 for making new soundings in the [illegible]. The object of the operation is, before commencing with the drying the bed, to discover the quality of the ground at the bottom. The soundings previously taken, at depths of [illegible] 3 ft. 3 in., and 5 ft., showed that the bottom of the [illegible] portion is composed of four-fifth argillaceous [illegible] fifth sand. At present the sea, with the shoals of the [illegible] Zee, has an extent of 535,000 hectares ([illegible] acres [illegible]

The French committee of the permanent colonial exhibitions has had before them a method of giving a commercial value to serpent skins by tanning and preparing them for the morocco leather manufacture.

SCIENCE AND ART AT MIDDLESBOROUGH.

On Wednesday, 8th October, the Chancellor of the Exchequer had the opportunity, on the river Tees, of inspecting those works of river improvement which are the effect of the vast trade the centre of which is now in Middlesborough, and on Thursday he took part in the steps that are in progress to supply one of the scientifically educational institutions of the town with a local habitation. Coming down from the hall of Mr. Bolckow, his host, Sir Stafford Northcote had ample evidence that that growth is unchecked, for villas, churches, chapels, and other less ornate buildings are studding fast the fields over which the agriculturist held sway. Middlesborough early availed itself of the benefits of the Free Libraries Act. The Cleveland Literary and Philosophical Society, the foundation stone of the new hall of which the Chancellor laid, was established in 1863 to cultivate an interest in and taste for literature, science, and art. It has formed an extensive library of branches of advanced literature, has yearly a course of lectures by men eminent in science and literature, as well as on subjects of local interest. The building will contain a hall, with galleries for a museum, reading-room, and library, and other subsidiary rooms. It will be in the Gothic style, and its total cost will be about £4,000. The President of the Society is Mr. John Gyers, and Mr. Thomas Teasdale is the Hon. Secretary. The architect for the new buildings is Mr. W. H. Blessley.

There was a large and fashionable company, and the President of the Society having introduced the Chancellor of the Exchequer, and the secretary having read a statement of the aims of the Society and the mode it adopted to carry them out, the architect, on behalf of the committee, presented to the Chancellor a trowel and mallet, with which the stone was duly laid.

The Chancellor of the Exchequer said he had had great satisfaction in performing a task which the committee had kindly imposed on him, and he hoped that he might in the future see the progress of the work now begun. He had received such hospitality in the town that he looked forward with great pleasure to a future visit to Middlesborough. "I have indeed," he said, "several objects to look after. I have laid two foundation-stones upon which I should wish to see the superstructure raised, and this morning I had on my way here the privilege also of planting a little tree in your beautiful park, the progress of the growth of which I may be able to watch and delight in. I could not help thinking, when our excellent friend Mr. Bolckow introduced me to that beautiful park, for which you are so highly indebted to him—and when he asked me to commemorate my visit by planting a tree—of the very good advice given by one of our greatest writers, whose works no doubt are to be found in your own library—Sir Walter Scott—which he puts into the mouth of one of his characters, a laird: "Keep aye sticking in a tree, Jock, it will be growing while you are sleeping." I felt that that was true enough of the tree; but let me say in regard to this institute, that this is an institute which if you wish it to grow you must not allow yourselves to sleep over. It is always gratifying to see that where material prosperity is found, causing the advance of a great population, there are those who attend to higher than material interests, and assuredly great lessons have of late years been given by those who have addressed themselves to the cause of education in England, and especially that great man, whose honoured name—Prince Albert—the park bears. Those who have so striven have reaped and are reaping their reward in the progress of education throughout England. Everywhere we see those institutions arising. I know no part where they have taken so deep a root as in the great county of York. I call it a good omen that on this morning on which I have laid the foundation-stone of this local institution, I have also had the privilege of reading in your newspapers an account of a great meeting held yesterday in another part of the county to celebrate the inauguration of the Great Yorkshire College of Science. In all directions the progress of science and literature is of great interest to the people, and in no part more so than in those great centres of commercial and manufacturing industry. I am interested to hear your secretary's account of the institution, and pleased to find that it was a building to be erected which the institute had itself created need for by its own development." Thus they had already got the people, and they were giving them the building, and he did not doubt that they would use that building well and fill it to overflowing. Exaggerated ideas had once been entertained as to the advantages and work of these institutions. He hoped they had out-lived these, and that though they had learnt their true importance and felt it to be as great as was anticipated by the originators, yet they believed it was not precisely in the way it was originally supposed they would operate. They must look for their beneficial effects in the library, lecture-room, and museum. Of the advantages of the library it was unnecessary to say anything. They knew that the course of education had tended to create a taste for reading among the people, and how difficult it was for the well-educated man, occupied by commercial pursuits, to satisfy the craving their early education might have awakened. It was difficult to find books, and time and place to read them. The establishment of a library was the great step to overcome that difficulty. Lecture rooms he well knew the value of, in awakening an interest and directing research. Education could not be given by them alone. Men could not live on lectures alone. What was wanted was that those who listened to them should endeavour to profit by them, and take them as the key-notes to studies which they were to pursue. He was glad to see that they proposed to have a museum. He thought that was a mode in which the State ought to render assistance. They had done a great deal in London in the way of founding a central museum and schools of art at South Kensington, under the auspices of that great man, the late Prince Consort; but much more was wanted in the direction of awakening interest in museums in the country. He had been interested in this movement since 1851, and he trusted that the time would come when they would be able to organise a system by which it would be possible for them to render help from the great central museum in London to the local museums that were springing up, and he should take great interest in the welfare of that museum which they were founding. (This view was received with loud cheers). He could only say that he wished them all success in the great work they were undertaking, a work which he believed would not be allowed to decay from any fault of theirs.

Mr. W. R. J. Hopkins then proposed, and **Mr. Dodd, M.P.**, seconded, a vote of thanks to Sir Stafford Northcote for his presence and aid, which was carried with cheers.

Again the Society may see fruits of its work. A chancellor declares a local museum "was a mode in which the State ought to render assistance." This is an object for which the Society has been working for years.

The old "John Bull," the first locomotive ever run on the Camden and Amboy-road, which has been laid up at the Borden-town shops for many years, is being put in running order again and will be sent to the Centennial next year. It was built by Robert Stephenson over 40 years ago, has 12 in. by 20 in. cylinders, one pair 4½ feet drivers, and weighs about 12 tons.

A new material for tanning sails without colouring them has lately been introduced. The chief object of the process is to enable yacht sails to be tanned by some other than the unsightly red tan process. The inventors are Messrs. Astbury, of Manchester.

There are now 500 miles of railway in course of construction in New Zealand, while 360 miles more are authorised.

SANITARY ART.—CHEAP AND IMPROVED MEANS OF PERSONAL ABLUTION.

One of the functions intended to be exercised by the first General Board of Health was the collecting and communicating to each local authority, for its guidance, information as to all tried and well-assured means of improvement that have arisen within the whole field of service or beyond it. Hence, minutes of information, carefully collected, on the improved means of drainage of lands and houses, and on the application of sewage to agricultural production, were circulated for the use of the Local Boards. But the exercise of these functions has fallen through, or the existing authority is not, at present, in a condition to continue them. Unless, however, it can be enabled to resume them, some other arrangement for the purpose is extremely desirable, and indeed necessary, for local progress. The following is an example of an improvement in detail, of great value, for use not only in prisons, but in children's asylums and schools, and large workshops, and indeed in private houses, for effecting complete personal ablutions with a greatly reduced time, consumption of water, and expense. The superiority of the method of washing by a running stream of tepid or warm water to the method of washing over and over again in the dirty water of the bath need not be pointed out. For the quick and agreeable ablutions of individuals, the method has long been used in Turkish baths and water-cure establishments.

EDWIN CHADWICK.

East Sheen, Mortlake.

NOTES ON THE SYSTEM OF ABLUTIONS ADAPTED TO THE USE OF THE PRISON OF ROUEN, BY DR. MERRY DELABOST. FROM THE "ANNALES D'HYGIENE."

"Ably managed as it is by M. H. Salles, director of the prisons of the Seine-Inferieure, the expense of the novel system of baths do not exceed 1,200 francs. The arrangements are as follows:—

"A tower with a steam engine on the ground-floor and two large reservoirs of cold water on the top story, at a height of about fourteen yards. On the lower story there is a reservoir capable of containing 1,200 litres, which is used for warm water; a pipe introduced into the middle allowed the steam to circulate and thereby raise the water to the temperature desired. Pipes from the hot and cold water reservoirs enter the chamber about to be described, and provide for either hot or cold douches.

"There are three adjoining rooms devoted to this purpose, and warmed by steam during the cold weather. The first serves as a waiting-room, the second as a dressing-room, the third and largest contains six compartments, separated only by wooden partitions. Above each one is a hose fixed to a bent pipe, which is connected with a common conduit, at which the flow is regulated by cocks. The floor, which is cemented, is slightly inclined, so as to allow the water to flow away into a gutter which carries it off, and the ceiling is perforated so as to allow the steam to escape.

"Six prisoners at a time enter the room, one in each compartment. Their towels are laid on the hot water pipes; the prisoner, who is chosen as "doucheur" turns the tap, and the douche descends on their bodies for about half a minute, when the water is stopped again. Then time is allowed for each man to soap himself, then another douche, and so on for four or five times in the space of five minutes. Each man then takes his warmed towel and returns to dry and dress himself in the next room, and their places are taken by six more. In the course of two days the whole population, consisting of from 900 to 1,200 prisoners, passes under the douche. Each day all who enter or leave the prison are washed in this way. The convicts are washed once a month in winter, twice a month in summer. About 40 pints per head suffices, instead of 400 to 600, which would be required for an ordinary bath.

"With some modifications, this system could easily be applied everywhere. In every prison there is a furnace for heating the water of the baths. Let this stove be placed on the first story, and (either by the arms of the prisoners or by steam) let the water be pumped up to the desired height, whence it can be distributed to the different taps in the intermediate room devoted to the washing.

"It is hardly necessary to dwell on the economy of time, of water, of fuel, and of expense effected by this method. Forty pints are sufficient instead of the old the water of ten baths cleans one hundred people more efficiently than the ten persons would be cleaned in the ten baths. This system might be equally well applied in the case of soldiers, who are certainly deserving of as much care and attention as prisoners; and it might also be recommended to the attention of municipalities, for the benefit of workmen, whose health would be much improved if they could refresh and clean themselves at the end of the day by a douche bath, involving such a small outlay of time or of expense."

SHIPMENTS OF GOODS TO THE CENTENNIAL EXHIBITION.

The following circular to exhibitors has been issued by Mr. D. Torrey, Chief of the Bureau of Transportation:—

(1) *Reception of Articles.*—The general reception of articles at the Exhibition buildings will commence January 5, 1876, and close on April 19, 1876. Machinery and other heavy articles will be admitted as soon as the special foundations for them are prepared, and it is desirable that they should be in place prior to the reception of other exhibits.

(2) *Boxing.*—In boxing goods for the Exhibition, screws should be used instead of nails.

(3) *Shipping Directions.*—Each package must be marked, "To the Director General, International Exhibition of 1876, at Philadelphia," and should be marked on two adjoining sides, giving the following information:—Name of the exhibitor; siding at which to be unloaded; specific location allotted to the exhibitor, weight of the package; total number of packages sent by the exhibitor; serial number of the particular package. Within each package should be a list of articles and a copy of the outside directions. Unless this information is on the package, it will be withheld from delivery, at the expense of the exhibitor until obtained.

NOTE.—*Sidings and Platforms.*—To facilitate the delivery of packages so marked there have been constructed within the Exhibition grounds several lines of railway. At convenient points on these lines are located sidings and platforms for the delivery of articles to be exhibited in the immediate vicinity. Each siding is designated by a number, and the address label or tag on each article or package must give the number of the siding at which it is to be delivered. The address label should also state the location in the building in which the article is to be exhibited, in accordance with the system for designating localities, as follows:—

Location.—Each column within the building will be lettered and numbered; the letters designating the lines of columns lengthwise, from east to west, and the numbers the lines crosswise, from north to south. Each exhibitor will have his location defined with reference to the nearest column, and the official directory of the building will give the positions according to the system.

(4) *Arrangements with Transportation Companies.*—The exceptional arrangements made by the United States Centennial Commission with transportation companies do not in any way affect the regular rules of such companies in regard to the classification of goods, or the conditions of receiving or transporting the same, except in requiring the prepayment of freight and other charges.

e rates for transporting goods for the Exhibition will obtained from the agents of the transportation comnies at the place of shipments, and not at Philaphia.

(5) *Through Bills of Lading and Advice for Shipments de.*—Through bills of lading should be obtained, so t goods will, without any attention by the shipper, be t direct to the Exhibition, and letters of advice should addressed at the time of shipment to the Chief of the reau of Transportation, giving information of the ipments made and full particulars in regard to articles bulky dimensions or excessive weight. Packages ould contain only articles intended for a single departnt.

(6) *Terminal Services.*—The transportation, receiving, packing, arranging, re-packing, and re-shipping of goods exhibited, also the storage and repair of empty es, will be at the expense of the exhibitor. Foreign mmissions, or such agents as they may designate, will responsible for the receiving, unpacking, and arrangent of exhibits from their respective countries, as well for their removal at the close of the Exhibition; and person will be permitted to act as such agent until can give to the Director-General written evidence of approval of his appointment by the proper Commisn.

(7) *Terminal Charge.*—To secure order and dispatch the reception and installation of goods in the Exhibin, all packages, on arrival at the Exhibition inclosure, ll be received by the Chief of the Bureau of Transrtation. They will then be unloaded and placed on space allotted to the exhibitor, the empty cases will stored, and at the close of the Exhibition they will be urned, and when re-packed will be removed from the ldings. For this service, which the United States ntennial Commission will undertake as agent for hibitors, and especially for their accommodation, a minal charge will be made.

NOTE.—*Provision for Performing Terminal Service.*—e regulation providing a terminal charge to meet tain specific expenses, for which exhibitors will be ble, will establish system and organisation in the retion and delivery of goods at the Exhibition. The penses of this terminal work include the construction railroad trucks, freight platforms, storing sheds, air shops, cranes, derricks, trucks, telegraph lines, , &c., and the service of a large organised force ich, to secure efficiency and prevent confusion, will under the direction of the Commission.

(8) *Pre-payment of Freight and Charges.*—All charges freights, transfers, &c., and terminal expenses, must repaid at the time of shipment, or be assumed by the nsportation company delivering the goods. The ited States Centennial Commission will not be rensible for any such charges, nor will exhibits be eived unless this regulation be complied with.

(9) *Rates and Terminal Charges.*—The terminal charges ll be as follows:—On articles or packages weighing 0 lbs., or less, 1 dollar each; on articles or packages ighing from 250 lbs. to 5,000 lbs., 40 cents. per 100 lbs.; articles or packages weighing over 5,000 lbs., 50 cents. r 100 lbs. Articles weighing over 10,000 lbs., fragile icles, plate glass, &c., and works of art, may be subt to an additional charge after arrival at the exhibin, to cover the extra cost of handling.

(10) *Customs Regulations.*—The customs regulations, ued by the Secretary of the Treasury of the United tes, permit the immediate transportation to Philaphia of goods imported from foreign countries. They l be transported by bonded line from the port of ival to Philadelphia, and delivered to the collector at t city. The customs regulations for these goods must strictly complied with.

(11) *Neglected Packages.*—If no authorised person is at nd to open and arrange the goods in the Exhibition lding, they will be removed and stored at the cost and k of whomsoever it may concern.

(12) *Removal of Goods.*—The Exhibition will close on the 10th of November, 1876. The removal of goods will not be permitted prior to that date, and must be completed before the 31st of December, 1876. Goods then remaining will be removed by the Director-General and sold for expenses, or otherwise disposed of under the direction of the United States Centennial Commission.

The Centennial Commission reserves the right to explain or amend these regulations, whenever it may be deemed necessary for the interests of the Exhibition.

A. T. GOSHORN, Director-General.

D. TORREY, Chief of Bureau of Transportation.

Philadelphia, Sept. 11, 1875.

SALICYLIC ACID.

Salicylic acid (to which much attention has lately been drawn), originally a product obtained in the laboratory in small quantities from the plant called Wintergreen (*Gaultheria procumbens*), is now being produced from carbolic acid on a commercial scale on the Continent by the process of Professor Kolbe, of Leipzic, and is thus described in his letters patent, dated April, 1874:—Carbolic acid is heated with the solid hydrated oxide of sodium in a closed iron retort (the temperature being maintained at about 183° C., till the water, and the excess of carbolic acid, have passed over into a receiver), dry carbonic gas being passed into the contents of the retort in a continuous stream. The temperature is finally made to exceed 200° C.; the mass becomes solid, and the operation is terminated when but little residual carbolic acid distils over. The contents of the retort after the above operation (consisting of salicylate of soda together with some free carbolic acid), are dissolved in water, and by the addition of hydrochloric acid to the solution in slight excess, the salicylic acid is precipitated; it is then washed and thus purified from all traces of the hydrochloric acid.

The salicylic acid thus produced is a yellowish white powder, devoid of smell, fusing, when pure, at 158° C., sparingly soluble in cold water, but readily soluble in boiling water. Its chemical composition is—

$$\underset{\text{Salicylic Acid.}}{C_7H_6O_3} = \underset{\text{Carbolic Acid.}}{C_6H_6O} + \underset{\text{Carbonic Acid.}}{CO_2};$$

or, in other words, one equivalent of carbolic acid + one equivalent of carbonic acid. It may be sublimed unaltered, but when heated strongly with powdered glass or sand in a retort, it is resolved into carbolic and carbonic acids. It possesses antiseptic properties, though in a less degree than carbolic acid. As a general disinfectant, it cannot become a rival to carbolic acid, owing to its lesser antiseptic power (which repeated experiments have shown), and its higher price, this latter being entirely dependent on the cost of the carbolic acid from which it is manufactured. It is, however, being now employed in some of the German hospitals instead of carbolic acid for the "antiseptic treatment," but in the opinion of Professor Lister, of Edinburgh, the originator of this treatment, who has lately visited these hospitals, carbolic acid is more reliable in its results. According to the *Hospital Gazette* of July 31st, Mr. Callender, of St. Bartholomew's Hospital, London, after some months trial of salicylic acid, finds it gives less satisfactory results than carbolic acid, and has abandoned its use in favour of the latter.

For internal administration it has as yet been little employed, and there is reason to suppose that in this respect it will prove inferior to carbolic acid, which can be and is manufactured of extreme purity.

The aqueous solutions of the salts of salicylic acid possess no antiseptic properties.

The Mercers' Company have issued their announcement for the Gresham Lectures. Those on Law, Physic, Divinity, and Geometry will be delivered in English and Latin; those on Astronomy, Rhetoric, and Music, in English only.

ECONOMY IN FUEL.

A process for economising fuel is stated to have been carried out with considerable success for some time past in Denmark. The arrangement consists of a combination of coke ovens and gas retorts so constructed that the heat generated in the coke ovens during the coking process of the coal is in part utilised for producing a crude lighting gas in the retorts, which gas is then conducted through suitable flues to the furnace, where it meets the remaining heat and gases from the coke ovens, and a sufficiency of air to produce perfect combustion. As the waste heat, crude gas and air are under perfect control, a uniform heat can always be maintained, a very essential point in all manufactures.

The inventors, Messrs. Erichsen and Maardt, have applied this system of economising fuel to the evaporating pans at their salt works at Copenhagen, with reported beneficial results, the salt turned out being of the finest quality.

It is stated the coke produced is of a very superior description, and that its value fully covers the total cost of the coal, so that the heat used for evaporating or for other industrial purposes is in reality costless.

These furnaces are applicable to various manufactures, and have, it is said, already been most successfully adopted in Denmark and Sweden for lime burning. The kilns are built vertical, the coke ovens with their retorts being grouped around the base of the kiln, the gases from which produce a most intense combustion; the limestone is shot in as required at the top of the kiln, and on its becoming converted into lime gradually drawn out at the bottom, thus yielding a continuous delivery of clean burnt lime without any loss of time or waste of heat in charging the kilns or drawing the lime. In Bohemia these furnaces are being erected for the manufacture of iron.

Patents have been taken out in this country as well as on the Continent, and in America, for this invention.

OBITUARY.

Sir Charles Wheatstone, K.C.B.—The death of this eminent man of science took place at Paris, on Monday, the 19th inst., in the 73rd year of his age, he having been born at Gloucester in 1802. It is of course for his connection with the practical introduction of the electric telegraph that his name will always be known. The exact share of merit due to him will certainly never be precisely defined, nor perhaps is there any need to rake up in these pages the ashes of a dead controversy. Suffice it to say that among the many names which must be associated with the birth of the telegraph his will always take a foremost place. Like all great inventions, the telegraph was the offspring of no single mind. Ronalds, who with frictional electricity succeeded in sending signals through a considerable length of wire, and whose appeal to the Admiralty elicited the now historical answer that, "Telegraphs of any kind are now wholly unnecessary, and no other than the one now in use will be adopted" (1816); Oersted, whose discoveries in magnetism and galvanism provided a practical means of communicating electrical signals; Baron Schilling; Steinheil, whose experimental telegraph first drew Mr. (now Sir) W. Fothergill Cooke's attention to the subject: Fothergill Cooke himself; Morse, who was working by a different route to the same end;—all these and many others must be joined with Wheatstone, nor is the honour to each individual the less because it is shared amongst the rest. The labours of Sir Charles Wheatstone met with deserved recognition at the hands of the Government and of the scientific bodies of England and the Continent. Among other acknowledgments of the services he had rendered, the Albert Medal of this Society was awarded "to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in recognition of their joint labours in establishing the first electric telegraph." The medal thus jointly awarded was, however, declined by Sir Charles Wheatstone.

GENERAL NOTES.

The Germon Cotton Trade.—The *Allgemeine* [illegible] contains a series of official statistics which indicate the [illegible] growth of the cotton manufacturing industry in Germany. In the period 1836-40 the average annual imports of cotton amounted to 233,749 cwt., and the exports to 47,778 cwt., leaving 185,971 cwt. for home consumption. For [illegible] the averages were:—Imports, 784,343 cwt.; exports, [illegible] cwt.; consumption, 561,106 cwt.; the quantities having steadily increased during the intervening periods. During 1861-65, the American war period, the average imports were 1,270,410 cwt.; exports, 294,759 cwt.; consumption, [illegible] cwt.; during 1866-70, imports, 2,024,052 cwt.; exports, 621,549 cwt.; consumption, 1,402,513 cwt.; and during 1871-74, imports, 3,362,958 cwt.; exports, [illegible] cwt.; consumption, 2,444,415 cwt. The figures for the last period of course include the important consumption in the Alsatian spinning mills. The cotton exported was sent chiefly to Russia, Switzerland, and Austria; small quantities were also sent to Bremen, France, and the Netherlands. Deducting 20 per cent. for waste and for use in other ways from the figures showing the total consumption of cotton, the average quantity of yarn produced per year would be—[illegible] 148,757 cwt.; 1851-55, 448,885 cwt.; 1861-65, [illegible] cwt.; 1866-70, 1,122,010 cwt.; 1871-74, 1,955,532 cwt. The average imports of twist were:—1836-40, [illegible] cwt.; 1851-55, 497,747 cwt.; 1861-65, 241,178 cwt.; [illegible] 285,614 cwt.; 1871-74, 406,650 cwt. Until [illegible] there was a steady increase in the quantity of yarn imported, but after that year a decline began, notwithstanding the fact that the import duty was reduced from three thalers to two thalers per cwt. The average for 1871-74 shows a revival of the yarn import trade, but the figures for 1874 show a decline from this average, and are much below the [illegible] average (1856-60, 518,573 cwt.) being 387,[illegible] cwt.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Farmers' Club, Salisbury-square, E.C., [illegible] p.m. Dr. Voelcker, "Root Crops, as affected by Soil, [illegible] and Climate."

Royal Institution, Albemarle-street, W., 2 p.m. [illegible] Monthly Meeting.

Society of Engineers, 6, Westminster-chambers, [illegible] p.m. Mr. Hamilton W. Pendred, "Screw Propellers, [illegible] Shafts and Fittings."

Medical, 11, Chandos-street, W., 8 p.m.

Wed. ...Geological, Burlington House, W., 8 p.m. 1. Mr. Henry Woodward, "Some new Macrurous Crustacea from the Kimmeridge Clay of the Subwealden [illegible] and from Boulogne-sur-Mer." 2. Mr. Henry Woodward, "A new Fossil Crab, from the Tertiary of New Zealand." 3. Mr. Henry Woodward, "The discovery of a Fossil Scorpion in the English Coal-measures." 4. Mr. Henry Woodward, "A remarkable Fossil [illegible] Insect, from the Coal-measures of [illegible]." 5. Mr. Thomas Belt, "The Drift of Devon and Cornwall, its Origin, correlative with that of the South Coast of England, and Place in the Glacial Series."

Thurs...Linnean, Burlington House, W., 8 p.m. 1. Sir John Lubbock, "Bees, Wasps, &c. (Part 3)." 2. Professor Oliver, "Plants collected by Lieutenant Cameron [illegible] Lake Tanganyika." 3. Professor Oliver, "A Collection of Celebes Plants, made by M. [illegible]." 4. [illegible] W. Dennett, "The Rate of Growth of the [illegible] Flower Stalk of *Vallisneria Spiralis*." 5. Mr. [illegible] "Polynesian Ferns gathered during the [illegible] Expedition." 6. Mr. H. N. Moseley, "[illegible] at the Admiralty Islands."

Chemical, Burlington House, W., 8 p.m. 1. Dr. C. H. Beckett and Dr. C. R. A. Wright, "[illegible] and their Derivations (Part V.), and the Alkaloids contained in the Aconites (Part I.)." 2. Mr. [illegible] Page, "A simple Form of Gas Regulator [illegible] ing a Constant Temperature in Air-baths, Water-baths, Incubators, &c." 3. Mr. R. W. [illegible] "The Fluorides of Arsenic, Phosphorus, and [illegible]." 4. Mr. Thomas Carnelly, "Iolyl-phenyl, a New [illegible] carbon." 5. Mr. T. M. Morgan, "[illegible] Acetylene." 6. Mr. W. N. Hartley, "The [illegible] Liquid Carbon Dioxide in Quartz Cavities."

OURNAL OF THE SOCIETY OF ARTS.

No. 1,198. Vol. XXIII.

FRIDAY, NOVEMBER 5, 1875.

ll communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NOTICE TO MEMBERS.

The 122nd session of the Society will commence n Wednesday, November 17th, when the opening ddress will be delivered by Lord Alfred Churchill, Chairman of the Council.

Candidates proposed for election as members are rivileged to attend on this occasion.

Evening Meetings of the Society will be held on he following dates, subject to any alterations which may be found necessary:—

Ordinary Meetings.

The following arrangements for the Wednesday evenings before Christmas have been made:—

November 17.—Opening Address by Lord Alfred S. Churchill, *Chairman of the Council.*

November 24.—"On the Registration of Trade Marks," by H. T. Wood, Esq., B.A. On this evening A. J. Mundella, Esq., M.P., will preside.

December 1.—"On the Legislative Enactments requisite for safe Conduct of Sewage Grounds," by Alfred Smee, Esq., F.R.S. On this evening Henry Letheby, Esq., M.A., M.D., will preside.

December 8.—"On the Mode of Levying the Sugar Duties in France, and its Influence on the Sugar Industries of Great Britain," by Professor Leone Levi, F.S.S., &c.

December 15.—"Health, Comfort, and Cleanliness in the House," by Thomas Blashill, Esq., A.R.I.B.A.

December 22.—"On a method of producing Pure Charcoal Steel directly from the Ore," by Henry Larkin, Esq.

Cantor Lectures.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows:—

First course by Dr. Thudichum, "On the Discoveries and Philosophy of Liebig—with special reference to their influence upon the advancement of Arts, Manufactures, and Commerce."

	CANTOR LECTURES.				AFRICAN MEETINGS.				ORDINARY MEETINGS.					INDIAN MEETINGS.				CHEMICAL MEETINGS.				SPECIAL LECTURES.			
	Mondays.				Tuesdays.				Wednesdays.					Fridays.											
1875.																									
November	—	—	22	29	—	—	—	—	—	—	17	24	—	—	—	—	—	—	—	—	—	—	—	—	—
December..	6	13	20	—	—	—	—	—	1	8	15	22	—	—	—	—	—	—	—	—	—	3	10	17	—
1876.																									
January ..	—	17	24	31	—	—	—	25	—	—	19	26	—	—	—	—	—	—	—	—	—	—	—	21	28
February..	7	14	21	—	—	—	15	—	2	9	16	23	—	—	—	18	—	—	11	—	25	4	—	—	—
March....	6	—	20	27	—	14	—	28	1	8	15	22	29	3	—	—	24	—	17	—	31	—	—	—	—
April	3	—	—	24	—	—	18	—	5	—	19	26	—	7	—	—	28	—	—	21	—	—	—	—	—
May......	1	—	—	—	—	9	—	—	3	10	17	24	31	—	—	19	—	—	—	12	—	—	—	—	—

Second course by W. Mattieu Williams, Esq., "On Steel Manufacture."

Third course by George Jarmain, Esq., "On Wool Dyeing."

The second and third courses have been arranged with special reference to the Society's Technological Examinations.

African Section.

Meetings of this Section will be held on Tuesday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

Chemical Section.

Meetings of this Section will be held on Friday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

Indian Section.

Meeting of this Section will be held on Friday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

Juvenile Lectures.

During the Christmas vacation, Lectures will be delivered, specially suited to a juvenile audience. Particulars will be announced in the *Journal.*

Special Lectures.

A series of reports has been prepared by Dr. Richardson, appointed by the Council to make special inquiry into the subject of "Unhealthy Trades." These will be delivered in the form of Lectures on Friday evenings in December, January, and February.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

A book of tickets for the admission of friends to the Ordinary Meetings is sent to each member with this *Journal.* Tickets for the Sectional Meetings and Cantor Lectures will be delivered with the *Journal* in due course.

Members are admitted on signing their names.

MISCELLANEOUS.

THE PORT OF TRIESTE, ANCIENT AND MODERN.

By Captain R. Burton, Her Majesty's Consul at Trieste.

(*Continued from page* 986.)

I now approach the plan which is actually being carried out. It may be called a dependency of the Südbahn, the "Great Southern," connecting Trieste with Vienna. This line was begun by the Austrian Government, under the late Baron de Bruck, Minister of Finance. Circumstances compelled the Empire, on April 23, 1858, to sell it shortly after it was opened (June, 1857), to a mixed private company, French and Austrian. The General Direction was and still is at Paris; the Vienna Branch Board of Administration consists of eight members, the most conspicuous of whom is the Rothschild house, by far the most powerful subjects of the Austrian Crown, and the president was the late Baron A. S. de Rothschild.

It is not within the scope of this paper to show the injury done to Trieste, and, through her, to all Istria, by this powerful monopoly of transit between chief port and capital. Suffice it to say that it is an *imperium in imperio*, a financial despotism in a constitutional land. For instance, on April 13, 1867, the Südbahn renounced its right of being the only line of communication until December 31, 1873; after which it would enjoy the monopoly for 99 years. At the end of that period (1867), the proposed rival lines of Trieste-Laak and Trieste-Predil had contended against each other till neither could obtain a concession, and the company might have insisted upon claiming its century of career without concurrence, but an arrangement was entered into deferring the evil day for a few years. Those familiar with local politics cannot fail to see how the affair will end.

The first steps towards providing Trieste with the new harbour, which is still being constructed, began in 1861, under the Stadthalter (Governor) Baron von Burger. The Südbahn had, I have said, become the property of a company: it proposed to extend its operations, and supported by His Excellency Count F. Zichy, and the Vice-President of the Central Maritime Government, Chevalier (afterwards Baron) von Becke, Minister of Finance for Austro-Hungary, M. Talabot, a French engineer distinguished by the Marseilles harbour-works, deputed by the Südbahn, presented his project, in June of that year, to the Crown. His original plan is now become a matter of archæology. It proposed one long quay formed into a basin by two moles; the northern projecting from the Lazzaret-basin (Bacino del Lazzaretto nuovo), which was to be filled up, and the other from the Molo Klutsch (No. 11). A vast breakwater, beginning parallel with the former, and sweeping with a curve opposite the latter, was to be carried on till fronting the Molo San Carlo (No. 9), which was also to be enlarged. Lastly, another, but a short, thin breakwater was to project north-westwards or seawards from the Molo Santa Teresa, which was to be opened for a ship passage, whilst a similar dam would pass round the point of Sant' Andrea, and form another port (Sant' Andrea) between the point and the establishment of the Austrian Lloyds.

On December 12th, 1861, the podestà (mayor), and the President of the Chamber of Commerce, alarmed by the amount of change proposed, memorialised the Ministry against the first Talabot project. But the Austro-French War, which ended with the Treaty of Villafranca, had left the Empire in a state of financial and commercial depression when capitalists were practically invincible. Moreover, the action of constitutionalism, in countries not accustomed to it, is a Liberal measure which adds almost despotic powers to the authorities at head-quarters. Prince Metternich would have consulted the wishes of the Triestine public; Baron de Bruck and his successors did not. As late as December 12th, 1872, the City Council of Trieste has memorialised the Ministers of Commerce and the Chamber of Deputies at Vienna to arrest the works because they are injuring the port, but the effect has been absolutely *nil*.

The city was soothed by the kindest of promises, but on April 22nd, 1862, a Commission was appointed to sit upon the French project at Trieste, under the then governor, M. Talabot himself being present. The pamphlet, "Das Triester Hafen Project" (Wien: Manz, 1862), contains the names of the Commissioners, and provides a plan of the works which is shown in the map of Captain Poppovich. After sending for M. Pascal, the chief engineer of the Marseilles harbour, and obtaining his approval, the Commission, amongst whom were four representatives of the powerful Südbahn, adopted by a large majority, 123 to 3, the second Talabot project. At the same time they rejected the three rival plans and modifications put forth by Major von Schröder, Captain Poppovich, and H. von Conti.

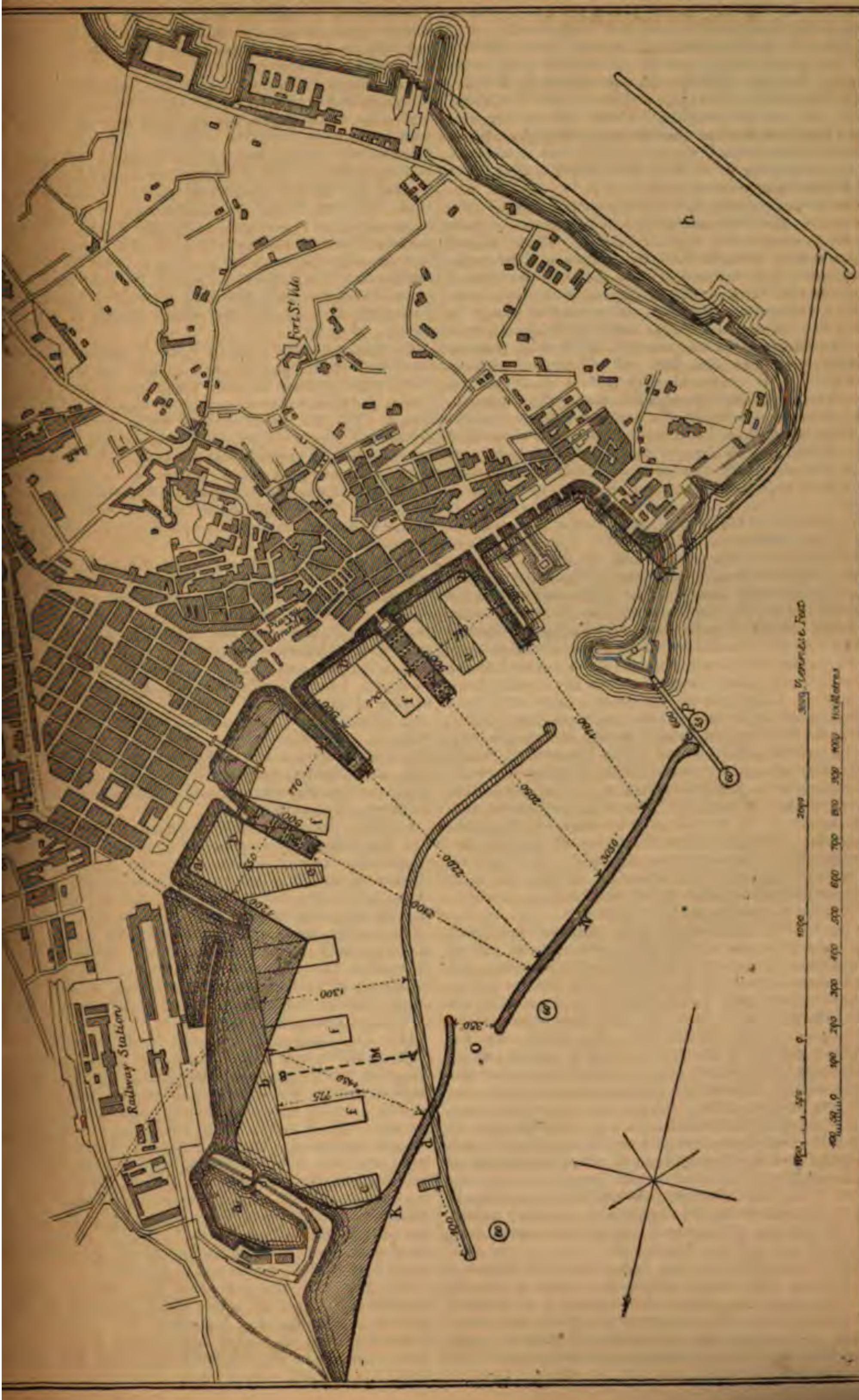
On April 22, 1862, the Talabot harbour was submitted to the Crown. It proposed two forms to be divided into two periods of execution.

1. The original or imperfect form consisted of a masonry breakwater (Schutzdamm or Diga,) [illegible] feet long, bending from north to south-west, stretching 1,300 to 1,500 feet from the shore, and provided with a double entrance, the northern 300, and the southern 700 feet wide. The whole water-line, from the lazaretto to the lighthouse, 2,721 fathoms, or [illegible] feet long, was to be converted into a quay of solid masonry, pushed out to a maximum of 600 feet. Four monster moles, [illegible] to 775 feet in length by 240 to 285 feet broad, to form as many basins; the area of the latter to be [illegible] Austrian Joch (4,139 square fathoms) accommodating in toto 2,500,000 to 3,000,000 tons of shipping. The most unpopular part was filling up the secure Bacino del Lazzaretto Nuovo, *alias* the Porto Santa Teresa, and the Bacino della Darsena, or railway basin lying to the south-east of the former. The estimates for the first step were fixed at 18,000,000 florins.

2. The perfected form added 6 moles, making a total of 10; the length of the quays and piers would be thus increased from 2,721 fathoms to 4,139 ([illegible] feet), and the area of the seven new basins would be reduced from 159·13 to 140·57 Austrian Joch ([illegible] square fathoms.) In the new port of Marseilles ([illegible]) these figures would be 4,000 metres (2,109 fathoms) of quay, and 52 hectares (87 joch) of basin. The projected harbour gave accommodation to 5,000,000 or 6,000,000 tons of shipping: here we see the extravagance of space proposed for Trieste, whose entering tonnage in [illegible] was only 750,000. But, as it reduced the height of the breakwater from 40 to 8 feet, the sum of [illegible] florins was deemed sufficient.

A glance at the plan (in Poppovich) shows that it proposed fundamentally to alter the whole disposition of the roads, in fact, to force a port upon nature, without the least regard for her own arrangements in the matter of winds and currents. I need hardly notice the imminent danger of such operations, a remark applicable to all hydrographical "improvements," unless tentative measures, perhaps prolonged for a term of years, are employed with all prudence. Hasty works, it need hardly be said, are likely to convert disadvantages into the gravest defects, and they may end in the utter ruin of a harbour. Under such circumstances, also, costs easily rise to double; Cherbourg and Algiers are instances, if any be wanted, of immense estimates which proved utterly insufficient. Buenos Ayres has been wise to suspend her judgment.

When this plan was printed and published, a general [illegible]



THE NEW PORT OF TRIESTE.—"MODIFIED" PLAN OF M. TALABO.

arose from the citizens, especially from the naval portion. Press, public, Bourse, and Chamber of Commerce all joined, for once, in an "expression of natural Conservatism," and the result was a protest (November 29th, 1862) praying that the "Bacino del Lazzaretto S. Teresa" might be spared for the City, and saved from the Monopolist. A host of pamphlets, plans, and counterplans issued from the press, advocating or opposing the thirteen to which allusion has been made; and it was understood, to the satisfaction of all, that the French Südbahn had yielded to the popular storm.

The next step was the consultation of Sir Charles Hartley by the Hafencommission, which seems to have sat *en permanence* till April 23, 1863. That eminent engineer, who brought no local prejudice to his work, remarked that no favour had been shown to the French Company and their employés beyond what their commercial enterprise deserved. After careful study he would have preferred a single long mole projected from the Quarantine basin, but he gave his opinion that the Talabot plan was the best of all those hitherto submitted to Government, with certain modifications, such as reducing the parapet and widening the entrances. The Commission accepted this expression with twenty-six votes out of thirty, and also discussed a ship-canal from Trieste Bay to Muggia Bay which had been proposed at a cost of three millions of florins. Still protests made their appearance on May 19, 1863, and June 8, 1864.

On April 13, 1867, five years after the first draught had been submitted, the "Talabot" reappeared in force under the title, "Il Porto di Trieste." The Imperial Government had determined that only the reduced breakwater and the four great northern moles opposite the railway station should be built, the other six being left for a future time. The project also underwent a variety of modifications by steps of which there are no published accounts; indeed I am assurred that a few sheets of manuscript represent all the documents on the subject. For instance, the moles were reduced from a breadth of 95 metres (312ft.) to 80 metres (263ft.) except the northernmost which having been begun, was left 93 metres (305ft.) broad. The breakwater, which was nearly straight in the second Talabot plan was bent, outwards so as to facilitate entrance, and along the whole inner line the "block wall" was sunk perpendicularly from to two to six metres in order that ships might lie alongside. These are a few of the crucial changes concerning which it is vain to consult experts; the latter are all more or less prejudiced either pro or con, and there is the latitude of assertion usual when questions of expenditure are complicated by politics.

The "Porto di Trieste" again proposed the highly unpopular measures of converting into railway ground the northern or Lazzaretto basin, which has been done, and the Darsena or railway dock which still remains (1875). Thus it at once made a gain, said its enemies, of 25,000 to 30,000 square fathoms, which, at 50 florins per fathom, represented a total of 1,500,000. The water-room was greatly curtailed by the increased and inordinate depth of the quay, now thrown out a hundred more feet seawards, and the basins were seriously diminished by the four huge moles which, even in their shrunken forms, appear intended for warehouses and building ground. The silting up of the new port would be increased, and pushing forward the quay beyond where it is sheltered by the railway buildings would greatly increase the power of the Bora. The two passages between the breakwater and the moles are dangerously narrow; indeed, on a windy day, one marvels how sailing vessels could either enter or quit the "new port."

The press and public now openly said, "Insomma si sacrifica il tutto per la parte; e si erige la Società Francese a padrona assoluta del Commercio di Trieste." All attributed the evil to the desire, which was rather the necessity, of pleasing the house of Rothschild. And thus, despite the most energetic representations to the Ministers of Commerce and Finance, the Sovereign authority was obtained on April 9, 1867; on the following 13th the convention was signed, and the works were expected to begin in that year.

The sum of 13,500,000 florins was guaranteed to the company, but of this 1,125,000 was advanced on July 1, before the works began, and the same amount was to be paid for the next twelve years. A further sum of 1,713,750 florins expressing interest, raised the total to 14,713,750 florins. The Südbahn was allowed to delay defraying its debt of 20,000,000 florins due on November 1, 1866. It was relieved of income-tax for twelve years a boon calculated to represent 18,000,000 florins. The concession of its network was prolonged for fifteen years, and this was estimated from the balances to bring 150,000,000 florins into its coffers. Finally it was authorised (April 13) to maintain the tariff of freights established November 1, 1866, for the whole length of its concession, 99 years.

In this "leonine contract" the Südbahn evidently received everything and gave nought—in theory. In 1866, after paying interest, amortisation and reserve funds, its balance showed a clear dividend of 17,000,000 francs. Yet no demand was made from it. The secretary's report (April 18, 1866) naïvely says of its last bargain, "Ces conditions nous ont paru acceptables, elles suffisent pour nous mettre à l'abri de tout mécompte, et des améliorations considerables pour notre reseau se trouveront ainsi realisées d'une manière certaine et prochâine, *sans rien ajouter aux charges de la compagnie.*"

After vain attempts to annul, or at least to revise and modify the fatal concession, the city assembled on September 13th, 1867, a municipal commission, composed of M. F. Hermet, president, and Drs. Righetti and D'Angeli, the actual mayor (1875). Their report to the Town Council was printed in the *Cittadino*, of September 25th and 26th, 1867, and it is couched in the strongest language. It declares with an abundant display of figures:—

I. That the new port is wholly unnecessary, even in view of the Suez Canal being opened; that the Sacchetta, between the lighthouse and the Molo del Sale, the Canal Grande, and the Santa Teresa basin, would suffice for many years. Detailed calculations accompany this statement.

II. That the port is highly injurious to local interests. The Südbahn, an irresponsible company whose books cannot be inspected, after buying the Sormann, Preinitsch, and Panfilli estates, obtained gratis, with the object of building its "monumental station," the sites of the old slaughter-house, and of the pauper institute, an area estimated at a total of 300 million florins. Thus it monopolises the only ground where rivals can locate themselves, the sole line which leads out of Trieste with an ascent of 1·80 instead of 1,000 feet, within a few miles. The close basins, also, will be dangerous in case of a ship catching fire.

III. The company obtained the exclusive right (April 13th, 1867) to run rails, and to lay down tramways along the "rive" (quays), another evil to the one Austrian harbour which, under influence of the railway, has become from a purely importing centre, one also of export. The effect will be to make her an entrepôt, a French dependency in the hands of the Südbahn, a mere canal, down which the stream of trade will flow, like Buffalo, after she was unseated by Chicago. Her commerce will be a simple transit, monopolised by the Südbahn; the effects will be permanently to unsettle her position, and will cause vast losses to a city, where the ground-floors of the grandest dwelling-houses command high rents as magazines and stores.

IV. That the new port may give rise to political complications; on the other hand, it brings no compensating advantages. Including the value of the lazzaretto basin, converted into ground, the cost to the State amounts to 217,000,000 florins; and a far larger

will not pay for spoiling the port by reducing its to half size. The four great moles, thrust forward ond the defences of the Carso escarpment, will make seas higher, the Bora more likely to dash vessels upon breakwater, and the entrance of the harbour more icult and dangerous. The "Diga" will probably uire a large and expensive counterdyke, or, at least, the Malamocco of Venice, it will entail endless outlay repairs. The Cloaca Maxima (Klutsch) and the series drains opening upon the sea front, instead of being ject to the currents, will deposit their burdens to the riment of public health.

. That the old roads want only the following re-dial measures:—

a.) Deepening and enlarging the Lazzaretto basin. This ght be done by filling up the smaller or eastern por-near the Lazzaretto-house, and the reclaimed ground ld answer for the future railway station.

b.) Widening and lengthening the existing quays, but to the exaggerated extent of 165 metres proposed by Talabot, and taking care that all the masonry should upon arches.

c.) Providing the quays with one or two more moles landing and embarking goods, also built viaduct hion, but not broadened to 285 feet nor lengthened to .

d.) Building a quay along shore from the Molo utsch, or the Darsena pier, to the mouth of the lazzaret in; it should also be provided with piers, and defended a solid breakwater to the north, proceeding from the tteria Santa Teresa.

e.) If it be held necessary to defend the roads from the e Libeccio, it would be sufficient to extend the Molo nta Teresa some 550 metres by a breakwater, which ght be floating or stationary.

f.) And lastly, opening the Molo Santa Teresa to in-ase the scour.

As has been seen, the latter measure was strongly vocated by Dr. de' Rossetti; the necessity is recognised thout a dissentient voice; there are absolutely no gineering difficulties to be met, and the expense uld be trivial. Yet such is the local *vis inertiæ* at nothing is done. Committees abound, but, like uncils of war, they make no forward move. In 1873 Commission came down from Vienna, sent in the usual ge report, and went the way of the rest. The only asures of improvement adopted during the last two ars and a-half has been to deepen the Sacchetta, an a of 8,000 fathoms, whose bottom is literally a layer coal and sewage. In the winter of 1874 a few mines re sprung, the blasting was done with dynamite at ght, under the superintendence of M. Closse, C.E., d these trivial operations were kept up for a few weeks intermittent work. Meanwhile, the new works will ly tend to injure, at an increased ratio, the Sacchetta hich the Romans wisely chose for their inner port, and hich the moderns allowed to be silted up from 35 to feet of water.

This very able and angry report ends with proposing d advocating a project submitted by the late Dr. faele Angelo Visentini, C.E. He proposed to prolong e Molo Santa Teresa at an expenditure of 7,092,750 rins, or a total of 9,092,750 florins if a breakwater added from the Lazzaretto basin. These figures are a vourable contrast with the 18 millions, the 16 millions, d the 14,713,750 florins specie successively estimated the French Company.

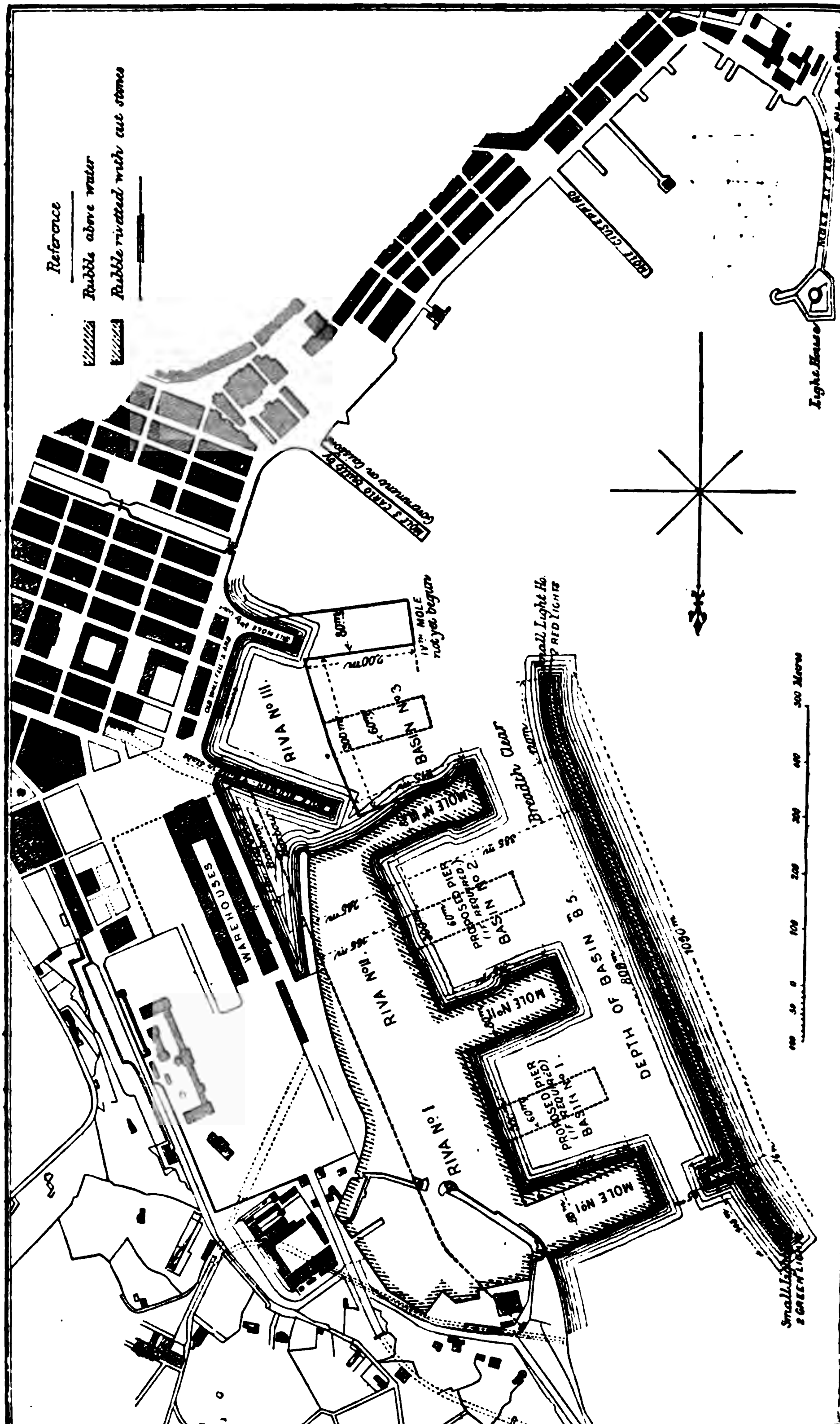
In 1868 began another mixed Commission of the hamber of Commerce, composed of M. F. Hermet resident), M. M. Gregorutti and Sirovich (members), d Dr. d'Angeli (relatore, secretary, and reporter). his body, which concluded its labours on January 21st, 869, again protested against the fatal Convention of pril 13th, 1867, which had placed the port and the ty in the hands of the Südbahn; it unanimously re-gnised the necessity of saving the Bacino del Lazzaretto uovo; it altered the position and shape of the break-water; it repeated the time-honoured advice about opening the lighthouse-mole and building with arches instead of solid masonry, and it suggested the deviation of the Torrenti Martesin and Klutsch, with its annual discharge of fæcal matter amounting to a million of cubic feet. But the battle for preserving the two old basins had been fought and lost; and the Commission regretfully found itself driven to a compromise. It adopted perforce the quays and moles of M. Talabot, but with various common-sense modifica-tions. It proposed to enlarge the present piers, Giusep-pino and San Carlo (Nos. 7 and 9); it reduced the re-claimed ground to a considerable extent; its northern quay was diminished in depth from 240 to 140 metres (*i.e.*, from 787 to 460 feet. Three of the four great moles shrank from 95 to 60 metres (*i.e.*, from 312 to 197 feet), and thus the basins were enlarged to the more reason-able extent of 260,000 square metres (*i.e.*, 310,960 square yards). The labours of this last Commission ended with proposing two plans, which were marked A and B.

A contained a quay, 160 metres (525 feet) broad from the railway station about the Lazzaret basin to the Molo San Carlo in the mid-frontage of the "borgo" or new city: here I have said it is greatly wanted. In this line there would be four moles, with the following dimensions:—One (the northern), of 210 × 95 metres (689 × 312 feet); two central, of 215 × 60 metres (705 + 197 ft.); and one (southern), of 250 × 60 metres (812 × 197 feet). These four piers would form three great basins, each of about 8,700 square metres (10,405 square feet), or a total of 25,100 metres (30,020 ft.). The breakwater defending these basins was reduced to a mere wall, in length 1,50 metres (3,445 feet), bending seawards to the south, and affording a double entrance, northern and southern. This compromise has partly been adopted, but the four moles, of which three are now building, have been disposed between the filled-up Lazzaretto basin and the little Molo Klutsch at the bend of the bight, and the exaggerated dimensions of the piers, 215 metres (705 ft.) by 80 metres (262 ft.), and even 93 metres (305 ft.) in the northernmost, have been retained, whilst the breadth of the two basins is only 300 metres (984 ft.), and the width of the northern entrance is 95 metres (312 ft.), and the southern 160 metres (525 ft.).

B was on a far more extended scale, surpassing even M. Talabot in extravagance of conception. It adds two large basins south of the railway to the three northern; it shows two breakwaters opposite the Südbahn station and the city with three entrances, respectively of 75, 80, and 65 metres (246,262,213 feet). With an eye to the future development of the port it also makes a long strip of basin by throwing out, as did M. Talabot, a third mole to the south-west, an arc of a circle from the lighthouse round the point of Sant' Andrea. I may safely predict that this project will not be adopted.

Upon the occasion of H.I.R. Majesty's visit to Trieste (April 2 and 3, 1875), M. Friedrich Bömches (Hafenbauleiter und Inspector der Südbahn) published a detailed ground plan and sections of the works as they then stood, accompanied by a lithographed pamphlet (Trieste, March, 1875), of which he kindly gave me a copy. I am also indebted to that gentleman for a care-ful inspection of the works, which have been under my eyes for nearly two years and a half. The following is the information which his brochure affords.

The Südbahn Company has undertaken the new harbour on consideration of receiving from the I.R. Treasury the sum of Viennese florins 13,616,000 (silver), to be paid in twelve equal portions, distributed over as many years. [It is generally believed that nearly twenty millions have already been spent upon the works; the official reports own to 2,000,000 of excess.] The Govern-mental Controllers (Controls-Organe) are M. Jäger, the Baurath, and his subordinates, who forward three-monthly reports to the local chief of the Maritime



THE NEW PORT OF TRIESTE, ACCORDING TO THE PLAN OF M. TALABOT, MODIFIED BY CAPTAIN POUPOVITCH.

Government and to the Oberbaurath at Vienna. The end of 1873 had been fixed for the opening of the port, but it was found necessary to extend the period of seven years to five more (end of 1878), [I may add that a still longer period will be found absolutely necessary.] The new harbour covers the eastern half of the old roads or the space between the Lazzaretto basin and the Molo del Sale, a total length of 1,200 direct metres (3,937 ft.) including the Darsena or Eisenbahnhafen, built partly by the railway company and partly by Government in 1856-8. Four piers disposed upon this artificial line form three basins, with a minimum of 8·5 metres defended seawards by a breakwater, and entered by the northern passage.

The works were begun in February, 1868. The preceding year had been spent in preparations; and there was no ceremony of laying the first stone. The general director of the Südbahn, at Vienna, was M. Tostain for two years (1867-9); M. Pontzen was the Vienna inspector, who reported to the former. The director-general of the Austrian branch * was, first, the late M. Michel, then M. Bontoux, and now M. F. Bömches, since May, 1869. They are at times directed by the technical consultee, M. H. Pascal, who built the harbour of Marseille, now Inspecteur-Général des Ponts et Chaussées, Paris. The works began under the head contractors, MM. Dussand (Frères), of France, who undertook the breakwater, the walls of the quays and moles, and a considerable part of the *remblai*. After two years (1868-9) they were unable to fulfil their contract, so the Südbahn was compelled to add Josef Ritter von Masser, of Trieste, who undertook a portion of the *remblai* under water, together with the whole of the dredging, and M. Willy, a Swiss, to whom was entrusted an important part of the *remblai* and the *enrochement*. The engagement of the French contractors expired at the end of 1873. The Südbahn then thought it better to buy up their material, and, from the beginning of 1874, to work for itself. M. Bömches remained as head inspector: under him were M. T. Hainisch (who became inspector of the railway in October, 1874); the sectional engineers; MM. A. Fraisse, C.E., a Swiss; the engineers J. Krause and C. Perinello, and the two assistant-engineers, MM. J. Müller and H. Glayre. All the departments, dredging, filling-up *(remblai, auschüttung)*, besides the superintendence of the divers, mechanics, sailors, and workmen, are still carried out by these gentlemen, under the company itself.

The works were expected to be finished in four or five years, but the system adopted led to enormous delays, as well as to additional expense. It was resolved to begin, as at Marseilles, with throwing in stone *(enrochement)*, then laying the artificial blocks, and lastly stuffing or filling up *(remblai)*. But the French port has a sound sandy bottom; that of Trieste is of soft silt and slime, measuring in depth a minimum of 16 metres. Instead of clearing this away or sinking caissons for a firm foundation, a plan adopted in almost all the older harbours of the Austrian Government, the engineers began the mole and quay No. 1 on the system of Marseilles; the immense weight of the blocks caused the stone foundation to sink, and the mud to splay out on either side, whilst the base proved throughly unstable, the blocks having required removal twice, and even three times, and displacement of the mud rendered repeated after-dredgings *(nach baggarungen)* indispensable. In the other moles and quays the order of operation was changed to (1) the stone sinking *(enrochement)* 3 to 4 inches thick; (2) the filling *(remblai* or *terrassement)*; and (3) lastly, when the foundation is secured, the blocks built into a temporary wall of three or four tiers. Thus the operations were increased to 5; dredging to the depth of the bed required, stone filling, rubble filling, 3 to 4 metres deep; pressing with blocks, building the walls with cut stone and redredging; moreover it was found necessary to dispose the stone base at a slope of 1·4 instead of 1·2. This reconstruction had added about 85 per cent. to the cost.

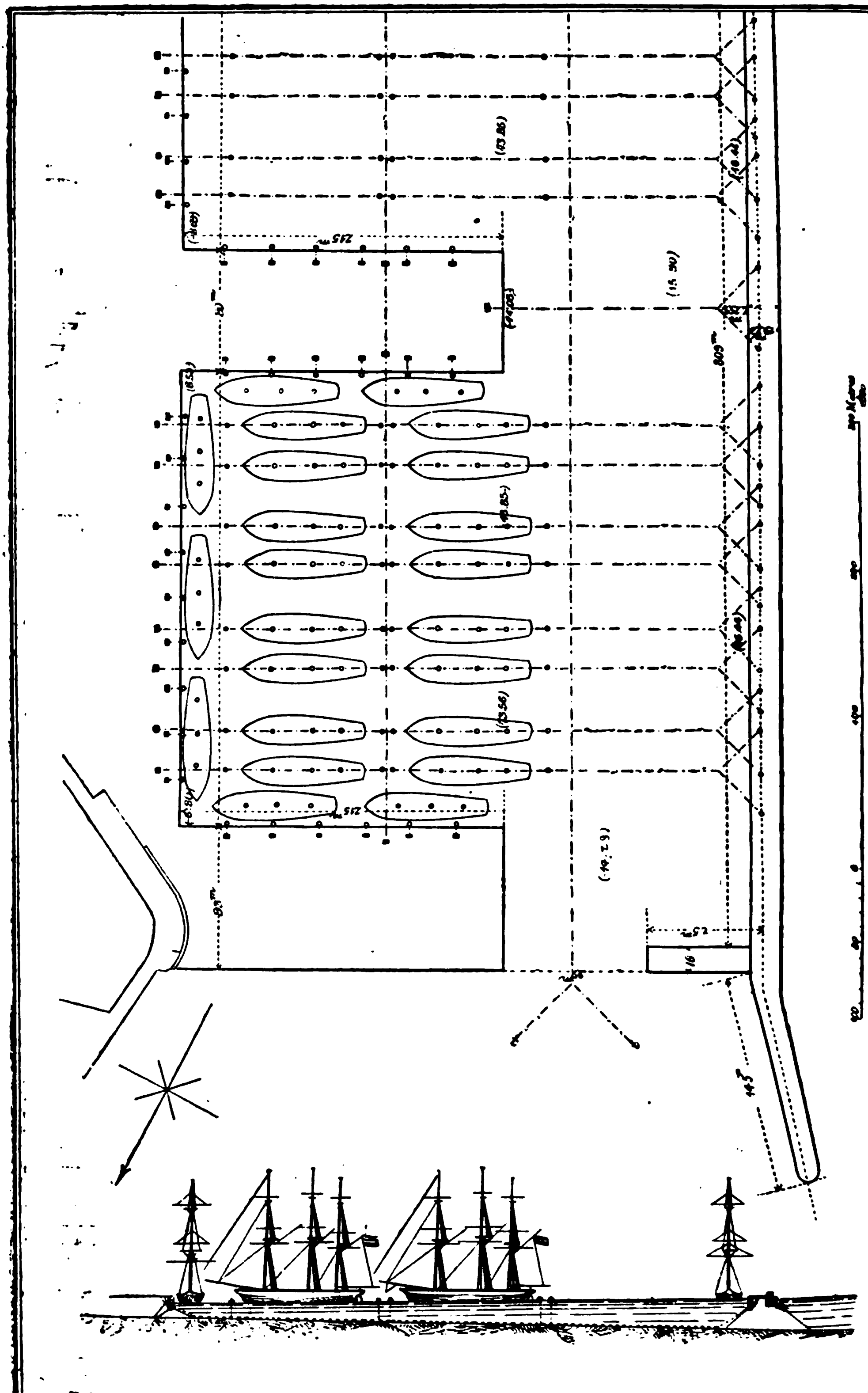
The system of the so-called blocks *(cyclopenbau* or *kunstiche blöcke, blocs, blocchi artifiziali)* deserves notice. The size, 12 feet long, 7 broad and 5 high, is marked upon the ground *(blockplatz)*, and the masons build up the cubes with stone and mortar, having four boards to show the place of the two grooves which serve to swing the mass: these channels are 2 ft. 4 in. from each end; the breadth is 8 in. and the depth is 5½ in. Each contains 420 cubic feet, weighs about 500 *zoll-zentner* (492 cwt. English), and costs from 100 to 110 florins; the larger the rubble used of course the less is paid for mortar. The latter comes through Marseilles from the manufactory of M. Lafarge at Theil in Ardèche; it has been used for the last sixty years, and it enjoys full confidence, nor is it dearer than the inferior fabrics at Stein, near Laybach, or even of M. Escher, at Trieste, the price of all three things being about 1·50 florin per quintal. On the other hand, it is asserted that national interests have favoured the French manufactory: M. Escher declares that he can supply the hydraulic lime used in the harbour works for 60 soldi the quintal or cwt. His Roman cement, the only kind made at Stein, costs 1·20 florins, and his Portland cement is worth 2·50 florins per cwt. The French company building the Hungarian port of Fiume prefer "Santorin," the natural cement imported from the island of that name, and requiring only to be mixed with sand and water, but the material is new, having been used for only 30 years. The total number of these blocks was estimated at 9,980; they are now made at the root of the mole No. 1, and when finished they are embarked at a temporary lading-wharf (Verlad Bühne) north of the same pier. Of these masses 7,062 had been made, and 5,763 had been laid in January, 1874. They acted very well, even those removed three times were not injured; five per cent, would be the maximum of breakage, and a air percentage would not exceed two. It was hoped that these "Cyclopean blocks," placed upon the stone base and piled one upon the other, and without mortar, would form an elastic wall, and render any necessary reconstruction easy. But as I have said, the foundations gave way.

The enrochement, or base, to support the works, was well and carefully made after the slope had been doubled in length (1·4 instead of 1·2). The stone was not to be less than a certain size. The material was the hard nummulitic limestone of the Karst plateau and the Flysch, a generic term for the slaty sandstone and argile forming the buttresses of the latter, and surrounding the Port of Trieste. The Italians call it tassello when laminated; macigno (corrupted to masegno) when it contains limestone, and marna when there is a greater proportion of calcareous matter. This material pulverises in the air, but it contains veins, sometimes curiously contorted, of sandstone, fine and hard as calcaire, which travels in steamers to Alexandria. Of these two local products nearly 6,000,000 cubic metres have been used, two-thirds being required for filling in, which was of earth as well as stone. Table I. (p. 1004) shows the distribution of the work and the names of the quarries, &c.

Here we see that in 1871 there was the greatest produce of raw rock, 1,044,700 cubic metres, which would give, allowing 264 days to the working year, a daily average of nearly 4,000 cubic metres. Such a quantity is abnormally large even in the extensive operations of Europe, and only the abundance, and the easy working of the material lying about Trieste, together with the activity of the three contractors who were accepted in 1870, rendered it possible. The decline since 1871 is to be explained by the necessity of allowing a longer time, in fact till the loads settle to a sound bottom.

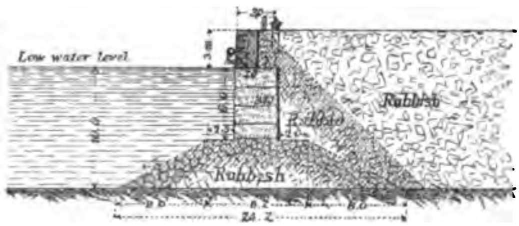
The park of machinery consisted in 1871 of six steam

* Paris was and is the head quarters of the Concessionaires; and here the annual meetings take place in April. The general director of the Austrian branch is at Vienna; of the Italian, at Turin.

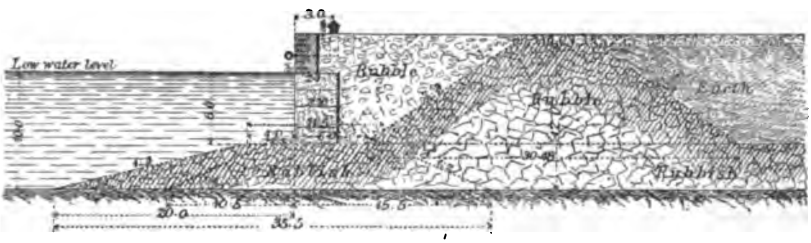


Plan for Mooring Ships in the New Port, Trieste, by the Imperial Royal Councillor in the Edile Department, Cavaliere de Mauser.

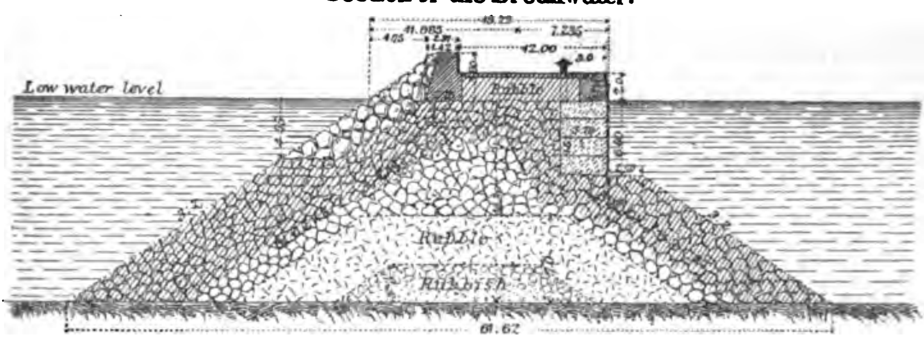
Section of the Wall. Mole I, and Riva I.



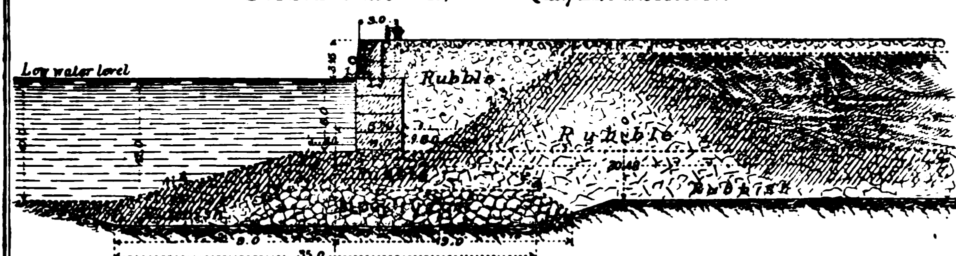
Section of the Wall, Mole II and Riva II.



Section of the Breakwater.



Section of the Wall, Mole III. Quay III. and Mole IV.



Martesin Channel.

Section with one opening.

Section with two openings.

SECTIONS OF BREAKWATERS, &c., DESIGNED BY M. TALABOT.

TABLE I.—MATERIAL FOR RUBBLE.

Quarries.	Transport.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	Total cubic metres.
Camp Buchler	land	27,000	185,400	243,300	212,700	168,800	157,000	..	994,800
Cava Romana	,,	..	..	122,000	63,000	93,000	110,600	47,400	436,000
Sestiana..............	sea	6,000	17,500	2,400	12,100	..	..	..	38,000
Monfalcone	,,	..	..	87,000	220,600	89,200	..	..	377,100
Near Trieste..........	land	76,000	68,800	141,800	129,300	19,100	1,700	42,000	479,300
Around	sea	..	..	..	52,600	59,800	22,500	54,000	188,900
MATERIAL FOR STONE LAYING AND WALL BUILDING.									
Camp Buchler	land	1,000	2,700	10,000	6,400	13,400	900	..	34,400
Cava Romana	,,	..	..	..	62,500	43,500	1,100	..	107,100
Sestiana..............	water	63,000	139,100	202,400	267,700	319,600	80,300	1,100	1,073,200
Near Trieste..........	land	3,600	100	2,500	11,300	7,900	1,700	4,400	31,500
Around	water	..	..	4,800	5,700	21,500	4,000	..	36,000
Totals..............	land and water	177,300	413,600	816,500	1,044,700	835,800	379,900	148,900	3,816,600
Annual per centage..	..	4·6	10·8	21·6	27·6	22·1	10·1	3·2	100

[The total number of quarries was ten; some are of large size, especially in the sides of the Rojano Valley, behind the railway establishment, which has formed an extensive plain and building ground.]

dredgers, the two patented systems being the "Paternoster" (*à gaudet*), an endless string of buckets like a rosary, and the spoon-shaped dredge *Löffelbagger à cuiller*). One of the former, called the "Wall," can reach a depth of 12 metres. The transport was managed by ten steam-tugs (schlepp-dampfern), 100 large and 100 smaller barges, five locomotives working upon temporary rails, eight steam cranes, eight ships' cranes, 500 rubble-carts, and 200 vehicles, besides the apparatus required for making the Cyclopean blocks. The maximum of hands employed upon the works (1871) was about 2,000; the minimum (1875) is 200. The divers and blacksmiths receive a little more than the carpenters, who are paid two florins per diem; masons and sailors range from 1·50 to 2 florins; and labourers, at first procurable for 1·10 florins, now cost 1·20.

The dredging, also a considerable expense, has required repetition. The first simply cleared away the silt for the stone bedding, and this having to do with homogeneous matter, progressed fast enough. The second, rendered necessary in order to recover the depth of basins upon which the silt when pressed down encroached, was a slow and difficult operation, causing frequent slips and sinkings of the moles, the last (Mole No. 2) in April, 1875. It had to deal with heterogeneous matter, slime, fragments of stone, and small stuff mixed with natural blocks, some of them weighing 200 Zoll zentners (178 cwt. English). Thus the dredge-power was wasted in throwing up with the rubbish perhaps three times the amount of water. The greatest care also was required so as not to endanger the solidity of the adjacent works. The delay was increased by the necessity of working the layers metre by metre and of using divers to direct the dredges. The following table shows the cubic metres which were removed between the beginning of 1870 and the end of 1874:—

TABLE II.

Year.	Silt.	Small Materials.	Broken Stones.	Blocks.	Total.
1870	44,400	...	...	...	44,400
1871	23,800	...	...	...	23,800
1872	202,300	2,000	1,400	200	205,900
1873	57,300	18,200	19,800	2,000	97,300
1874	65,100	15,500	34,900	2,200	117,700
Total	392,900	35,700	56,100	4,400	489,100

The progress of the works in their several items is the object of

TABLE III.

Year.	Remblai.	Enrochment.	Quay Walls.	Dredging.	Total.	Proportions of each year.
1868...	109,600	64,300	...	...	173,900	[illegible]
1869...	271,800	135,700	10,200	71,500	489,200	[illegible]
1870 ..	597,000	207,800	28,200	44,400	877,400	[illegible]
1871 ..	691,000	349,700	5,200	23,800	1,069,700	[illegible]
1872...	429,900	389,300	16,300	206,800	1,041,300	[illegible]
1873 ..	289,900	78,000	21,000	97,400	486,300	[illegible]
1874...	143,400	5,500	12,700	117,700	279,300	[illegible]
Total.	2,532,600	1,230,300	86,400	506,000	4,355,900	

These figures prove that the fourth year (1871) had reached sixfold the amount of the first; the subsequent delay arose from the necessity of observing the rule recognised in all the older harbour-works of Trieste, namely, allowing a considerable time, never less than a year, for the subsidence and the consolidation of the new material thrown in. No. 1 basin was worked too hurriedly; the evil results were so apparent as to call for a long delay in finishing the others. It is now understood that the builders and contractors may take their time. No. 2 was carried out upon the new system, consequently it has not, like the former, required total reconstruction, and Nos. 3 and 4 may be expected to prove even greater progress. Table IV. (page 1,005) shows, in cubic metres, the amount of work carried on, according to contract with Government, by the several contractors working under the company:—

It remains only to consider the actual state of the works. Part of the condition of the new port was the deviation of the Fiumara (burrone) Martesin, which drains the Rojano Valley, north of Trieste, and of the Cloaca Maxima (Klutsch), to the south of the railroad establishment. The former has been completed for the last two years. The whole lower course is covered, and the double-arched mouth is built with strong masonry. The Klutsch has not yet been attempted, for reasons which will presently appear.

The breakwater (hafendamm) has a total length of

TABLE IV.

Contractors.	Period.	Remblai	Enrochment	Quay Masonry.	Dredging.	Total.
...sand ..	1868 to end 1873.	1,064,000	1,091,000	73,700	...	2,228,700
...ser ...	1870 to end 1874.	515,000	...	...	489,100	1,004,200
...ly......	1870 to end 1874.	591,800	128,100	...	...	719,900
...ious ...	1868 to end 1874.	324,400	11,200	...	17,500	353,100
...pany.	In 1874	37,300	...	12,700	...	50,000
...otals to	end of 1874	2,532,600	1,230,300	86,400	506,600	4,355,900

...90 metres (3,576 feet), curving slightly seawards at ...h ends, with small fanals, two green lights to the ...rth, and two red to the south. In the former direc-...n, at about 145 metres (475⅝ feet) from the end, is a ...r-pierlet (traversa), nearly at right-angles, measuring ...metres (246 feet) in length, and 16 metres (52½ feet) ...breadth. It thus narrows the entrance to 95 metres ...1⅔ feet), and there are some who complain that during ...therly gales the passage is still too broad. This fine ...rk was begun in July, 1868, in 16 metres (52½ feet) ...low the low-water line. The base was made only ...·62 metres (202⅛ feet) broad, and the consequence was ...t it gradually sank in a bulge 8 metres (26¼ feet) ...ep: it was then broadened to 100 metres (328$\frac{1}{12}$ feet). ...e foundation consists (1) klein (small) material, (2) ...uchstein, or stone rubble, (3) blöcke, or large blocks, ...d (4) cut stone (pflasterung). The original height of ...e terreplein or platform was to be 16·30 metres ...3¼ feet) from the base, but the sinking increased it to ...·30 metres (79⅔ feet); the estimate was for 905,000,000 ...bic metres, or $\frac{1}{18}$ of the whole, but it now represents ... per cent. Seawards it is fronted by large untrimmed ...ocks, and by a large parapet (bexronungsmauer,) ...hose crest is 1·42 metres (4⅔ feet) broad; the terreplein ...r landing goods measures 12 metres (39⅓ feet), and is ...ovided with metal rings and substantial posts of cut ...one (vertäuungsobjecte) for making fast. The inside ...e has now a clear depth of 6 metres (19⅝ feet), so that ...ips can lie alongside, the original plan being only ...metres: here the facing is of five "Cyclopean blocks," ...ch 3·70 metres broad (12¼ feet) by 1·50 metres (4$\frac{11}{12}$ ...et) deep, and the upper are revetted with cut stone. ...he fatal objection to this splendid construction which ...as ended in November, 1874, after six years and three ...onths of work, is that it fronts between west south-...est (Ponente Libeccio) and south-west (Libeccio) ...hence storms very rarely come; it is thus thoroughly ...en to the most violent and dangerous wind, the Bora ...ast north-east, and partially so to the turbulent and ...oublesome Sirocco (south-east). In fact, it is unique, ...breakwater to leeward not to windward.

...No. 1 basin together with No. 1 (northern) mole are ... far finished that they may be opened before the end ...f the year. The shape of the former, unlike its two ...eighbours, is a trapezoid, the breadth of the tail being ...reater than that of the head, 93 metres (305$\frac{1}{12}$ feet). ...t was found necessary to add to the inner side a slice ...easuring at the base 5·78 metres (19 feet), and at ...e head 3·20 metres (10½ feet). The work is good, ...nd reflects the greatest credit on Mr. Bömches and ...is energetic staff. The slope of the base (Bruch-...ein und Kleinmaterial) has been widened from 1·2 ...o 1·4, and it is faced, like the breakwater, with cyclo-...ean blocks and cut stone. The length, as in the case ...f the two others, is 215 metres (705½ feet). The riva, ...r joining quay of cut stone, connecting Moles No. 1 and 2, has a length of 300 metres (984⅓ feet); it has sunk and slipped so much along the whole line that the walls have had to be reconstructed, and their bases to be dredged a third time. Thus each basin represents 64,500 square metres, which may allow seven large steamers to lie alongside the walls. The depth of water was originally determined to be 6·50 metres (21⅓ feet), but a Government order increased it to 8·50 metres (27$\frac{11}{12}$ feet), when the new basin of Marseilles (1871) and those of the Suez Canal do not exceed eight metres.

No. 2 basin is in progress; the *enrochement* for both pier and quay and the *remblai* have been done for some years. The northern mole (No. 2) is narrower than its finished neighbour, 80 metres (262½ feet), instead of 93 metres; yet the size appears excessive, unless it be intended as a building ground for warehouses, which will pay the company, but not the city. It has also required an extensive modification of the base, strengthening the stone profile and repeated dredgings; moreover, it has by no means settled, and it gave way very seriously in February, 1873. The quay No. 2 is beginning to show above water, and the mole No. 2 is finished except the masonry at the southern half.

No. 3 basin has not yet been begun. The northern mole No. 3 will be in all points like No. 2. The delay in this part of the works was caused by the Government insisting that until at least one of the basins have been opened, the little Darsena, with its quay, where most of the large English steamers load and unload, and the Molo Klutsch, useful to native craft, shall not be meddled with. Thus the company has found the greatest difficulty in building mole No. 3, the narrow space to the south hindering the work of tugs, barges, and dredges. As yet only the head of this pier has assumed a finished form, and there was a subsidence in the filling in at the root about March, 1875. No. 4 mole of M. Bontoux' port, will, if made, obliterate the Molo Klutsch and the Molo del Sale; but it is strongly to be hoped that local opposition may avert this final blow. The last proposal on the part of the Maritime Government was to fill up the Darsena and to omit the third basin, allowing that between the Molo del Sale and Klutsch to the Molo retain its place.

Part of the project is to reduce the level of the ground occupied by the whole railway station behind or east of the new port, and thus to render the first tunnel unnecessary It was 10·12 metres (33⅓ feet) above mean water, and it will be lowered to 3·16 metres (10⅓ feet). This work is progressing satisfactorily.

The stranger landing at Trieste sees with surprise the vast space of ground now prepared for building at the far north of the city; there will in fact be an old town, a new town, and a port town. The public and the local authorities have done their utmost to stop the works, but in vain. They complain that the diminutive basins will not provide for the ever-increasing trade of the chief emporium of Austria, and that the gigantic moles, intended to pay ground-rent to the company, will do immense injury to all the highly valuable warehouse property elsewhere. They also complain of the exorbitant expenditure, nearly two millions of pounds sterling, not to speak of immense claims which may be anticipated on the part of the company; and of the irreparable mischief done to the roads by increasing the deposit of silt; this, indeed, can be repaired only by removing, which would cost nearly as much as building, the works. The malcontents, by no means hoodwinked by the letters and pamphlets which periodically appear, see a deeply-laid plan for taking away the freedom of their port. They declare that their city, instead of being a place of trade, will be a mere line of transit for the benefit of the Südbahn. But their efforts are in vain; all the protests of December 12, 1861; of May 19, 1863; and of June 8, 1864, have had the same fate. Shortly after the middle mole (No. II.) had given way bodily (Feb. 1873), a deputation set out for Vienna to report the state of affairs, yet the Chambers were officially

assured, within the shortest possible interval, that the best news had come from the new Port of Trieste.

The company, however, must now continue its works or leave them to be continued by the Imperial Government. The basins may be kept clear by the expensive process of perpetual dredging, and, possibly, contrary to public opinion, the rest of the roads will, to a certain extent, be defended from silting up. The immense tract of building-ground obtained by quarrying the hill slopes behind, and by reclaiming from the sea, will eventually become valuable, and will enable the builders to recoup their enormous expenditure. Perhaps the ultimate effect of the harbour may be beneficial especially if it result in turning public attention to Muggia Bay, the true port of Trieste.

What Austria does Hungary must do, consequently Fiume has imitated her nothern rival. The expenditure will, perhaps, not reach the half of that described above; the situation of the new harbour is far more central, and the works have not to meet the same difficultities. But the pieces of solid masonry where floating breakwaters would have served, may prove as injurious to the roads of Fiume as to those of Trieste.

REVISED PLAN OF THE PORT OF TRIESTE.

The Talabot project, modified and approved by the Commmission appointed April 28, 1862, showing the defects remarked by the majority of navigators, ship-owners, and others of the town, and marking the necessary corrections.

REFERENCES.

The fillings in of earth (*a*); the quays (*b*); the moles (*c*); and the dyke or breakwater to be built (*d*), are darkly shaded.

The dyke of defence (*e*) at the lighthouse point; the projected moles (*f*); the cutting in the Santa Teresa pier (*g*); and the port of Sant' Andrea (*h*); are simply outlined to show that these works works are at present suspended.

The new "mandracchio" (basin, or inner port) for coasting craft is marked by (*i*).

N B.—The numerals in the port represent Viennese feet.

Along the outlined quays would be horse tramways, flanked by warehouses, to protect the goods from weather. Behind, or landwards, there would be a space for the free thoroughfare of carts, &c., the total demanding a width of about 160 feet.

ACCESSORY EXPLANATIONS.

The quays and all the new works, darkly shaded, are lettered as follows:—

K. Quays and pier flanking the new lazzaretto, the latter to be retained.

L. The new quay, securing ample space for the railway, and forming the large and ample basin (M); concentrating the torrent-drains "Klutsch," and "Mortesin"; and securing from the Bora (north-easter) the vessels made fast to the moles R. Hence also the advantage of preserving the new lazzaretto.

N. New dyke, intended as a substitute for that marked *d*, and, together with the pier (K), making the basin safe.

O. P. New approaches by which ships could enter and depart whatever winds may be blowing.

R. Moles or piers improved and pierced for the free passage of water.

The third ballot for Fellows in the Royal Aquarium and Summer and Winter Garden was held on the 1st inst. Eight hundred and forty-two ladies and gentlemen came up for election, of whom six hundred and twenty were elected. The executive have secured a large site for a skating rink. The first tank was filled with water on the 1st inst., and the fish may now be seen disporting themselves therein.

Some fear has been entertained that the disease called *pébrine* has attacked the silkworm in certain parts of Japan, as the corpuscles which were the invariable concomitants of the disease in France and Italy have been disclosed by careful microscopic examinations of the silkworm of Japan. It is stated that M. Pasteur announced the existence of these corpuscles in the Japanese silkworm as early as 1865. There is, therefore, nothing to warrant the conclusion that *pébrine* exists in Japan.

The production of the Westphalian portion of the coal basin of the Ruhr, amounted in 1873 to 16,213,964 tons. The corresponding production in 1874 was 15,351,131 tons, so that that the output declined last year to the extent of 5½ per cent.

CENSUS OF INDIA.

The memorandum on the census of British India contains some interesting particulars with regard to the manner in which this great work of enumerating the people was effected. The census was not carried out in the various provinces in one uniform system. In Bengal, owing to the want of administrative machinery from the great expense anticipated to supply this need, and to the vast extent of sparsely populated territory in Assam, which was then under Bengal, in Cooch Behar, and in Chota Nagpoor, it was determined to make no attempt to obtain a synchronous enumeration of the people, or to deal with the precise condition, in all respects, of every individual. The general plan adopted in this province was to have lists prepared of the villages and hamlets, which were made over to the police for supervision. In each village two or more residents were selected, who, in complimentary letters, were requested to act as enumerators, and to submit lists of the houses in these villages, with the name of the principal occupant of each, the correctness of a certain number of these lists being tested by the police. Though the enumerators would, doubtless, have preferred to be paid for their trouble, it was found that the office was, for the most part, coveted as an honourable distinction, and the cases in which legal measures had to be adopted to enforce them to complete the tasks they had undertaken were altogether exceptional, and were confined to two districts. In one, Thannah, in Hooghly, however, the names set down as enumerators were found to be those of persons unable to read or write; the educated people having threatened to beat the watchmen if they put in their names, and the men having accordingly entered those of persons of whom they were not afraid. There is some reason to think that the enumerators, in a few cases, used their power to extort a small tax from the people, but no great amount of oppression appears to have been practised.

In a large number of villages difficulty arose from there being no resident able to read; in such cases, and generally in less civilised districts, paid enumerators had to be employed, or the work was undertaken by the police. The census in towns was, as a rule, effected by the municipal authorities. The large floating population on the various rivers was counted by a census of the boats at each landing place. Travellers by land were reckoned at the several serais or halting places. In the hill tracts of Chittagong, and in the Khasia hills, each chief took the census of his own clan. In the Southal pergunnahs the people were enumerated by their national method of counting, knots being tied in a number of strings of different colours, to distinguish males from females, and children from adults. In some parts of Orissa the agents employed could only write in the customary manner, with an iron style, on strips of palm leaves, from which the returns had to be afterwards copied out in printed forms. On the tea plantations of Darjeeling and Assam the census was taken by the planters. None was attempted in the Saro hills, or in the wilder parts of the Naga hills and Luckimpoor.

For three years the people were instructed in the object of the census, and experimental enumerations were made, so as to familiarise their minds with the idea and allay any fears they might entertain. In most instances the forms were filled in beforehand, and only corrected on the night in which the actual enumeration was taken. Over very large tracts of country the final counting took place in a single night; in the Rajshahye and Dacca divisions—together, as large as England—on the 15th, and in the Patna division on the 25th of January; and so far as the regulation districts are concerned, it might probably be hereafter effected in one day without difficulty. In the non-regulation divisions of Chota Nagpoor and Assam, however, the enumerators, who were sent out in November, did not return from their work till February, March, or April.

Of the anxiety of the people to obtain accuracy, some riking instances are given. One village consisted of o hamlets, two miles apart; the enumerator having only sited one of them, two residents of the omitted hamlet me a dozen miles to report the circumstances. In anher case, an enumerator went eight or nine miles to ention that a washerman had been absent from his me on the day of the census, and therefore had not en counted. In the Southal pergunnahs, some vilges having been accidentally found over at the junction the supervisors' beats, the residents came back to ask hat fault they had committed that their houses had not en numbered. On the whole, the census is believed to ve been taken with a very fair approach to accuracy, ough, in the non-regulation districts especially, omisons have occurred.

ARMING, VENTILATION, AND LIGHTING.

The first of the lectures in connection with the Sanitary d Educational Exhibition at Brighton was delivered Captain Douglas Galton, C.B., who had undertaken speak of those matters in it which related to warming, ntilation, and lighting.

Captain Galton commenced by directing attention to e sanitary principles which should guide the inventor his design, because so far as this exhibition was conrned, the merits of the several inventions rested upon eir fulfilling sanitary conditions. In sanitary science may be broadly stated that pure air was essential to urity of blood, and that pure air consequently afforded e best safeguard to enable the human frame to resist tacks of epidemic disease. Directing attention to a ass of apparatus for the preservation of pure air in our omes, and to the prevention of pollution of external r by smoke, the speaker pointed out that the temperare of the body was about 98° Fahr., and the tendency the surrounding air was to cool down the body, which, carried too far, was productive of disease. Thus, hilst requiring ventilation for providing pure air in wellings, the ventilation must be combined with warmg. Ventilation could only be accomplished by the eation of currents of air—one to remove the air of e room, and the other to bring in fresh air, the amount fresh air required in an occupied room being very nsiderable. A space occupied by six persons would quire 11,200 cubic feet of air to be passed through in der to keep the atmosphere sufficiently pure for health; , in other words, the air of the room ought to be reoved and replaced seven times in an hour. In such a om so inhabited it would be very difficult to provide y means of warmth within the room which would unteract the repeated cooling down which an adequate mount of ventilation by means of cold air would create. he inflowing air should therefore be warmed, otherwise very means would be sure to be taken by the occupants shut out fresh air rather than to encourage its inflow. he methods of warming houses in general use might e classed under (1) Open fire-places of one sort or nother; (2) Hot air carried in flues from some central urce of heat; (3) Hot-water pipes or steam pipes rried round the house from a central boiler. In this xhibition the first mode of warming, viz., by open fireaces, was the one which appeared to preponderate. With an open fire-grate of ordinary construction the armth in the room was derived from the direct radiation the fire. The greater the draught up the chimney, e greater the inflow of cold air to replace that removed, nd the greater inducement to make the fire blaze to inrease the radiation. But the more the fire blazes the ster is the draught up the chimney and the consequent moval of air from the room. Therefore, the tendency the open fire is to accelerate the evils which it is inended to remove. There was a novel apparatus, well orthy of examination, exhibited here by Mr. G. B. harp, by which he proposed to place the fuel in an iron movable grate or cradle, provided with a cover. Amongst the warming apparatus exhibited, some were designed to use gas, and others to consume mineral oils. The characteristics of these he explained at some length. Gas was useful for heating purposes in many places, but it contaminated the rooms in which it was burnt largely. The apparatus for lighting by artificial heat was not very fully represented in the exhibition, but the mineral oils, besides the gas, deserved consideration. Mineral oils are about as cheap as gas, but it is not probable that they will ever supersede the use of gas. As to other sources of artificial light, magnesium was too costly to rival gas, and its dazzling brilliancy rendered its application very difficult for domestic use. Such was also the case with the lime light and the electric light, but the broad fact remained that the present modes of obtaining artificial light were clumsy, and he trusted that it might not be long before some new system of artificial lighting was produced. Having thus briefly explained some of the leading principles which affect health in the warming, ventilating, and lighting of buildings, Captain Galton proceeded to point out the apparatus in the exhibition which appeared to deserve especial mention.

BRUSSELS INTERNATIONAL EXHIBITION.

The Brussels International Exhibition and Congress, which is to take place next year, will be opened by the King of the Belgians, in person, on the 15th June. It is honoured by the presidency of the Compte de Flandre, patronised by the City, and directed by a Belgian Executive, constituted for the purpose. Buildings are being especially erected in the park at Brussels, for exhibits, which will have to conform to a published classification, and, it is said, must be of distinguished merit to gain an *entrée*. A London committee has been formed, with an executive committee, and the Lord Mayor as the chairman. The exhibition and congress, which are complementary to each, have a humanitarian object, the classification having special reference to the preservation and protection of human life and well-being, more particularly in those occupations were the lives of the workers are in constant peril. Class I. is to be devoted to saving life from fire, the sections including apparatus and means for preservation against fire by land and sea; instruments for detecting and announcing fire; life saving apparatus; means of extinguishing fire; and means of transport for men and materials. Class II. does for water what Class I. accomplishes for fire; while Class III. embraces all means of preventing accidents resulting from traffic on roads, railways, and tramways. Class IV. will deal with aid to wounded in time of war, embracing transports, surgical apparatus, and ambulances, with a section for the treatment of the corpses of the dead, either by burying or burning, with the purification of battle-fields and camps. Class V. will deal with the broad subject of public health; while Class VI. will include sanitary measures and means of life-saving applied to industry. The remaining four classes are devoted to domestic and private hygiene; medicine, surgery, and pharmacy in relation to the preceding classes; institutions for improving the condition of the working classes; and hygiene and the protection of life as applied to agriculture. All these matters will be fully discussed at the Congress, while the means, apparatus, and processes will be, of course, exhibited, and, as far as practicable, experimented with, and the experience thus gained will be recorded.

The yield of gold in Victoria appears to be gradually falling off. In 1871 it amounted to 1,290,844 oz.; in 1872, to 1,218,094 oz.; in 1873, to 1,162,492 oz.; and in 1874, to 1,105,115 oz. The number of persons engaged in Victorian gold mining last year was 46,012, or 5,545 less than in 1873.

EXHIBITION OF ELECTRICAL APPLIANCES, PARIS.

According to a report, presented by Count Hallez d'Arros to the Managing Committee, whose provincial office is at 86, Rue de la Victoire, this exhibition will be divided into the following groups:—

1. *History of Electricity.* — The first discoveries. Primitive apparatus and instruments.
2. *Apparatus for Demonstration*, intended for use in laboratories, and among classes for instruction in natural philosophy. Static and dynamic electricity.
3. *Piles and Batteries.*—Different methods of producing the electric fluid. Manufacture of substances as well as raw products, serving for the production of electricity.
4. *Electro-magnetism.* — The electro-magnet; effects, improvement, methods of manufacture.
5. *The Electric Telegraph.* — Bells, signals, clocks, electric wires, and ropes. Manipulating and receiving appliances; those for percussion, writing, &c.
6. *The Electric Light.* — Illumination of towns and workshops. Lighthouses, &c.
7. *Electric Motors.*—Continuous wheels. Lathes, sawing and drilling machines, trucks, attempts at locomotion, &c.
8. *Electrotyping.* — Gilding and silvering. Reproduction of bas-reliefs, statues, and works of art.
9. *Therapeutic Electricity.*—Electro-medical machines, baths, brushes, galvanic chains, &c.
10. Applications of Electricity to purposes of war, military and naval.

PRIZE ESSAYS.

The Lords of the Committee of Council on Education have received, through the Foreign-office, a despatch from her Majesty's Consul at Cadiz, enclosing copies of a notice issued by an association of that city, denominated the "League of Ratepayers" (*Liga de Contribuyentes*), offering prizes for the most successful essays which may be addressed to the association on the means best adapted for promoting new industries or manufactures within the municipal district of Cadiz. The following are the terms of the notice in question:—

LEAGUE OF RATEPAYERS.

The directing board of this association, impressed with a sense of deep concern for the fulfilment of the duties that are imposed upon it by the 9th clause of its regulations—which is to the effect that its proceedings shall be devoted to the general interests of this city, in order that the welfare and prosperity of bygone days may, within the shortest possible period, be restored to her—and considering that one of the best means of realising so noble a project is that of promoting, as far as possible, the establishment at Cadiz of industries of more or less consequence, has determined to publish the following resolution:—

Competition is invited, with a view to the awarding of prizes for the best written essays on the installation and development, in this city and its municipal district, of one or more industries or manufactures. Each essay to be accompanied by its corresponding estimate of the cost that would attend such installation and development.

The essays will be rewarded with medals of gold, silver, or bronze, or with diplomas and certificates of honourable distinction from the directing board, which shall be given according to their respective merits and conformably with the decision of the apprizing judges, who will be guided in their considerations, not so much by the literary worth of each composition, as by the excellence and opportuneness of the ideas propounded and the facility of carrying them into practical effect.

Should one or more of these papers be found to excel the others in a remarkable degree, they will be published in Spanish, at the expense of this association; and one hundred copies of every such excelling paper will be given to its author.

That essay will be deemed to excel in merit which will be found to treat most effectually of the conditions of speedy installation and expansive development, as well as offer to the greater number of people the advantages that would immediately accrue from the industry or industries to which it should refer.

On the prize medals will be inscribed a statement commemorative of the occasion, in which the object for which they are given, as well as the name of the association by whom they are presented, are set forth.

The essays should be written in a distinct and legible hand, and in the Spanish, Portuguese, Italian, French, English, or German language.

It is also necessary they should be forwarded to, and, before the 1st of February, 1876, delivered at, the office of the Secretary of the League, which is situated on the ground-floor of the "Casa Consular," Cadiz. The authors must not sign these papers, but mark them only with a distinguishing device or motto, which should closely resemble another device or motto on the outside of a sealed envelope accompanying each essay, and enclosing the signature and address of its author.

Essays found on arrival to differ in form or substance from the above prescribed conditions, or the authors of which shall have made themselves publicly known, either directly or indirectly, will be excluded from the competitive examination.

The envelopes corresponding to the winning essays will be opened in public and solemn session when the prizes are awarded. The remaining ones will be destroyed, unless duly claimed by the parties interested.

The winning essays will be retained by the association as their own property. None of those forwarded can be withdrawn from competition.

For the examination of these essays and adjudication of prizes, the board will name a quorum of arbiters composed of competent persons, be they members of the association or not.

Respecting the formalities to be complied with on the occasion of the distribution of the prizes, the indication of the locality where that distribution is to take place, and other matters in connection with this subject, timely notice will be given to the public.

The above competitive contest will, whenever the Board may think proper, be followed by another, of which the object shall be to reward the best project of association for the purpose of facilitating the immediate inauguration of the industry or industries treated of in the successful essays.—Cadiz, 22nd of July, 1875. BERNARDO DE SOBRINO, president; PEDRO MARIN, JUAN M. PICARDO, JOSE FRANCO DE TEARN, and FRANCISCO LIZAUR, secretaries.

CORRESPONDENCE.

CHANNEL PASSAGE.—THE "CASTALIA."

SIR,—The measure of the success of the *Castalia* is a question of such general interest as to justify me in requesting that space in your columns which will enable me to place the results of her repeated trips across the Channel fairly before the public. In my remarks on the Channel passage, reviewed in the *Times* about twelve months since, it will be seen that I doubted the necessity of adopting any novel mode of construction in the hull of the vessels for this service, but rather leaned to a modification of the Dublin and Holyhead boats as more likely to be useful.

But that opinion has received considerable modification since I have had an opportunity of hearing, and also of witnessing, the performances of the *Castalia*. The public are now so well acquainted with the general principles of this twin ship, that minute details are perfectly unnecessary. A ship 290 feet long and 34 feet beam, flat bottomed, is divided right through in the direction of her length. These halves, placed 26 feet apart, are secured to each other by strong iron girders and decked over. The wheels of these two hulls are in the inside of these vessels, instead of the outside. It was conceived that this separation of these hulls by 26 feet would enable the weight of one hull to control the action of the other in their tendency to roll or pitch in a seaway, and thus reduce both of these actions to a minimum. Moreover, the placing of the wheels inside instead of outside the *Castalia* has enabled the inventor to utilise the entire breadth of both paddle-wheels for passenger accommodation. Thus a clear gain of 24 or 26 feet is added to the beam of the vessel, a gain of space equal to the entire breadth of beam of the first-class steamboats of the London and Chatham line, which have only 26 feet beam altogether. The *Castalia* has, therefore, a maximum amount of deck area and a minimum amount of beam—a most important feature in going in or out of harbours.

It has been contended by some seamen that the placing of these wheels amidships, and thus creating a large channel between the two ships, is a dangerous measure,

r baulks of timber might get in between the vessels and aterially damage the wheels. Without pretending to eny the possibility of this, I state that she has now een running between Dover and Calais for some three onths without any such accident happening, whilst the *essemer* with wheels outside, in two trips, when ntering the port of Calais damaged her starboard wheels wice—once slightly, the second time more seriously—nd proved herself utterly unfitted for the service from ad steerage.

That the *Castalia* is a marvellously easy ship and eers admirably, there can be no possible doubt, for the undreds of passengers that have crossed in her will bear mple testimony to that fact, and her popularity is in-reasing daily. I crossed over in her myself on the 13th lt., in charge of a lady, her two sons, and a maid ser-ant, with a fresh breeze from the south, and can speak ith confidence of the remarkable steadiness of a vessel at only draws seven feet of water. There was, literally, o perceptible pitching at all. I watched her closely; ot a drop of water was shipped on the lower fore deck. he rolling was limited to about four or five degrees, and as entirely free from that *jerking* action which any rson is certain to have to encounter in similar weather any of the mail boats. I have some experience of is action, having crossed the Channel, either to Calais Ostend, twice a year for the last fifteen years. There one material defect, however, in the *Castalia*, and at is her deficiency in speed, which militates also against r steadiness in a sea-way. Great experience and inute experiments in all seas have taught me that speed rough the water imparts steadiness to a vessel, and nsequent ease and comfort to all on board. Had the *astalia* possessed a reserve of horse-power, the day I ossed the Channel in her, equal to have produced an crease in speed of one or two knots an hour, I have od reason to believe that she would not have rolled at l. Speed is an essential feature in the reduction of the lling of steamers, which can be practically proved in instant, by stopping the engines in heavy ocean swell d then increasing the horse-power gradually. I have, der certain conditions, stopped the rolling of my eamer entirely by a proper adjustment of the speed. eamers should not be permitted to roll, if possible. he friction caused by passing through the water cannot avoided, but the friction caused by rolling can in the ajority of cases, when the steamer is of large dimensions d possesses ample horse-power.

The directors of the *Castalia* committed, therefore, error when they thought they might disregard speed, d could steady the ship entirely by the form of the ll adopted. The form of the hull, no doubt, has had large share in the matter, but the superior tonnage of e *Castalia* to that of those cockle-shells, the mail ats, is an important factor in the case. When new gines are placed on board of the *Castalia*—for new gines, without loss of time, she ought to have—she ay possibly realise twelve knots an hour, for all the late terations have borne good fruit. In adverse weather e deficiency in horse-power tells severely, for as the rse-power required to move a ship through the water creases as the cube of the velocity, an adverse gale hich reduces, say a steamer from ten knots to eight, ll nearly bring the vessel whose maximum speed is but ht knots to a standstill. What is required to produce high mean average speed, is momentum, and momen-m is the product of two factors, weight and velocity. he mail boats cannot maintain a high average velocity strong adverse weather, for they are deficient in weight hull, and the *Castalia* fails also, but from want of fficient horse-power.

The speed of the *Castalia* is now very good, when e take into consideration the smallness of her indicated rse-power, in proportion to the size of the hull, which 1,600 tons, or about double that of the largest of the alais mail boats. When I speak of the speed of the *astalia* I speak of it as it is at the present moment, for when she first came to Dover, from radical defects of the engines, she literally could hardly make headway. She has since had her steam chests enlarged, her boilers entirely changed, Morgan's feathering floats applied, her funnels lengthened, and a more perfect arrangement made to enable the compressed air to escape from the paddle-wheels amidships—a simple but most important arrangement, and one greatly needed. The value of these alterations I experienced in crossing the Channel both ways, when she obtained a speed of more than ten knots, being only 1 hour 50 minutes in making the run, a distance of 21 miles.

What speed she will ultimately attain I do not pretend to say, but I hear it is proposed to replace her present engines by others of greater power. Whenever this is done, I should recommend, if possible, that they should increase the diameter of the paddle-wheels, which, I believe, can be done. Increased area of float surface will then be obtained from increased immersion, for it appears that some injurious effect follows from having the floats too broad. I know from experience obtained in my runs over many thousand miles, in all quarters of the globe, that large wheels act most advantageously, especially in rough weather.

The directors of the company have acted most wisely in running their steamer even at a loss, for it has enabled the travelling public to judge for themselves. At first the numbers carried were less than 8 or 10; they are now more than 100 at times. Many passengers have sacrificed their through tickets when they found the *Castalia* in Calais harbour. By starting at nine o'clock in the morning from Dover, there is ample time to spare to enable parties to go by the mail train from Calais to Paris, as I found to my satisfaction when in charge of my party of four; and on the return voyage all have plenty of time to take their tickets by the 4.20 p.m. train from Dover to London. Had these facts been as well known as they ought to have been from the first, the numbers travelling by the *Castalia* would have been far greater.

The question now is, has not the *Castalia* run long enough this season to establish fully her reputation for steadiness and comfort? And would it not be prudent to withdraw her almost at once to enable the further necessary alterations to be made? Five months will soon pass away in making the improvements I have referred to, and trying the vessel's speed at the measured mile. The public are now satisfied with the fact that there is no comparison to be made between the present mail boats and the ease and comfort of the *Castalia*. She is at present monopolising nearly one-half the passenger traffic, and the numbers carried by her are increasing as the facts published get better known. The company have overlooked until within these few days the necessity of having an agent in Paris to give correct information. Had this been done earlier, the numbers carried by the *Castalia* would have been still greater. Having a house facing the sea here, I see daily the *Castalia* passing my windows, and it is evident how steadily she performs her work; and how much better and steadier the speed is since the funnels have been lengthened and the draft of the fires increased.

I cannot, in justice to Captain Pittock, fail to compliment him on the admirable manner in which he has handled so large a ship, and one so novel in her construction. I have heard with regret the probability of his resigning the command at the end of the month; this, therefore, is another reason why it would be prudent to take her off the line until all improvements that can be made are made. The directors must be aware that the Board of Trade's reduction of the load upon the valve by 15 lb. has materially affected the power of her steering apparatus. Whilst under repairs, the new boilers constructed by Messrs. Maudsley and Field could be further stayed, so as to justify the Board of Trade increasing the load upon the valve to the original pressure of 65 lb., and thus materially improving the action of the helm. On

the 1st of April next year the *Castalia* might commence work with the moral certainty of far greater efficiency having been obtained.

I am, &c.,

J. C. Hoseason, Capt. R.N.

19, East-cliff, Dover.

P.S.—Since writing the above, I have made a second trip to Calais and back in more adverse weather, but with the same result. All parties had abundance of time to enable them to pass their luggage at the Custom-house—93 in number—and lunch at the buffet before the train started for Paris. This I have now witnessed on two occasions.

I herewith attach the published list of the number of passengers carried both ways since the 12th of October, the day the Princess of Wales returned from Calais:—

			Out.		In.
Wednesday, Oct.	13th	....	80	..	66
Thursday, ,,	14th	....	71	..	73
Friday, ,,	15th	....	68	..	87
Saturday, ,,	16th	....	91	..	84
Tuesday, ,,	19th	....	76	..	70
Wednesday, ,,	20th	....	66	..	63
Thursday, ,,	21st	....	117	..	51
Friday, ,,	22nd	....	99	..	48

GENERAL NOTES.

Genevan Society of Arts.—On the occasion of the centenary of the Genevan Society of Arts, founded in 1776, that body proposes to offer a number of prizes in its various departments. A service which the Academy will render to horology will be the international competition in the regulation of pocket chronometers. The trials of these chronometers will take place at the Geneva Observatory, under the superintendence of M. Plantamour, the director. All chronometers intended for the competition must be forwarded to him before mid-day of February 14, 1876. All competitors not resident in Geneva should correspond with the Observatory through a resident agent, who will manage all the details. M. J. B. Grandjean, president of the Section of Horology of the class, offers his services gratuitously to makers who have no agent in Geneva. Each chronometer should be accompanied by a paper containing data to identify the chronometer, details of its construction, &c. The trial will last fifty-two days, from February 15, 1876, divided into nine periods. In a hot chamber and in an ice-house (*glacière*), the chronometers will be tested by being placed in all possible positions. All chronometers not complying with the following conditions will be excluded from competition:—1. The mean variation from day to day ought not to exceed six-tenths of a second so long as the chronometer preserves the same position in the Hall of the Observatory. 2. The values which express the mean rates during each of the periods except that of the hot chamber and the ice-house, ought to agree with their mean in the limits of two seconds more or less. 3. The error of compensation determined by the comparison of the rates in the hot chamber and in the ice-house ought not to exceed two-tenths of a second of degree Centigrade. 4. The difference of rates between periods six and nine (both in the Observatory-hall, horizontal position, dial above), *i.e.*, before and after the proofs relative to temperature, ought not be above one second in twenty-four hours. The value of the results obtained in the trials which concern the two former conditions will have an importance double that which will be given to the two latter. No competitor can receive two prizes. A sum of 3,000 francs at least will be devoted for the purpose of awarding gold medals, or an equivalent value, to competitors who will have been judged worthy. A number of medals in silver and bronze will also be awarded. Those who wish for further details concerning this and other competitions should apply to the secretary of the academy.

Cold in the Preservation of Food.—Monsieur Tellier, whose researches in connection with the application of cold to the preservation of food are so well known, said in a communication to the Academie des Sciences, in the month of October, that he has purchased a vessel called the *Frigorifique*, of about 900 tons burden, which is being fitted up specially for the transport of food and other organic matters preserved by cold. In an experimental voyage to the River Plate, she will have a cargo composed of wine, beer, butter, cheese, yeast, hops, vegetables, &c., and other things affected by heat, which, up to the present time, it has been impossible to convey across the tropics in a good condition. On the return voyage the *Frigorifique* will bring back a cargo of fresh meat, game, fruit, skins, silkworms eggs, &c.; in fact all sorts of productions which abound there, and which hitherto have not been attainable in this country in their fresh condition. Thus the solution of a great problem will be made by this expedition on a large scale, and Monsieur Tellier offers to the Academy facilities for any committee named by them to try any experiment in their discretion they may think desirable, and he places the appliances of the ship during the voyage at their disposal.

THE LIBRARY.

The following works have been presented to the Library:—

Official Guide Book to the Manchester Aquarium, by the Curator, W. Saville-Kent, F.Z.S. Presented by the Author.

Report of the Proceedings of the British Association of Gas Managers, 1875.

Proceedings of the Royal Colonial Institute. Vol. 6.

Annual Report of the Commissioner of Agriculture and Arts for Ontario for 1874.

Bethnal Green Museum—Descriptive Catalogue of the Collection illustrating the Utilisation of Waste Product. (Two copies.) Presented by the Science and Art Department.

Third Annual Report of the Silk Association of America. (Six copies.) Presented by the Secretary.

Study of Living Languages for Colloquial Purposes, by Sir Arthur Cotton. Presented by the Author.

The following have been presented by the American Statistical Association:—

Eleventh Annual Report of the Board of State Charities of Massachusetts.

Twentieth Annual Report of the Insurance Commissioner of the Commonwealth of Massachusetts. Part 1. Fire and Marine Insurance.

Sixth Annual Report of the Board of Railroad Commissioners.

Fifth and Sixth Annual Reports of the State Board of Health of Massachusetts.

Annual Reports of the School Committee of the City of Boston for 1873 and 1874.

Rules of the School Committee and Regulations of the Public Schools of the City of Boston.

Thirty-seventh and Thirty-eighth Annaul Reports of the Board of Education, Boston.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. President's address.

Tues. ...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. W. H. Price, "The Manora Breakwater, Kurrachee."
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Mr. Francis Galton, "Short Notes on Heredity, &c., in Twins." 2. Mr. Francis Galton, "A Theory of Heredity." 3. Mr. F. W. Rudler, "Report on Anthropology at Bristol."

Wed. ...Society of Telegraph Engineers, 25, Great George-street, S.W., 8 p.m.

Fri. ......Junior Philosophical Society, 6a, Victoria-street, S.W., 7.30 p.m. Mr. L. Franklin, "Notes on Physical Geography."

URNAL OF THE SOCIETY OF ARTS.

No. 1,199. VOL. XXIII.

FRIDAY, NOVEMBER 12, 1875.

mmunications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ROCEEDINGS OF THE SOCIETY.

NOTICE TO MEMBERS.

he 122nd session of the Society will commence Wednesday, November 17th, when the opening ress will be delivered by Lord ALFRED RCHILL, Chairman of the Council.

ndidates proposed for election as members are lleged to attend on this occasion.

vening Meetings of the Society will be held on following dates, subject to any alterations h may be found necessary:—

	CANTOR LECTURES.				AFRICAN MEETINGS.				ORDINARY MEETINGS.					INDIAN MEETINGS.				CHEMICAL MEETINGS.				SPECIAL LECTURES.			
	Mondays.				Tuesdays.				Wednesdays.					Fridays.										
75.																								
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ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

NOVEMBER 17.—Opening Address by Lord ALFRED S. CHURCHILL, *Chairman of the Council.*

NOVEMBER 24.—"On the Registration of Trade Marks," by H. T. WOOD, Esq., B.A. On this evening A. J. MUNDELLA, Esq., M.P., will preside.

DECEMBER 1.—"On the Legislative Enactments requisite for safe Conduct of Sewage Grounds," by ALFRED SMEE, Esq., F.R.S. On this evening HENRY LETHEBY, Esq., M.A., M.D., will preside.

DECEMBER 8.—"On the Mode of Levying the Sugar Duties in France, and its Influence on the Sugar Industries of Great Britain," by Professor LEONE LEVI, F.S.S., &c.

DECEMBER 15.—"Health, Comfort, and Cleanliness in the House," by THOMAS BLASHILL, Esq., A.R.I.B.A.

DECEMBER 22.—"On a method of producing Pure Charcoal Steel directly from the Ore," by HENRY LARKIN, Esq.

CANTOR LECTURES.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows:—

First course by Dr. THUDICHUM, "On the Discoveries and Philosophy of Liebig—with special reference to their influence upon the advancement of Arts, Manufactures, and Commerce."

ond course by W. MATTIEU WILLIAMS, Esq., Steel Manufacture."

ird course by GEORGE JARMAIN, Esq., "On Dyeing."

e second and third courses have been arranged special reference to the Society's Technological inations.

AFRICAN SECTION.

etings of this Section will be held on Tuesday ngs at eight o'clock. Papers to be read will nounced in the *Journal.*

CHEMICAL SECTION.

etings of this Section will be held on Friday ngs at eight o'clock. Papers to be read will nounced in the *Journal.*

INDIAN SECTION.

etings of this Section will be held on Friday ngs at eight o'clock. Papers to be read will nounced in the *Journal.*

JUVENILE LECTURES.

During the Christmas vacation, Lectures will be delivered, specially suited to a juvenile audience. Particulars will be announced in the *Journal.*

SPECIAL LECTURES.

A series of reports has been prepared by Dr. RICHARDSON, appointed by the Council to make special inquiry into the subject of "Unhealthy Trades." These will be delivered in the form of Lectures on Friday evenings in December, January, and February.

LECTURE I.—DECEMBER 3RD.

On the influence of physical labour on individual and national vitality.

LECTURE II.—DECEMBER 10TH.

Injuries incident to physical labour. (1) By exposure to dust and other foreign substances. (2) By exposure to noxious gases and heated and impure air. (3) From mechanical concussions, peculiar postures of body, and excessive exertion.

LECTURE III.—DECEMBER 17TH.

Diseases included under the first head.—Workers in the potteries, in lime, in stone and marble cutting, in trimming and furniture dressing, in sand-paper making.

LECTURE IV.—JANUARY 21st.

The same subject continued.—Workers in flour-mills, amongst old rags, in dust collecting, in breeze sorting, in fur dyeing, in coal mining, in walking-stick making, in hemp dressing.

LECTURE V.—JANUARY 28TH.

Diseases included under the second head. — Straw bleachers, sewer men, stable men, braziers, patent leather dressers, sugar bakers, japanners.

LECTURE VI.—FEBRUARY 4TH.

Diseases included under the third head.—Paviours, carpenters, blacksmiths, boatmen, porters and waiters, postmen, spring makers, scriveners, players of wind instruments, glass blowers.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

A book of tickets for the admission of friends to the Ordinary Meetings has been sent to each member. Tickets for the Sectional Meetings and Cantor and Special Lectures will be delivered with the *Journal* in due course.

Members are admitted on signing their names.

HEALTH AND SEWAGE OF TOWNS.

At the meeting of the Council, held on the 8th November, it was resolved to appoint a standing Committee to deal with this important subject in the manner stated below:—

Considering how much the health of towns is affected by the systems adopted for dealing with sewage, and also the numerous, great, and many-sided difficulties which at present exist in its treatment throughout the United Kingdom; the imperfect information which exists of the results of the various systems adopted; and the absence of any complete and comprehensive record of facts collected and published officially either by the Local Government Board or by Municipal Corporations, the Council of the Society of Arts have appointed a General Sewage Committee for the purpose of collecting facts and holding a CONFERENCE YEARLY, at which the experience gained and the progress made in the past year will be reported and discussed, such Conferences to be continued as long as necessary.

The Committee will consist of the Council and those members of the Society who express a desire to serve on it, together with eminent authorities on the subject, not members.

The Committee will work by sub-committees, each one dealing with a different branch of the subject. At the Conference to be held at the House of the Society of Arts, representatives of Corporations and Boards of Health will be invited to attend.

Corporations and Local Boards of Health are invited to communicate with the Secretary, and forward to him any suggestions they may think proper.

MISCELLANEOUS.

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the months of September and October, 1875. When they are counted by sight the words "by sight" are used, when by turnstile the word "machine":—

	Amounts voted in 1875.	Number of Visitors in September	Number of Visitors in October.	How counted.
	£			
1. British Museum	17,471	31,759[1]	35,60[illegible]	(by sight).
2. National Gallery[2]	6,346	732,790	—	,,
3. Kew Gardens and Museum	4,273	64,669	16,15[illegible]	,,
4. South Kensington Museum	39,019	...	...	(by machine).
5. Bethnal-green	7,325	...	...	,,
6. National Portrait Gallery	1,956	...[3]	—	,,
7. Geological Museum, Jermyn-street	9,070	1,771[4]	[illegible]	,,
8. Patent Office Museum	...	19,183	21,16[illegible]	,,
9. Edinburgh National Gallery	2,100	11,979	7,3[illegible]	,,
10. Edinburgh Museum of Antiquities	...	12,951	6,1[illegible]	,,
11. Edinburgh Museum of Science and Art	10,569	34,619	29,521	,,
12. Edinburgh Botanic Gardens	1,750	7,286	4,311	,,
13. Dublin Museum of National History	1,717	5,587	4,476	,,
14. Glasnevin Botanical Gardens and Museum	2,224	20,978	[illegible]	,,
15. National Gallery of Ireland	2,339	—	—	,,
16. Museum of Royal Irish Academy, Dublin	200	...	—	,,
17. Zoological Gardens, Dublin	500	9,382	[illegible]	,,
18. Tower of London	1,500	33,274	[illegible]	(by sight).
19. Royal Naval College, including Greenwich Painted Hall	...	29,269[5]	16,554	,,
20. Royal Naval Museum, Greenwich	...	8,313	2,816	,,
21. East India Museum[6]	5,883	4,036	[illegible]	(by machine).
22. Hampton Court Palace[7]	...	—	—	,,

1 Return refused; number given is for corresponding month last year in the Museum Report.

2 The Gallery was closed to the public from the 27th. There were fourteen public days in September.

3 Return refused.

4 Closed from 10th August to 10th September. Six visitors in August.

5 Open on Sundays.

6 Paid for by Indian Government. Admission daily by payment of 1d., except Thursday and Friday, 6d.

7 Open on Sundays.

A statement showing the estimated annual production of gold and silver in the United States, during the twenty-five years from 1849 to 1873, has been prepared by the Bureau of Statistics. The annual average production of gold, according to this statement, has been fifty million eight hundred thousand dollars, and that of silver for the fifteen years, from 1859 to 1873, thirteen million three hundred thousand dollars. The highest annual production of gold was during the five years from 1851 to 1857, both inclusive, when it was seventy million two hundred thousand. The highest annual production of silver given was in 1872, when it was thirty-five million seven hundred and fifty thousand.

In the first ten days of October, 37 ships passed through the Suez Canal. The transit revenue collected in the same period was £28,400.

CORRESPONDENCE.

SAFETY AT SEA.

Sir,—The destruction of several large ships during foggy weather has called attention to the desirability of availing ourselves of the means which modern science has placed at our command for the preservation of such disastrous accidents. Having made a suggestion on this subject, which was printed in the *Chemical News* for July 18th, 1873, and also in *Iron*, for Sept. 18th, 1875, I hope that you will find a place for this brief note in your valuable *Journal*, and shall be glad to answer any objections or inquiries which may be made with reference to this question. There can be no doubt that during the coming year an extraordinary number of travellers will be crossing the Atlantic in connection with the Great Exhibition at Philadelphia, and it is therefore of much importance that means should be devised to lessen, if not entirely obviate, the dangers of the passage.

For the purpose of preventing accidents, each large passenger ship should carry a small but powerful steam-boat or launch, and in foggy weather this steam-launch should be sent on a-head some few hundred yards, being connected with the passenger ship by means of a rope and a flexible telegraphic cable provided with an electric battery, so that the signal or messages might be continually transmitted from one to the other. The steam-launch should also carry an electric or other strong light, and be provided with a powerful steam-whistle or fog-horn. On meeting with ice or vessels, or unexpectedly approaching the coast, it would be comparatively easy to stop the steam-launch and give warning in time to save the passenger ship from danger.

It is to be understood that I would have exactly the the same precautions used on board the passenger ship as at present, including a slackening of speed, a careful look-out, sounding of fog-horn, ringing of bells, &c., but in addition to this, and as an extra precaution, I would have the pilot-launch in front. The steam-whistle or fog-horn of the launch might be made to emit a much more powerful sound than the similar instruments in use on board of passenger steamers, and thus without annoying the passengers give better warning to approaching vessels.

With regard to our ships of war, many of them are already provided with steam-launches, and therefore the extra expense incurred in the adoption of the proposed plan would be very light.—I am, &c.,

John Newlands, F.C.S.

Sucrerie de Pierrefonds, Department Oise, France,
Oct. 30th, 1875.

Sir,—With reference to the sinking of the *Vanguard*, and occurrences of a like nature taking place, I beg respectfully to make the following proposition.

I suggest that all ships should be provided with a series of steel plates (made like those we see for shutting-up shop windows), placed completely around the outside of the vessel, flush with the deck, and to be made to run on grooves, or ribs downwards, at certain intervals, and to be worked by simple machinery independently, so that in the event of a hole in the side or bottom of the ship, that compartment may be rolled downwards to exclude the water to such an extent as to allow the pumps to work effectually and carpenters to fill up the breach. Clever engineers may devise means to supply further aid, should it so happen that the breach had occurred on the groove or rib itself; I only respectfully offer the suggestion.—I am, &c.,

Cosmo G. Logie, M.D., Surgeon-Major, H.P.

16, Victoria-square, Grosvenor-gardens, S.W.,
October 29th, 1875.

PEAT.

Sir,—In looking through the article "Peat," in Mr Simmonds' valuable work on "Waste Products" (1873), I do not find any notice of what I consider one of its most important uses, viz., its application in building, as explained to me not long ago by an old and valued friend (the late Charles Rowcliffe, Esq., of Milverton, Somerset), from his own experience in more than one house that he had built or altered, and in which he had also seen its perfect success. I cannot, I think, do better than copy part of a letter which I received from that gentleman, in answer to inquiries I made after having a conversation with him on his use of peat in architecture. The letter, dated 20th August, 1875, says, "I did not sufficiently inform you of the great value and importance, in my estimation, which peat may assume as a building material, especially for the interiors of houses of all descriptions, from the highest mansion to the lowest cottage.

"Let me first enumerate its very great recommendations. Used in partitions, it fills them, and stops fire from running (as in the ordinary lath and plaster ones) from the bottom to the top of the building; it stops sound between rooms; it is so light that it may be placed anywhere, as lath and plaster, but not brick or other filled partitions, may be; it is a bad conductor of heat and consequently is always of the same even dry temperature, and it does not attract damp; it stops vermin, rats, mice, &c., which do not attempt it, as they find no hollow to run or lodge in; the space between floor and ceilings may be filled with it to stop sound. It is generally a very cheap material, the best for this purpose being the upper beds, spongy, fibrous, and light, the most worthless for fuel; and it requires neither laths nor rails in building it up; it takes plaster very quickly, as it absorbs the wet of the mortar and soon becomes dry. It may be used for any interior building or partitioning. I used it in the partition of my house at Stogumber, both on the ground and upper floor, in the year 1820, and they may now be seen as firm and good as when they were built; then the upper partitions do not rest on the under, but simply on joists.

"I should cut it from the peat bog in regular lines and thicknesses and sizes, such as might be required for any special purpose. For partitions, from three to four and half inches thick, and 13½ inches by 4½ inches in length and breadth, to be used alternately, so as to bind well together, with perhaps a stay or band of ¾-inch board, at every three or four feet high, fastened to the usual uprights, so as to afford more perfect stability, though perhaps that would not be necessary. Each turf should be laid with very little mortar, as bricks would be in a partition.

"Partitions are now filled, sometimes with sawdust, which, if a hole occurs, will soon run out; or shavings, which are most dangerous in case of a fire; turf will not flame, it only slowly smoulders, communicating a warning by its smell, when a jug will soon extinguish it. It is very strange that it has not yet been utilised for such purposes, and I think I am not wrong in believing that it only requires to be introduced, for its great value for building purposes to become known and appreciated."—I am, &c., W. C. Trevelyan.

Wallington, Northumberland, 3rd November, 1875.

The soundings for the submarine tunnel between England and France are being carried on actively. They are at this moment directed to the part of the straits near the English coast, at a few miles from the shore. Each evening the vessel which carries the Commission returns to Dover, Calais, or Boulogne, and work is recommenced the next day. The engineers charged with that important labour, MM. Larousse and Lavallée, are perfectly satisfied with the results obtained, and so far nothing has occurred to destroy their previsions relative to t[illegible]

MEETINGS FOR THE ENSUING WEEK.

MON. ...Royal Geographical, Burlington-gardens, W., 8½ p.m. 1. The President's opening Address. 2. Mr. W. L. Watts, "Journey across the Vatna Yokull, Iceland."
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.

TUES. ...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Messrs. R. S. Culley and R. Sabine, "On the Pneumatic Transmission of Telegrams."
Statistical, Somerset House-terrace, W.C., 7¾ p.m. 1. Inaugural, by Mr. James Heywood. 2. Mr. E. G. Ravenstein, "Statistics collected at the Geographical Congress in Paris." 3. Dr. W. A. Guy, "John Howard's true place in History."
Zoological, 11, Hanover-square, W., 8½ p.m.

WED. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Address, by Lord Alfred S. Churchill, Chairman of Council.

WED. ...Geological, Somerset-house, W.C., 8 p.m.

THURS ...Linnean, Burlington-house, W., 8 p.m.
Chemical, Burlington-house, W., 8 p.m. 1. Mr. T. M. Morgan, "On Ethyl Phenyl Acetylene." 2. Mr. W. N. Hartley, "On the presence of Liquid Carbon Dioxide in Quartz Cavities." 3. Mr. R. H. Davies, "Addendum to the paper entitled 'Monthly Analytical Examination of the Harrogate Spas, 1872.'" 4. Mr. M. M. Pattison Muir, "On certain Bismuth Compounds." 5. Mr. W. H. Perkin, "On the formation of Coumarins, Cumaric, and other similar Acids." 6. Communications from the Laboratory of the London Institution, (a) "On the action of Potassic Sulphite on the halord derivative of Phenol," (b) "Note on the action of Nitric Acid on Tribromophenol," by Mr. H. E. Armstrong. 7. Mr. G. A. Beckett and Dr. Wright, "On Narcotine, Cotarnine, and Hydrocotarnine." 8. Dr. Gladstone and Mr. Tribe, "On the Decomposition of Alcohol and its Homologues, by the joint action of Aluminium and its Halogen Compounds."

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg to acknowledge, with thanks to the Proprietors, the regular receipt of the following Transactions of Societies and Periodicals during the year:—

DAILY.

Hour.

WEEKLY.

Agricultural Gazette.
American Journal of Gas Lighting.
Architect.
Athenæum.
British Journal of Photography.
Builder.
Building News.
Builders' Weekly Reporter.
Capital and Labour.
Central News.
Chamber of Agriculture Journal.
Chemical News.
Colliery Guardian.
Concordia.
Cosmopolitan.
Draper.
Electrical News.
Engineer.
Engineering.
Engineering and Building Times.
English Mechanic.
Farmer.
Gaceta Industrial.
Gardeners' Chronicle.
Herapath's Railway Journal
Irish Builder.
Iron.
Journal of Gas Lighting.
Journal of the Photographic Society.
Land and Water.
Les Mondes.
Metropolitan.
Mining Journal.
Moniteur des Arts.
Musical Standard.
Nature.
Papermakers' Circular.
Pharmaceutical Journal.
Photographic News.
Produce Markets' Review.
Queen.
Railway Service Gazette.
Revue Scientifique.
Sanitary Record.
School Board Chronicle.
Schoolmaster.
Sessional Proceedings of the Social Science Association.
South African Dominion Budget.
Temperance Record.
Warehousemen & Drapers' Journal.
Workmen's Club Journal.

FORTNIGHTLY.

Brewers' Guardian.
Jeweller & Metal Worker.
Publishers' Circular.

MONTHLY.

American Artizan.
Annales du Génie Civil.
Atlantic Monthly.
Bayerisches Industrie- und Gewerbe-Blatt.
Bookseller.
Brainard's Musical World.
British Mail.
Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
Bulletin de la Sociét Imperiale Zoologique d'Acclimatation.
Bulletin du Musée de l'Industrie.
Educational Times.
Fortnightly Review.
Geographical Magazine.
Horological Journal.
Journal of Applied Science.
Journal of the Chemical Society.
Journal of Education.
Journal of the Franklin Inst.
Journal of the Horticultural Society.
Journal of the National Life Boat Institution.
Journal of the Pharmaceutical Society.
Journal of the Quekett Microscopical Club.
Leather Trades' Circular.
London, Edinburgh, and Dublin Philosophical Magazine.
Monatsschrift für den Orient.
Moniteur Scientifique.
Nautical Magazine.
Practical Magazine.
Printing Times and Lithographer.
Presse Scientifique des Deux Mondes
Revue Maritime et Coloniale
Sugar Cane.
Symons' Meteorological Magazine.
Telegraphic Journal and Electrical Review.

QUARTERLY.

Journal of the Asiatic Society.
Journal of the Geological Society.
Proceedings of the Geologists' Association.
Journal of the Linnean Society.
Journal of Mental Science.
Journal of Science.
Naval Science.
Journal of the Royal Geographical Society
Proceedings of the Royal Society.
Journal of the Royal United Service Institution.
Journal of the Statistical Society.
Journal of the Victoria Inst.
Transactions of the Zoological Society.

ANNUALLY.

Archæologia (Transactions of the Society of Antiquaries).
British Association for the Advancement of Science. Report of the.
Civil Engineers, Minutes of the Proceedings of the Institution of.
Engineers in Scotland. Transactions of the Institution of.
Gas Managers, Report of the Proceedings of the British Association of.
Naval Architects, Transactions of the Institution of.
Philosophical Transactions.
Royal Colonial Institute, Proceedings of the.
Royal Society, Proceedings of the.
St. James's Magazine.
Society of Engineers, Transactions of the.

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